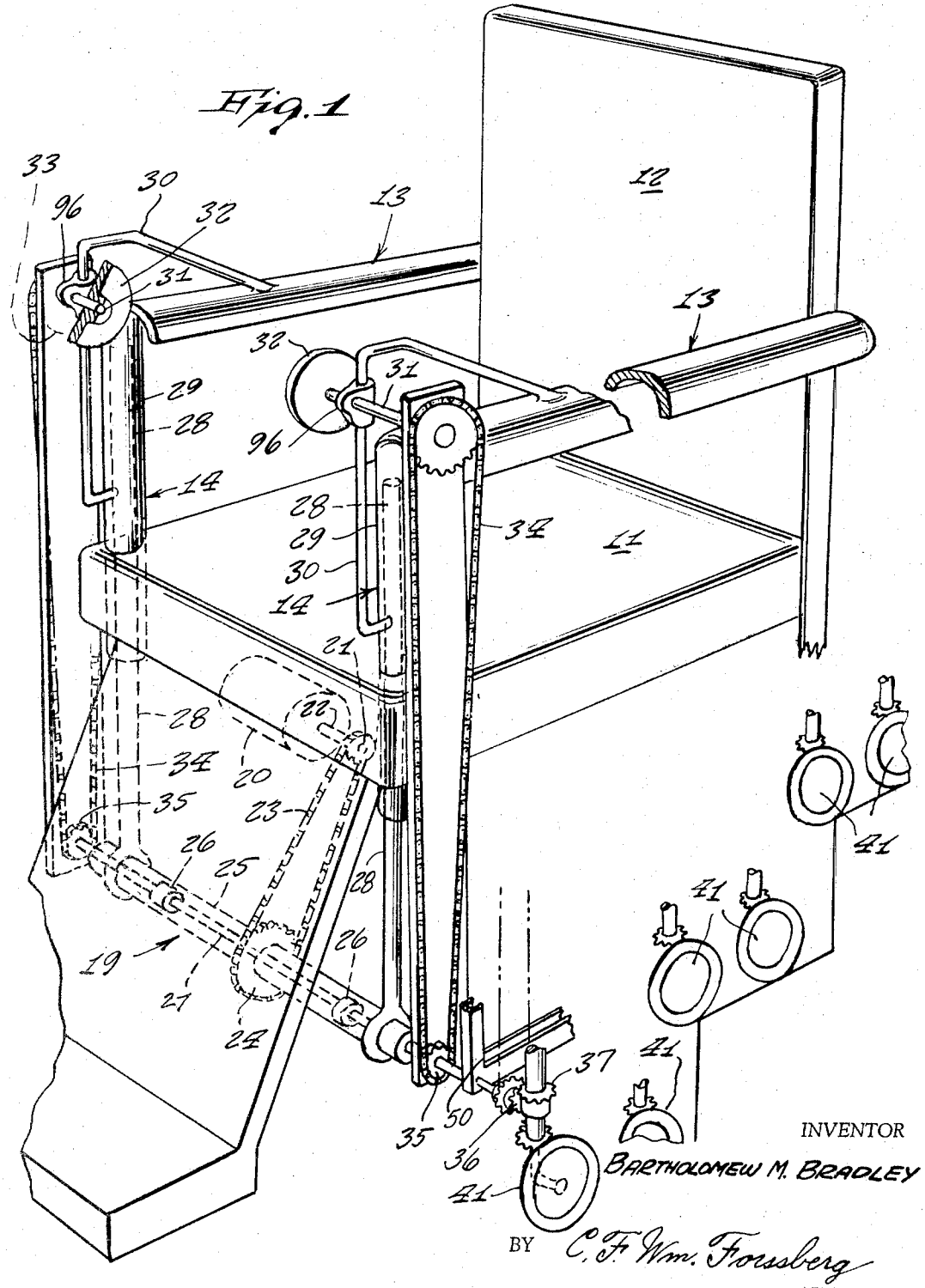
April 15, 1969 B. M. BRADLEY 3,438,641

STAIR CLIMBING WHEELCHAIR

Filed March 31, 1966 Sheet 1 of 5

Fig. 1



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STAIR CLIMBING WHEELCHAIR

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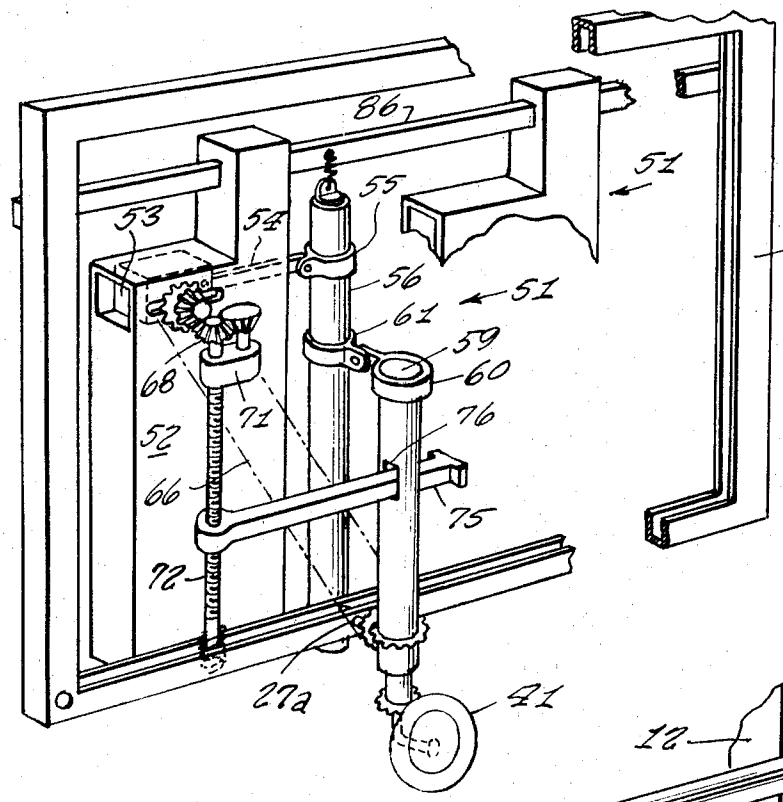


Fig. 2

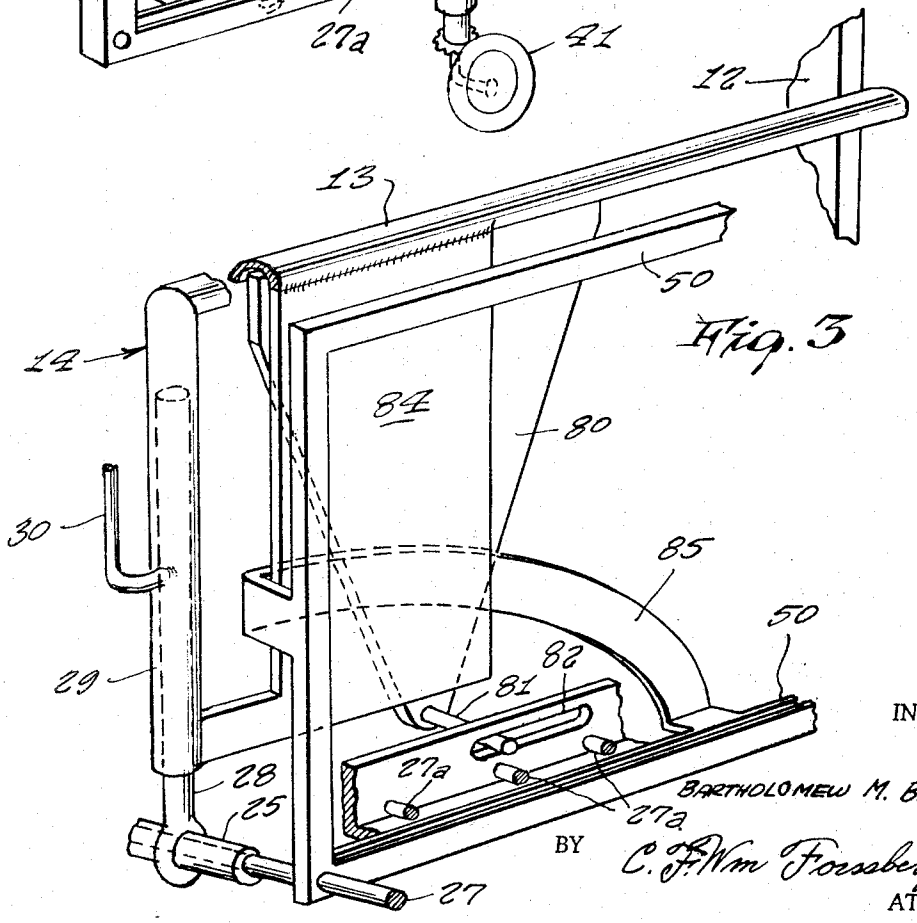


Fig. 3

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Fig. 4

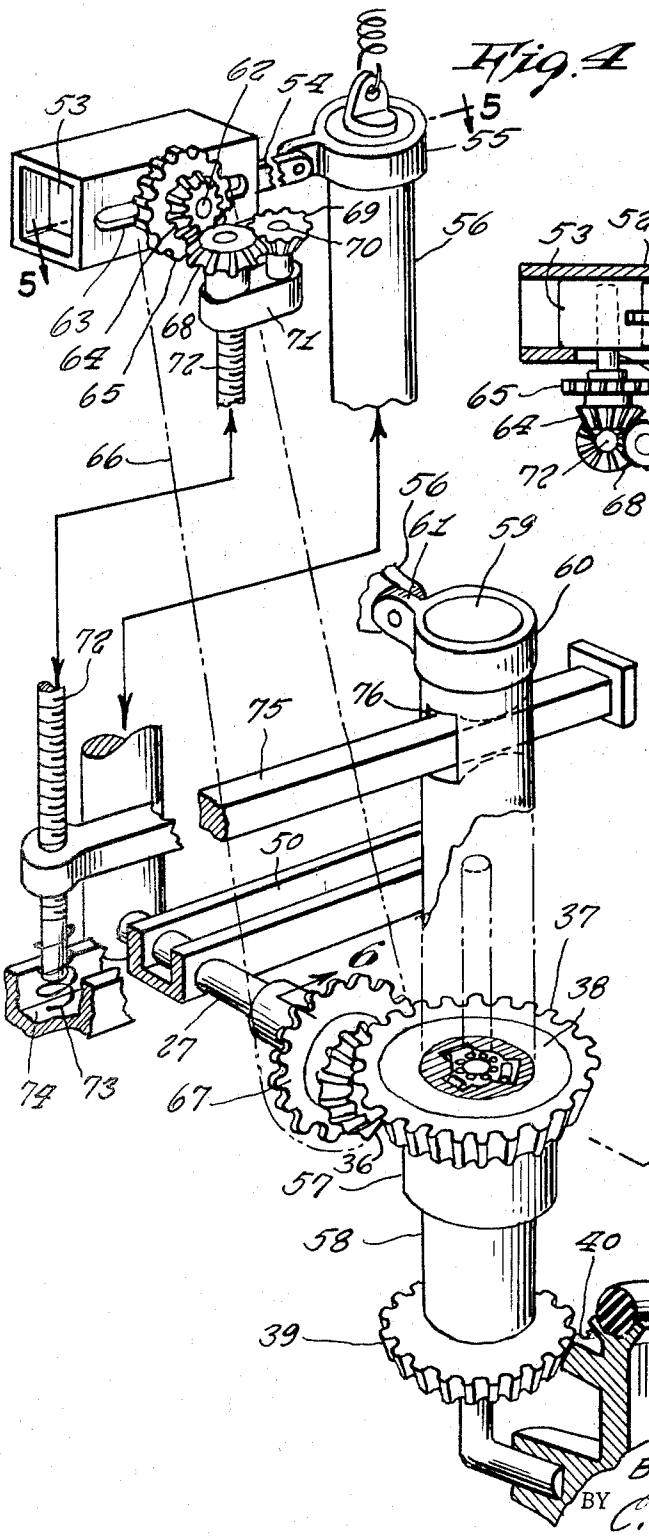


Fig. 5

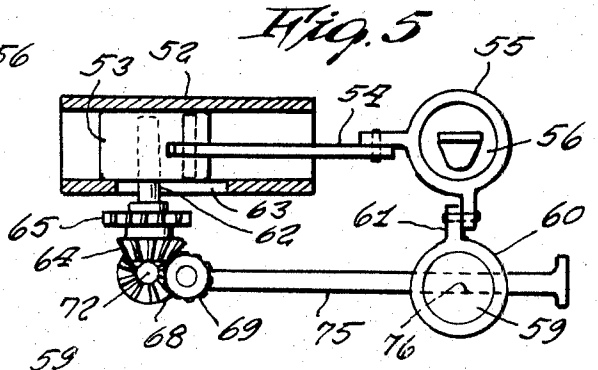
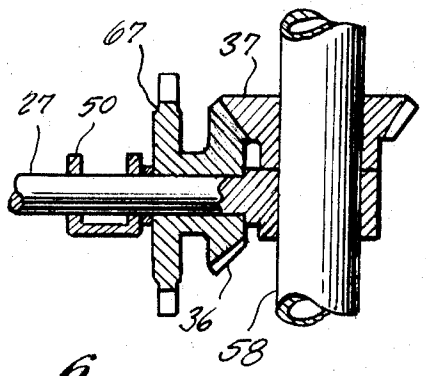


Fig. 6



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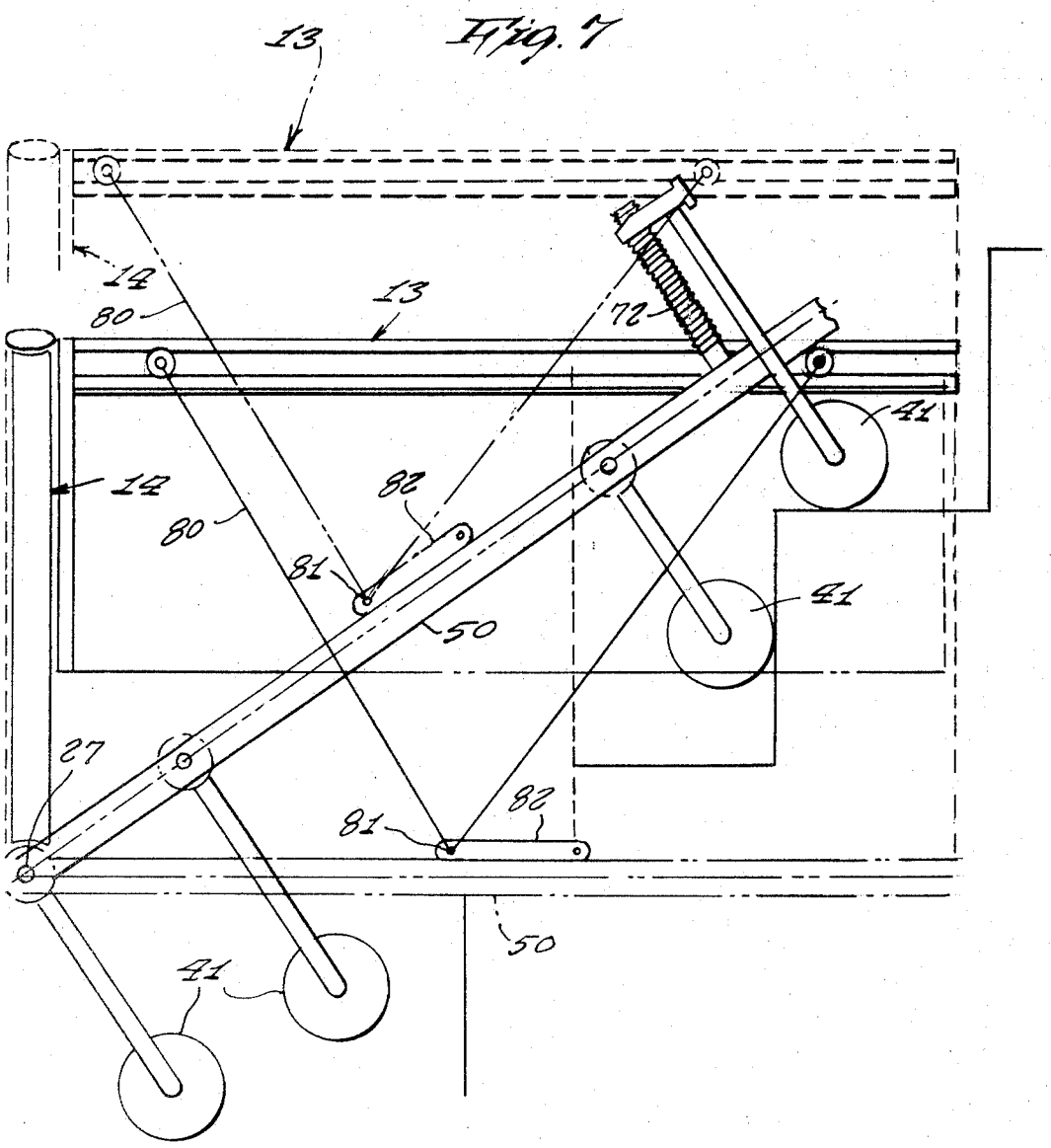
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Fig. 7



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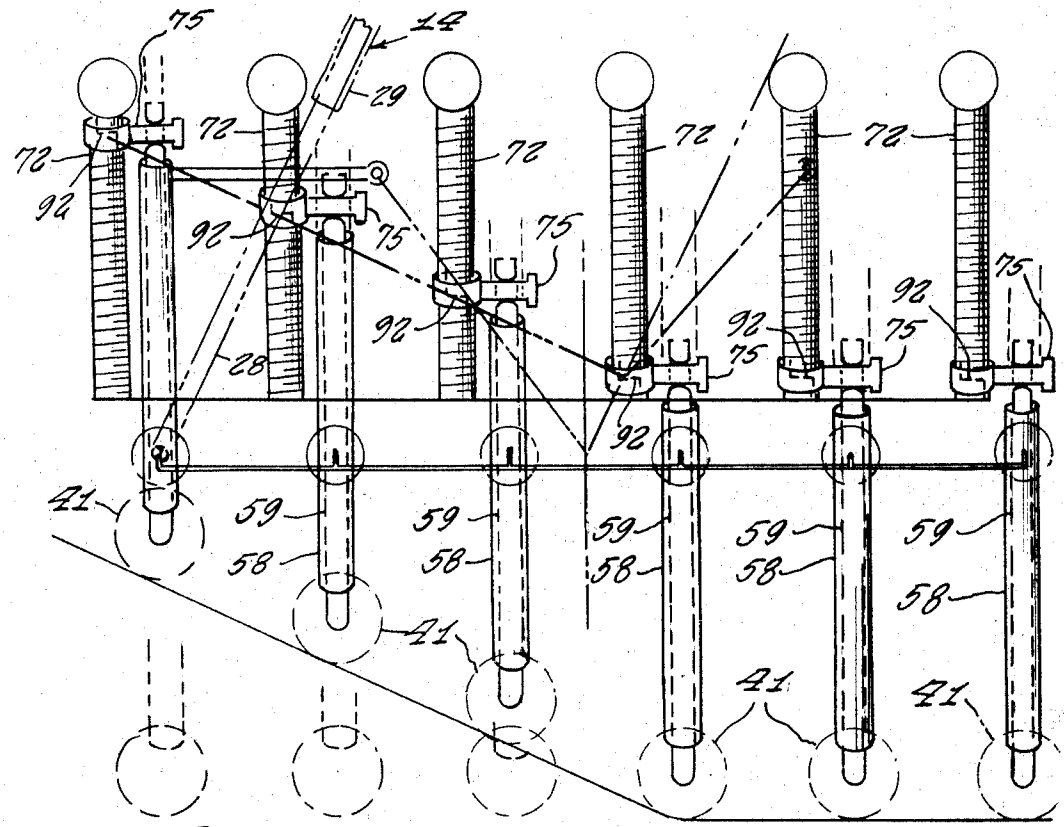


Fig. 8

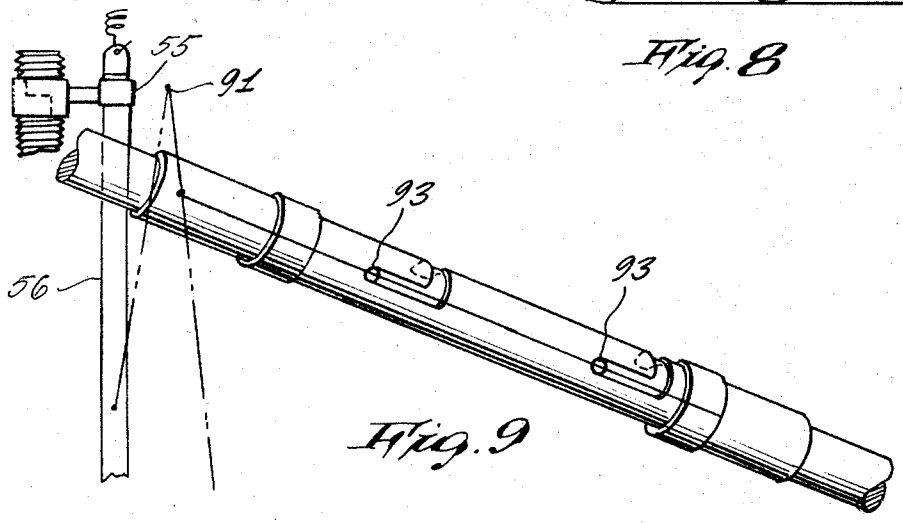


Fig. 9

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3,438,641

STAIR CLIMBING WHEELCHAIR

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U.S. Cl. 280—5.28 7 Claims

ABSTRACT OF THE DISCLOSURE

A motorized, self-propelled wheelchair adapted to ascend and descend stairs, has three pairs of driving wheels on each side, each set of wheels and the corresponding set of wheels on the opposite side of the chair are adapted to rest on the tread of the same stair while the other sets of wheels are on lower or higher stairs as the case may be. Mechanism is provided for raising or lowering corresponding sets of driving wheels together as necessary to negotiate stairs as the chair moves forward.

This invention relates to wheelchairs having stair climbing characteristics.

A principal object is to provide an improved stair claimbing wheelchair that duplicates the retractive leg movements of a person when ascending and descending a stairway, and wherein there is action of displacing steps in sequence.

Other objects are to provide a stair climbing wheelchair that is relatively simple in design, rugged in construction easy to use and efficient in operation.

These and other objects will be readily apparent upon a study of the following specification and the accompanying drawing wherein:

FIGURE 1 is a fragmentary front perspective view of the invention,

FIGURE 2 is a fragmentary perspective view of the mechanism on one side of the chair,

FIGURE 3 is a similar view showing additional structure not included in FIGURE 2,

FIGURE 4 is an enlarged perspective view of part of the mechanism shown in FIGURE 2,

FIGURE 5 is a cross sectional view taken on line 5—5 of FIGURE 4,

FIGURE 6 is a cross sectional view taken on line 6—6 of FIGURE 4,

FIGURE 7 is a diagrammatical side elevation indicating an inclination position of the chair,

FIGURE 8 is another diagrammatical side elevation indicating relation motion thereof, and

FIGURE 9 is a side elevation view of a locking device.

Referring now to the drawing in detail the numeral **10** represents a stair climbing wheelchair according to the present invention wherein there is a seat **11**, a back rest **12**, side arm rests **13**, telescopic legs **14**, and a foot rest **15** providing a support for a patient in a seated position.

The chair further incorporates a drive mechanism for propelling the chair up or down a stairway or along a level floor. The drive mechanism includes a plurality of drive units on each side of the chair, driving a plurality of wheels **41**. The first drive units on each side of the chair are interconnected by a transverse extending power shaft assembly **19** powered by a motor **20** mounted below the seat **11**. The motor carries a gear **21** on motor shaft **22**, the gear driving an endless chain **23** passed around a gear **24** on a sleeve **25**. The sleeve **25** contains bearings **26** therein to support a fulcrum shaft **27**.

The lower sections **28** of the telescopic legs, have sleeve **25** mounted rotatably free therein. The upper section of the legs comprise a cylinder **29** receiving section **28** therein.

A rod **30** secured to cylinder **29** and to the arm rest **13** supports a shaft **31** on which a hand wheel **32** is secured to rotate a gear **33** also secured on shaft **31**. An endless chain **34** powered by gear **33** transmits manual power to a gear **35** secured on shaft **27**. A clutch mechanism, not shown, disengages gear **35** from the shaft **27** when the chair is power driven; gear **35** being in driving engagement with shaft **27** only during manual operation. The ends of shaft **27** carry bevel gears **36** each of which is engaged with bevel gear **37** on a sleeve unit **38** for transmitting motion to a gear **39** to drive a gear **40** on wheel **41**. Each wheel has an automatic clutch built in with a predetermined setting (not shown). The purpose of the automatic clutch mounted in each wheel is to automatically disengage the wheel from driving relationship with the gear **40** when the wheel contacts an obstacle, thus permitting the wheel to ride freely over the obstacle. After the wheel passes or overcomes the obstacle, the clutch automatically re-engages the drive gear **40**.

As shown in FIGURES 1 and 2 a channel frame **50** is provided on each side of the chair, the frame **50** being pivotable about shaft **27** between positions shown in FIGURE 7. Each channel frame **50** supports six wheel units **51**, one of which is shown complete in FIGURE 2. Each wheel unit operates one wheel independent of the other wheels to climb or descend over a stair. Each wheel unit includes a housing unit **52** rigidly fixed on frame **50** which houses a square piston **53** that through a link **54** and collar **55** moves forwardly and rearwardly on the upper end of a pivotable bar **56** pivoted at its lower end on shaft **27** or one of the five corresponding shafts **27***a*, *b*, *c*, *d* and *e*. Control stops are provided for predetermined travel distance of the piston. In each wheel unit the sleeve unit **38** includes a retaining sleeve **57** on a ridge type barrel **58** comprised of a tubular pipe with key stock or ridge affixed. Barrel **58** is set in ball bearings by means of set screws. A shaft **59** vertically movable with respect to the floor or surface on which the wheel is resting, holds wheel **41** on fixed alignment by means of a collar **60** at its upper end connected to a collar **61** on the bar **56**.

The piston **53** has a sideward extending shaft **62** that extends out of slot **63** in the housing **52** and has a bevel gear **64** and sprocket **65** integrally affixed together carried rotatably free on shaft **62**. An endless chain **66** on each side of the chair transmits power between a spocket **65** and a sprocket **36** on each shaft **27**, **27***a*, *b*, *c*, *d*, and *e*. In this way the motor **22** drives all of the wheels **41** through the gears **21**, **24** and chain **23**, the main drive shaft **27** and gears **36** on either end thereof, and chains **66** at each side of the chair on gears **36** on each drive shaft **27**, and **27***a–e*, each drive shaft being in driving engagement with a pair of wheels **41** on opposite sides of the chair.

Bevel gear **64** engages selectively gears **68** and **69**. Gear **69** is freely rotatable on a stub shaft **70** supported on bracket **71**. Gear **68** is rigidly fixed on worm **72** having disengage spring **73** at its lower end nested in a channel **74** of frame **50**. The gears **68** and **69** provide forward and reverse transmission.

An arm **75** on worm **72** extends through an opening **76** in shaft **59**. When the arm is fully up or down it is in a free position wherein rotation of the worm depresses the spring **73** which in turn lets a triggering unit engage a more solid object causing the arm to move into a free state. The spring overcomes the inertia state of the triggering unit at a determined moment which is when the worm rotation is changed. This action would now be a down thrust, or a rotation change would now mean a pull or retraction when driven to a predetermined extreme. The triggering units are conventional devices, such as ratchet gear mechanisms, adapted to engage and disengage as

necessary. There are six triggering units on each side of the chair, and as will be seen later, these units operate only on descent of stairs and do not come into play when ascending stairs. Each triggering unit or ratchet device disengages its worm at the full travel positions of arm **75** at the top and bottom of the worm **72**. Disengagement at the bottom of the worm **72** prevents locking or freezing up of the unit since all parts thereof, including the worm, barrel and wheels are rotating and thus prevents the downward driving force of the arm on the worm from damaging the apparatus. Disengagement of the worm **72** by the triggering device at the limit of travel of the arm **75** at the top of the worm, similarly prevents jamming or damage to the apparatus. At any particular time, the six triggering units on each side will be at different levels on their respective worms. When the first or sixth triggering units are at the top or bottom of their respective worms, the other triggering units will be at intermediate positions on their respective worms, but all worms will be disengaged.

The worm has also a disengage spring at the top that works the same as the lower spring. Its only purpose is to overcome inertia state, this being at moment of change of rotation as result of chair in motion the wheel hits an obstacle, namely steps of a stairway, resulting now in change of rotation of the worm.

The arm rests are each channel shaped on the underside wherein the top edge of a triangular plate **80** is slidable. Each plate **80** has a shaft **81** that travels in a slot **82** of an angle **83** secured to the frame **50**. As the frame is tilted as shown in FIGURE 7 the shaft **81** travels from one end to the opposite end of slot **82**. As shown in FIG. 1, frame **50** is pivoted on shaft **27** at one corner and the opposite end of the frame is tilted due to the inclination of the stairs; one or more sets of the wheels **41** being higher or lower than the similar wheels **41** associated with shaft **27**.

A retainer plate **84** secured to one lower edge of the arm rest is secured to the cylinder section **29** of legs **14**. A stabilizer **85** is in slide engagement with the rear side of plate **84**, the stabilizer being secured to the frame **50**. See FIG. 3.

A flat stock bar **86** is supported on each frame **50** and has a two shift movement forward to engage piston **53** and gear **68** to retract legs. As best seen in FIG. 2, bar **86** is fixedly mounted in units **50** but slidably mounted in suitable mounting means (not shown) on frame **50**. The bar **86** as thus mounted is capable of being moved forwards or backwards manually as shown by the arrows in FIG. 2. Shifting bar **86** forward places the apparatus in condition ascending. Shifting the bar **86** rearwardly places the apparatus in condition for descention.

As shown in FIGURE 1 a flat stock stiffening plate **95** is provided on each side of the chair for maintaining shafts **31** at set distance from shaft **27**. It will be noted that as the legs **14** are telescoped the rods **30** affixed thereto will slide in brackets **96** which support shafts **31**.

In operative use when the chair travels along a level floor and subsequently encounters the first step of a stair for purpose of ascension, the automatic clutches on all wheels apply themselves momentarily as each wheel abutts with the obstacle or step causing rearward displacement of wheel **41** and causing the bar **56** to pivot forwardly about shaft **27** thus moving the piston **53** and causing power from gear **64** to be transferred to gear **69** thus causing reverse rotation of the worm **1** and ascension of arm **75** on the worm and raising the wheel so as to mount the step. Thus the remaining wheels remain on solid surface while a wheel is being retracted. When the chair attains the position shown in FIGURE 8 wherein the fourth wheel abutts the first step and the wheel is raised as above described and then the bar **56** pivots back to move the piston and change engagement of gear **64** to gear **68** to cause arm **75** to descend and cause a down thrust of the fourth wheel, an inclination occurs of the chair body respective to the drive mechanism **16** so that a person may sit at a normal angle while traveling on the stairway.

On descending stairs, when a wheel **41** leaves a stair, the weight of the chair and occupant is taken off the wheel, thus permitting the tension in the spring connecting member **56** to the bar **86** to become operative to pull the member **56** rearwardly. This operates member **54** and piston **53** to cause gears **68** and **69** to engage. Inasmuch as the reversible motor **20** is operated in the reverse direction when descending stairs, the engagement of gears **68–69** causes rotation of the worm **72** in the opposite direction from that in which it rotates on ascending stairs. Therefore, the wheel unit and wheel **41** is driven downwardly into engagement with the next lower stair.

It will be seen from the drawings and the above description of the various parts, that the apparatus comprises a chair having a motor **20** driving shafts **27**, and **27***a* through *e* by means of an endless chain **23** and gears **21** and **24**, and gears **36** and chains **66** as described previously. Auxiliary manual drive means is also provided on each side of the chair consisting of a hand wheel **32**, shaft **31**, gear **33**, endless chain **34** and gear **35** affixed to shaft **27**. A frame **50** on each side of the chair is pivotally mounted on shaft **27** for movement between horizontal and tilted positions as shown in FIGS. 1 and 7, respectively, a plate **84** affixed to the chair body and a curved guide member **85** on the frame **50** serving to guide the tilting movement of the frame **50** as best seen in FIG. 3.

Six wheel units **51** are arranged in three pairs of such units on each side of the chair. Each of the wheel units **51** is rigidly mounted on a horizontal bar **86** on each side of the chair, the bar **86** being movably mounted on the frame **50** for movement between a forward position and a rearward position. Each of the wheel drive units **51** has a sprocket **65** driven by an endless chain **66** and a sprocket **67** on one of the drive shafts **27**, **27***a*, **27***b*, **27***c*, etc. When the bar **86** is manually moved to its forward position bevel gears **64** on each of the sprockets **65** in the individual wheel units engages and drives a gear **68** to cause rotation of one of the worms **72** which operates as described hereinabove to drive mechanism rotating one of the wheels **41** of the wheelchair to permit the chair to ascend stairs. Similarly, manually moving the bar **86** on each side of the chair to its rearward position disengages gears **64** from gears **68** and engages them with reversing gears **69** causing the worms **72** to rotate in the opposite direction, to provide for descending stairs as described above.

I claim:

1. In a stair climbing and descending vehicle comprising a frame, means to support an occupant mounted on said frame, two sets of wheels mounted on said frame one set disposed on each of two opposite sides of said vehicle, a first drive shaft rotatably mounted on said frame, means for rotatably driving said first drive shaft, and means mounted on said first drive shaft for rotatably driving a first opposed pair of wheels consisting of the first wheel in each set of wheels on opposite sides of said vehicle, the improvement which comprises, a secondary drive shaft rotatably mounted on said frame for each additional opposed pair of wheels in said sets of wheels, sprocket and endless chain means connecting said first drive shaft and each secondary drive shaft whereby said secondary drive shafts are rotatably driven by said first drive shaft, means for raising each of said wheels substantially vertically and independently of the other wheels as said wheel encounters the riser of a stair on ascending stairs to elevate said wheel to the level of the next higher stair tread, and means for lowering each of said wheels substantially vertically and independently of the other wheels as said wheel leaves the tread of a stair on descending stairs to lower said wheel to the level of the next lower stair tread, whereby as said vehicle is propelled up and down stairs as the case may be, the wheels of each set of wheels are in contact with at least two stair treads at different levels.

2. A vehicle according to claim **1**, including clutch means which automatically and separately disengage each wheel from driving relationship to said drive means as said wheel encounters a stair riser on ascending stairs and as said wheel leaves a stair tread on descending stairs, said means for driving said wheels remaining in driving engagement with those wheels resting on a stair tread while ascending and descending stairs.

3. A vehicle according to claim **2**, wherein the means for driving said wheels comprises a reversible motor, whereby the direction of rotation of said drive shafts and said wheels may be reversed.

4. A vehicle according to claim **3**, wherein said means for raising and lowering each of said wheels comprises a generally vertically disposed, telescopic wheel mounting unit carrying one of said wheels, said telescopic unit having outer and inner portions the outer portion determining the level of said wheel, said wheel mounting unit being mounted on said frame, an elongated vertically disposed worm rotatably mounted on said frame, a generally horizontally disposed arm, one end of said arm being connected to the outer portion of said telescopic wheel mounting unit, the other end of said arm being in threaded engagement with said worm, reversing gear means mounted on said worm, and means driven by said first and secondary drive shafts for rotatably driving said worm through said reversing gear means for rotation in a predetermined direction, whereby said arm travels along said worm thus raising and lowering the telescopic portion of the wheel unit and the attached wheel, depending on the direction of rotation of the worm.

5. A vehicle according to claim **4**, including means for shifting said means for driving said worm between a position in which said reversing gear means drives the worm in clockwise rotation and a second position in which said reversing gear means drives the worm in counter-clockwise rotation, thus providing for raising and lowering said wheels as desired.

6. A vehicle according to claim **5**, including means at each end of said worm for temporarily disengaging said arm from threaded engagement with said worm and causing a change in the direction of rotation of said worm before re-engagement of said arm therewith.

7. A vehicle according to claim **6**, including means for pivoting said frame about the axis of said first drive shaft and with respect to said means for supporting an occupant, to permit said frame to assume a position generally parallel to the incline of stairs on ascending and descending such stairs, but to maintain said occupant supporting means generally horizontal.

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U.S. Cl. X.R.

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