Jan. 19, 1965 E. D. DUNN, JR 3,166,138

STAIR CLIMBING CONVEYANCE

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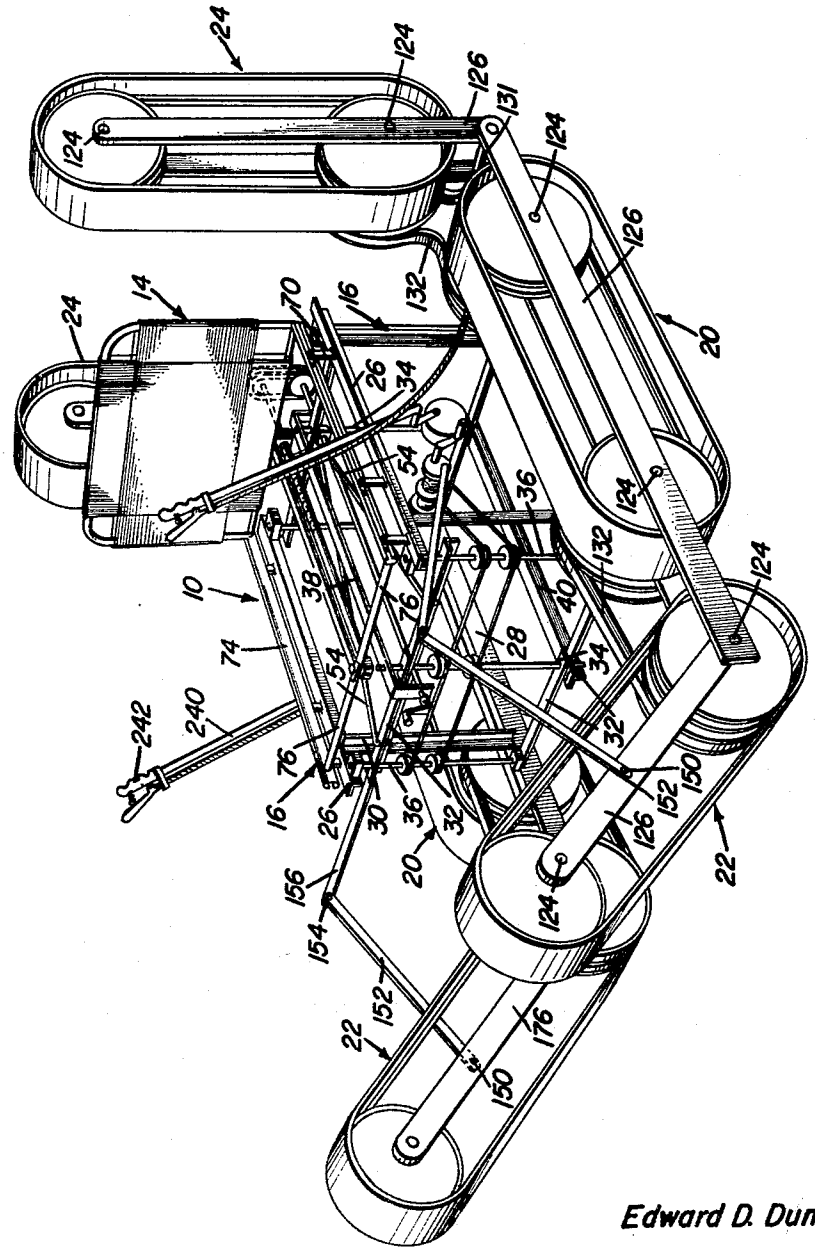

Fig. 1

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STAIR CLIMBING CONVEYANCE

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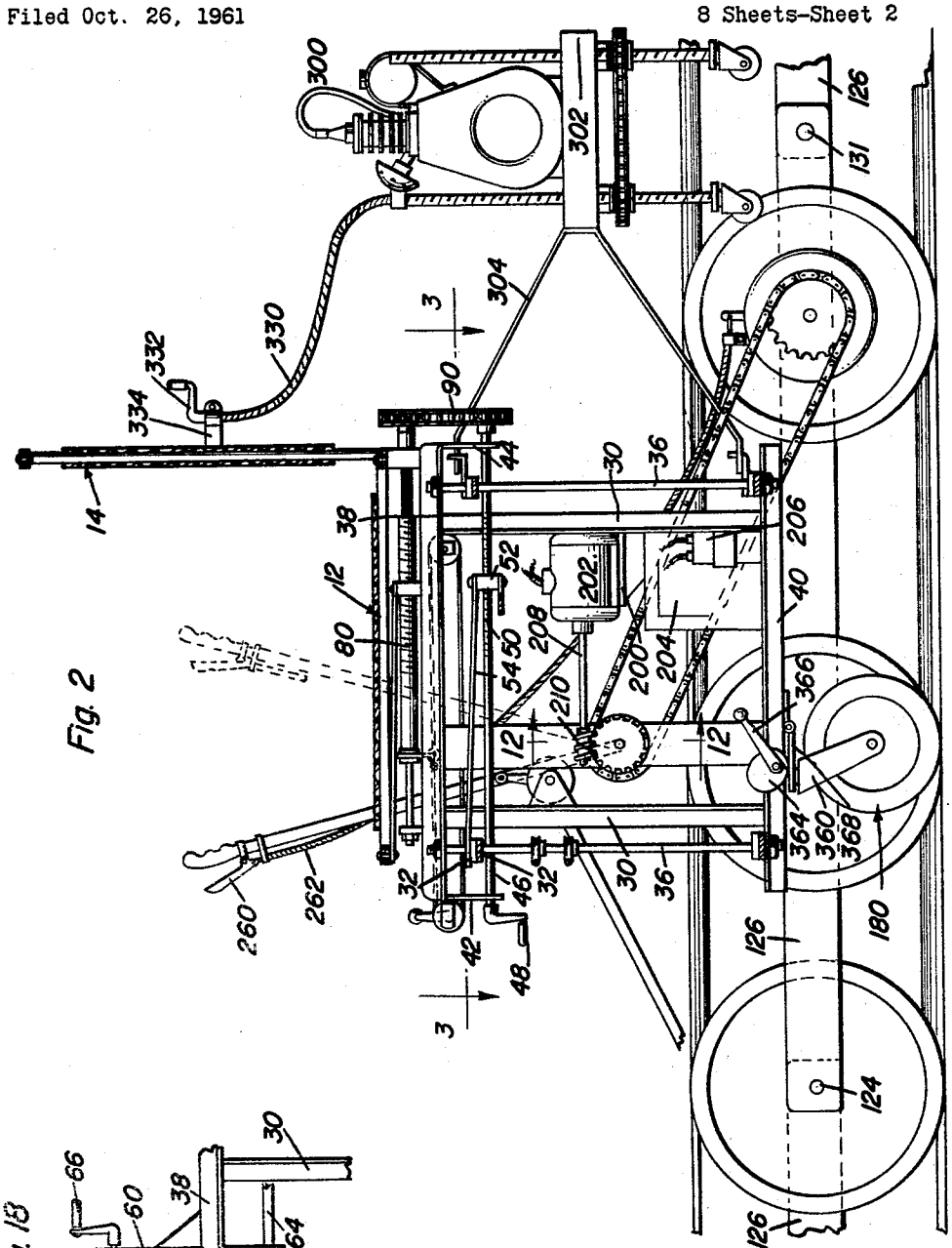

Fig. 2

Fig. 18

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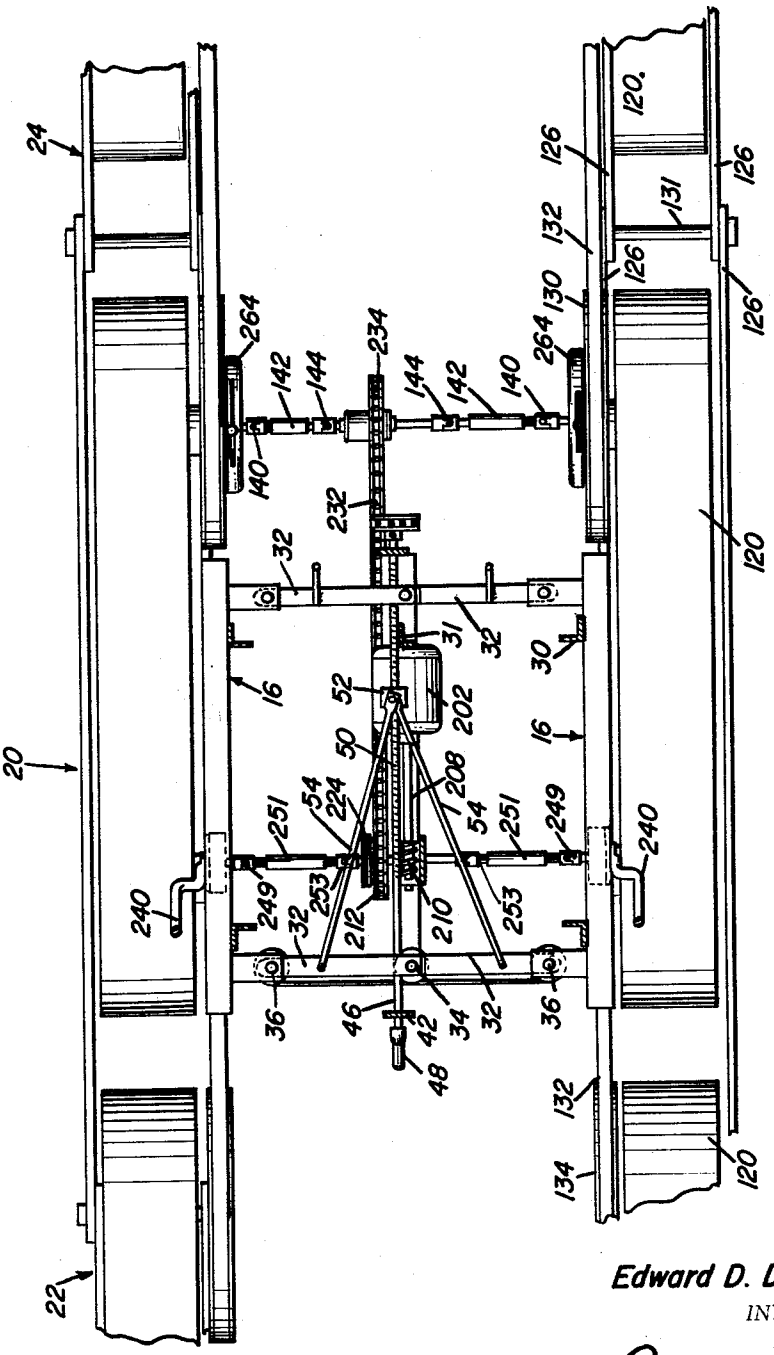
Fig. 3



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STAIR CLIMBING CONVEYANCE

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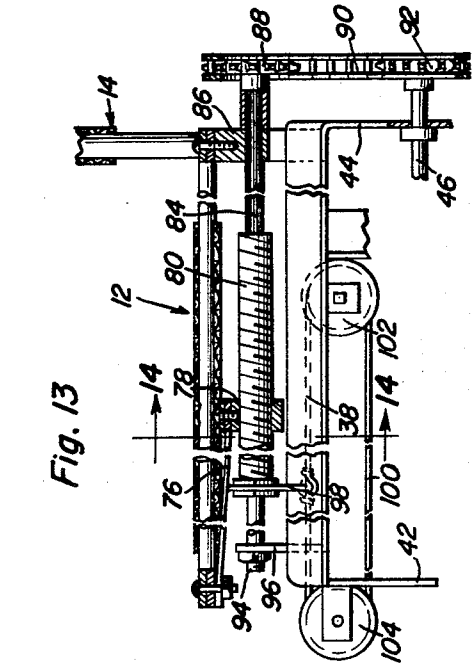

Fig. 13

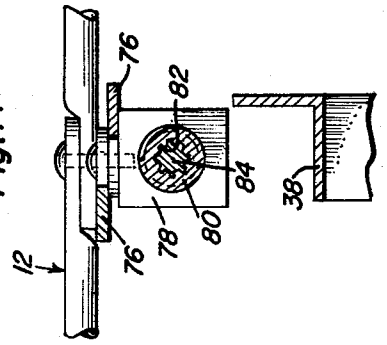

Fig. 14

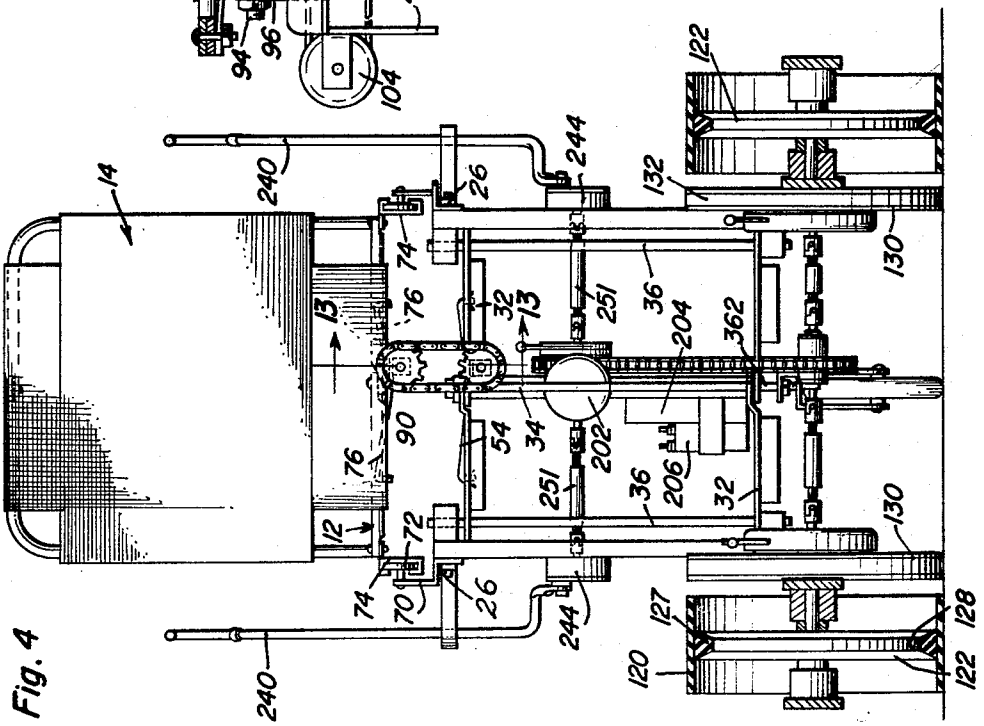

Fig. 4

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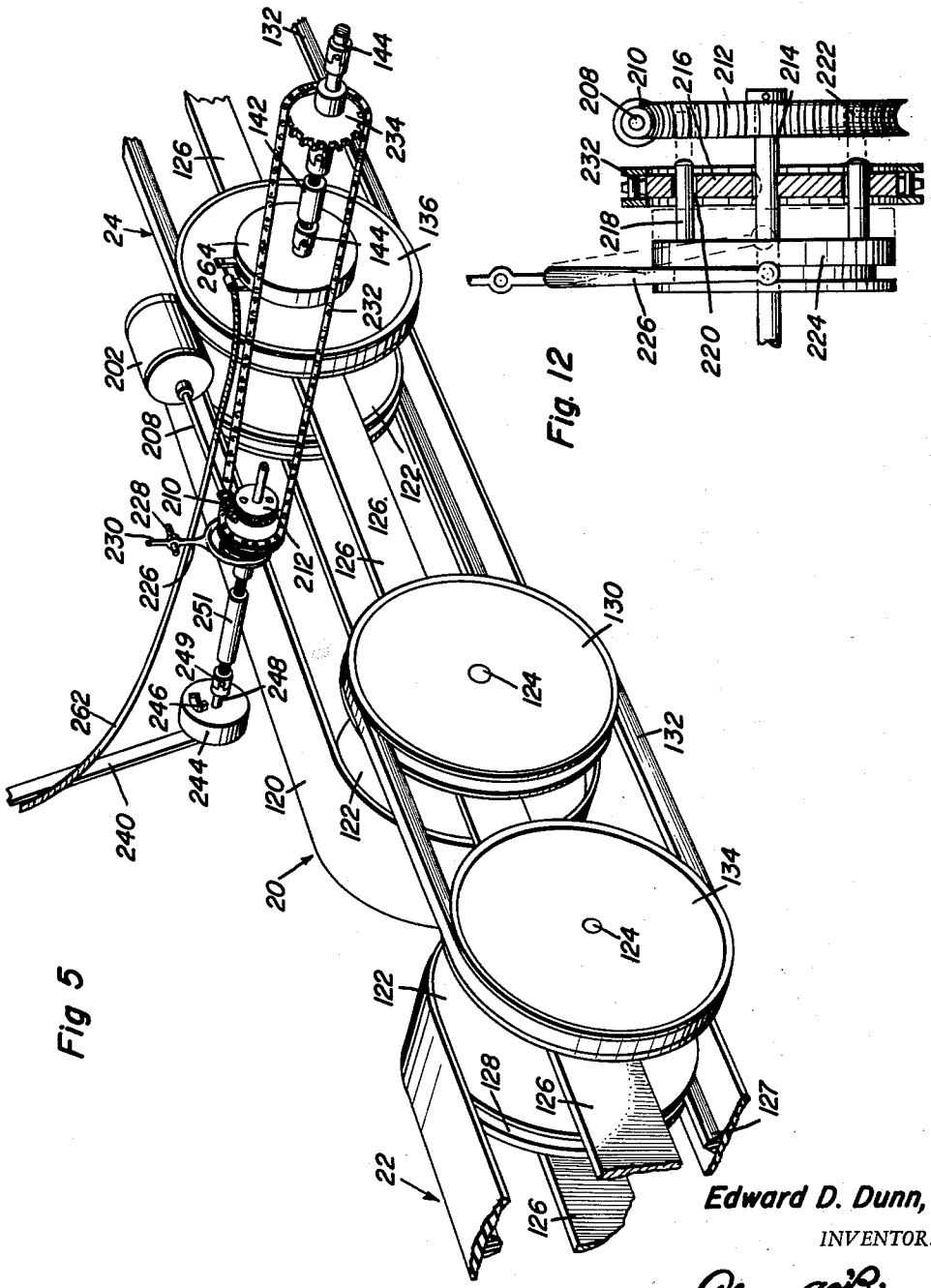

Fig 5

Fig. 12

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Fig. 6

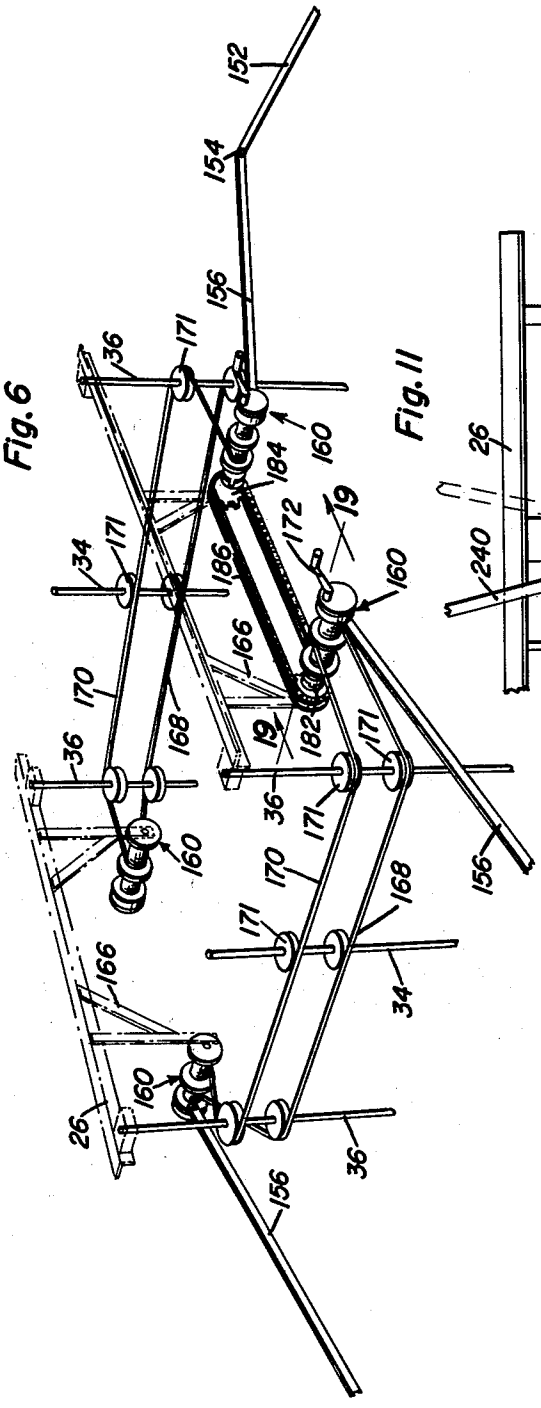


Fig. 11

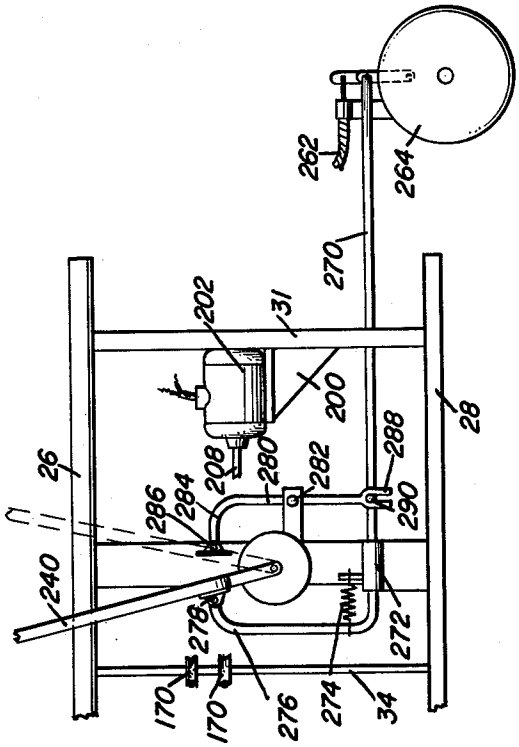
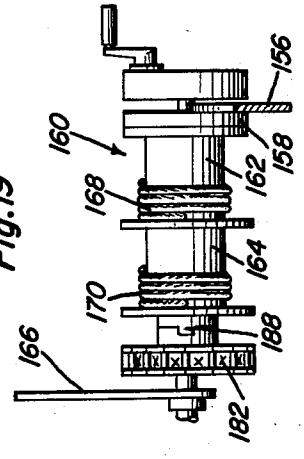


Fig. 19



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STAIR CLIMBING CONVEYANCE

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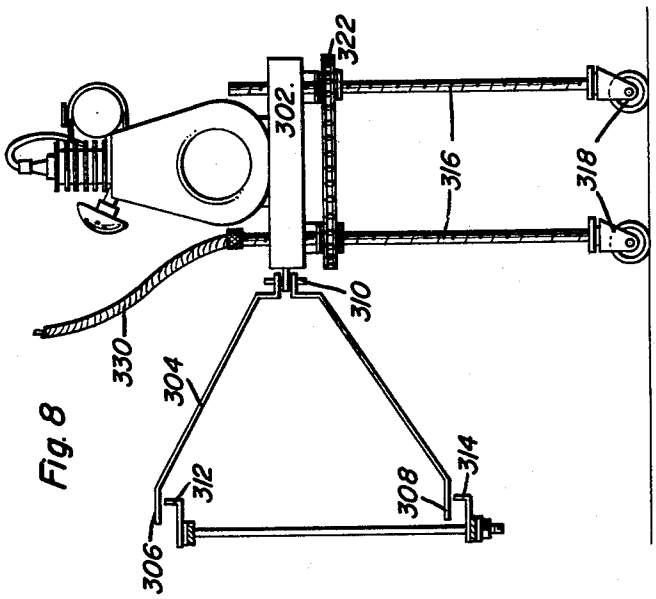

Fig. 8

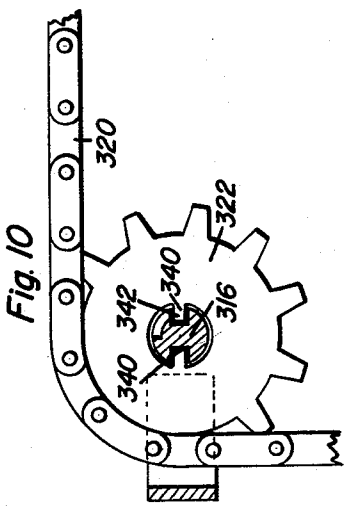

Fig. 10

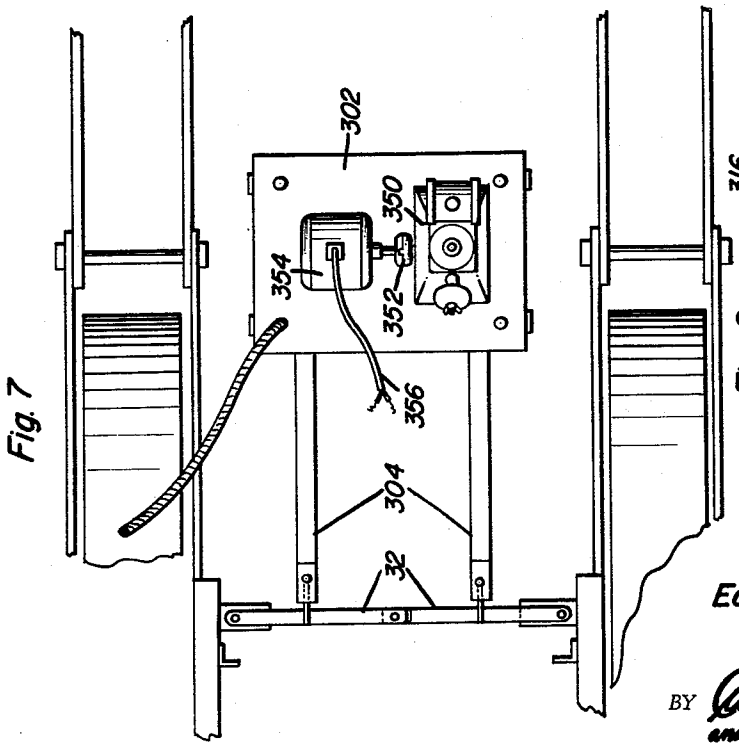

Fig. 7

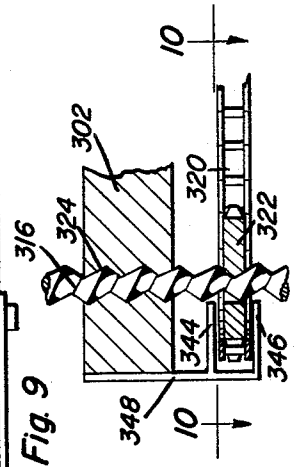

Fig. 9

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STAIR CLIMBING CONVEYANCE

Filed Oct. 26, 1961 8 Sheets-Sheet 8

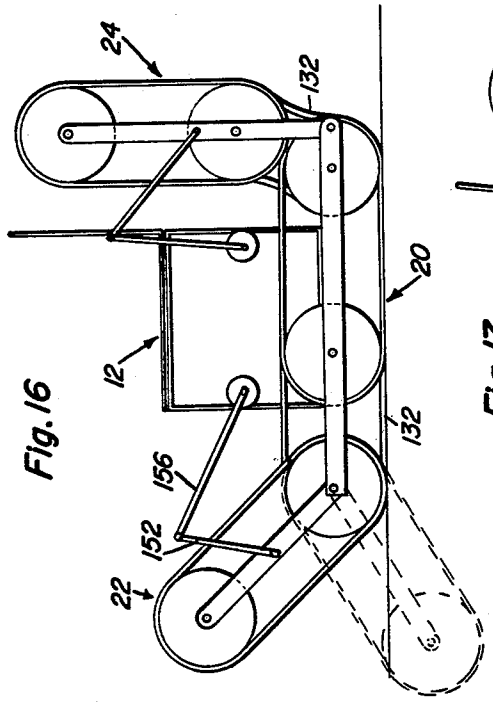

Fig. 16

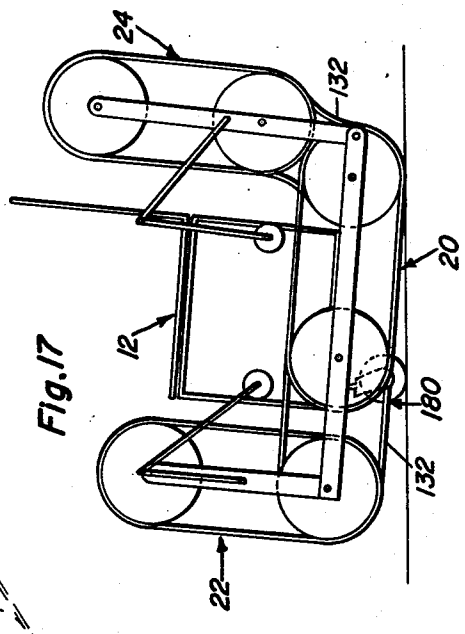

Fig. 17

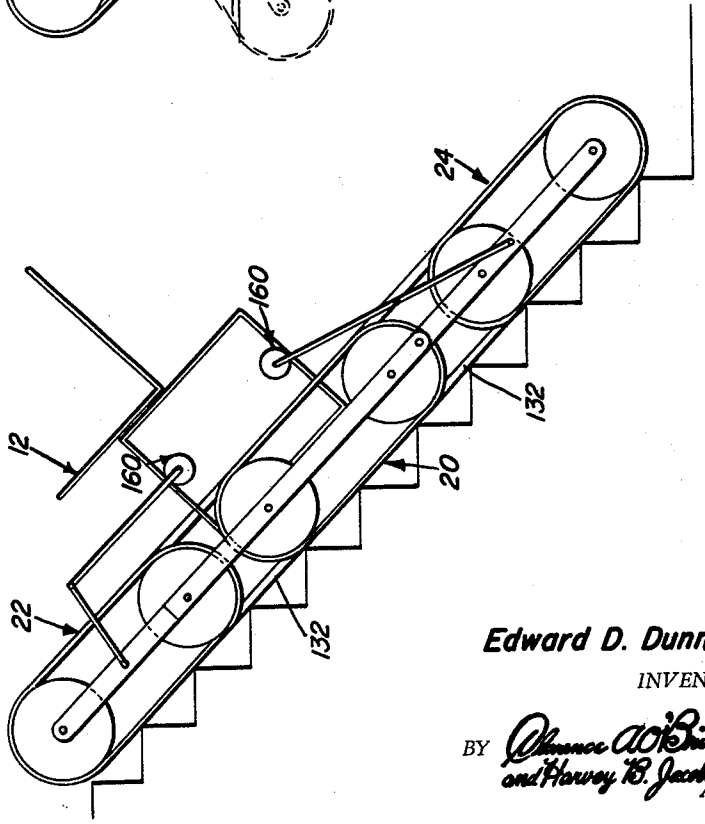

Fig. 15

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United States Patent Office 3,166,138 Patented Jan. 19, 1965

3,166,138

STAIR CLIMBING CONVEYANCE

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Filed Oct. 26, 1961, Ser. No. 147,795
16 Claims. (Cl. 180—9.24)

This invention comprises a novel and useful stair climbing conveyance and more particularly relates to a power operated apparatus of the wheel chair type specifically adapted for negotiating inclines and stairs in an improved manner, with increased safety and comfort for the rider and under a very complete and precise control by its occupant.

Elderly persons, invalids and semi-invalids of various ages are greatly handicapped by the loss of their mobility arising from their physical handicap. Often, if the disadvantage of lack of mobility could be satisfactorily overcome such persons would be restored to a full enjoyment and a full use of their facilities and capacities. It is therefore the primary object of this invention to provide an apparatus specifically designed to respond to and overcome to a substantially complete extent this loss of mobility thereby restoring to such persons a mechanically provided mobility which will closely approximate and in some instances exceed the natural mobility of which they have been deprived by their condition.

In previously designed power operated wheel chairs and the like, a number of various disadvantages, more or less serious in their effect, have been present. Thus, wheel chairs, during their use by a person are generally of a fixed width thereby greatly limiting their maximum serviceability to their user through their difficulty in negotiating narrow doors, passages or the like. Further, such devices have usually been capable of but a limited range of operation due to the necessity for them remaining in contact with their power source when they are electrically powered or limiting their use to outdoors when they are powered by gasoline engines and the like. Still further, such devices experience difficulty in negotiating relatively steep inclines such as stairways, irregular surface of terrain and the like which not only result in a considerable loss of comfort and confidence on the part of the user but frequently pose serious safety hazards to the user. Still further, where attempts are made to overcome one or more of the above-mentioned difficulties there has usually resulted an apparatus in which the controls thereof are so complex and complicated in their operation as to frequently be beyond the physical abilities of certain types of users.

It is therefore the primary purpose of this invention to provide an apparatus to effectively overcome all of the above-mentioned difficulties.

An important object of the invention is to provide a wheel chair type of power operated conveyance in which the power plant therefor shall be mounted in the framework of the device and wherein provision shall be made for controllably varying the width of the apparatus without in any way interfering with its continuous mobility and use as a conveyance for transporting persons.

A further object of the invention is to provide a conveyance as set forth in the preceding objects in which there are provided a plurality of supporting and driving units including a central unit directly attached to and supporting the frame of the conveyance together with front and rear units which are pivotally connected to the central unit and are mounted for vertical tilting about horizonal transverse axes at the ends of the central unit under the control of the operator to thereby facilitate ascending or descending inclines with a greater degree of safety and certainty.

A still further important object of the invention is to provide an apparatus in accordance with the preceding objects in which the power driving means therefor may

at any time be superseded by a manual actuating member detachably connected to the driving means.

A still further object of the invention is to provide a device in accordance with the preceding objects in which a trailer unit may be detachably coupled to the conveyance and will support an engine driven generator as a means for maintaining the storage battery in a charged condition thus permitting a wide range of outdoor travel for the device, and which may be uncoupled from the conveyance so that the latter may be used indoors.

Still another object of the invention is to provide a device in accordance with the preceding objects which shall have an improved brake and steering means affording a very precise control and maneuverability of the device under the control of the operator, together with a safety attachment greatly contributing to the safe handling of the device in emergencies.

Still another object of the invention is to provide a power operated wheel chair type of conveyance in which the seat assembly of the device shall be capable of manually controlled movement upon the frame of the device to suit the convenience of the user together with means for varying the width of the device, both of said means being operable independently and simultaneously as desired and without interfering with the power propulsion system of the device.

An additional object of this invention is to provide a power operated conveyance having means operable to shift the seat platform upon the mobile frame of the device in order to selectively position the occupant for various purposes such as better visibility when traveling on inclines, entering or leaving the conveyance or for performing various occupations while seated in the apparatus, and the like.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a diagrammatic perspective view of a preferred form of the invention, parts being omitted and broken away in the interest of clarity and simplicity of illustration, with the device being shown in its fully laterally extended position and with the tread units in their normal travelling position;

FIGURE 2 is a side elevational view of the apparatus of FIGURE 1 with a trailer attachment coupled to and being carried by the conveyance, parts being broken away and omitted and with all of the tread units being disposed in a common plane in position for travel upon level or inclined surfaces;

FIGURE 3 is a horizontal sectional view of the apparatus but with the trailer attachment uncoupled therefrom and with parts being omitted and broken away;

FIGURE 4 is a rear elevational view of the apparatus with parts being shown in vertical section and parts being omitted therefrom;

FIGURE 5 is a diagrammatic detail view in perspective of a portion of the tread units and the driving mechanism therefor of the apparatus;

FIGURE 6 is a diagrammatic view in perspective of the tread unit position synchronizing and controlling mechanism for the front and rear tread units of the invention;

FIGURE 7 is a fragmentary plan view of the rear portion of the apparatus with the trailer attachment connected thereto;

FIGURE 8 is a fragmentary side elevational view, parts being shown in vertical section, of the trailer attachment shown disconnected from the apparatus;

FIGURE 9 is a detail view in vertical section of the

adjustable support leg structure of the trailer attachment and its actuating mechanism;

FIGURE 10 is an enlarged detail view in horizontal section taken substantially upon the plane indicated by the section line 10—10 of FIGURE 9;

FIGURE 11 is a detail view, partly diagrammatic and in side elevation with parts omitted of a brake safety actuating means forming a feature of the invention;

FIGURE 12 is a detail view in vertical transverse section taken substantially upon the plane indicated by the section line 12—12 of FIGURE 2 and showing the manually operated throw-out for the power propulsion mechanism;

FIGURE 13 is a detail view in vertical longitudinal section, taken upon an enlarged scale substantially upon the plane indicated by the section line 13—13 of FIGURE 4, of the lateral adjusting mechanism of the seat positioning mechanism and its association with the width varying mechanism of the device;

FIGURE 14 is a view in vertical transverse section taken substantially upon the plane indicated by the section line 14—14 of FIGURE 13;

FIGURE 15 is a diagrammatic view showing the position of the tread units when the conveyance is ascending or descending stairs or a steep incline;

FIGURE 16 is a diagrammatic view showing the position of the tread units in full and dotted lines when the conveyance is preparing to ascend or to descend respectively a stair or other steep incline;

FIGURE 17 is a diagrammatic view showing the position of the tread units when the vehicle is travelling over floors or smooth level surfaces;

FIGURE 18 is a detail view in elevation of a modified mounting of the operating handle of the seat adjusting mechanism of the invention; and

FIGURE 19 is a detail view taken in vertical transverse section substantially upon the plane indicated by the section line 19—19 of FIGURE 6 and showing certain details of the manually operated control means for raising or lowering the front and rear tread units and synchronizing their movement and operation.

A preferred embodiment of apparatus in accordance with the principles of this invention is illustrated in the accompanying drawings and is disclosed and described as comprising a power operated conveyance of the wheel chair type with supporting and driving means which greatly facilitate its operation in climbing and descending stairs and other steep inclines. The complete apparatus or power operated conveyance is indicated generally by the numeral 10 in the accompanying drawings and comprises a mobile frame which carries a conventional chair assembly of any desired character, not shown, but including a horizontal chair supporting platform 12 together with a chair back structure 14 as suggested in FIGURE 2. Inasmuch as the details of the chair assembly including seat, armrests, back, footrests and the like may be of any conventional and known design and the invention set forth and claimed herein does not require any particular construction of the same, a detailed showing and description has been omitted as being superfluous.

The apparatus 10 consists of a suitable framework which includes a pair of side frame members each designated generally by the numeral 16 and which themselves support the seat assembly of the device and in turn are connected to and carried by a supporting and driving means of a type to be specifically set forth hereinafter. In addition to its frame structure and seat assembly the conveyance 10 in accordance with the present invention includes a plurality of pairs of supporting and driving means preferably in the form of endless track and wheel assemblies or units. Thus there is provided a pair of central units 20 mounted upon the opposite sides of the device and each of which is secured to one of the side frame members for supporting the latter and for movement with the latter. These central units preferably are

disposed upon the exterior of the frame of the device and extend at least the full length of the latter as shown in FIGURES 1 and 3 in particular. In addition to the pair of central units there is provided a further pair of forward units 22 and rear units 24 each of which is pivotally connected to one of the extremities of the corresponding central units 20 for pivoting or tilting movement about a horizontal transverse axis therebetween whereby the forward and rear units may be selectively raised or lowered between a downwardly inclined and an upwardly inclined position either singly or in synchronization with each other in a manner to be subsequently set forth.

The device also includes a means for variably adjusting the over-all width of the apparatus, which adjusting means is operable without interfering with the power operation of the device or the positioning and controlling of the tread units. There is further provided a power propulsion system for driving the apparatus together with a manually operable propulsion means capable of selective use in place of the power propulsion means. Still further there is provided a brake, clutch and steering mechanism of an improved design in order to afford complete control and facilitate maneuvering of the apparatus. Finally, there is provided a trailer attachment for the apparatus carrying an engine generator combination for maintaining the battery charged and thus providing an engine dynamo drive for outdoor use thereby greatly increasing the range of maneuverability of the apparatus.

The framework of the apparatus may be of any suitable design as being formed of a lattice-like or skeletonized assembly of bars and rods. Thus, each of the side frame members 16 may conveniently comprise longitudinally extending horizontal upper bars or structural members 26 together with lower horizontally extending beams 28. Vertical members 30 rigidly connect together the upper and lower members to form a generally rectangular type of side frame member.

The two side frame members are rigidly connected together but in an adjustable manner to permit movement towards and from each other while maintaining a generally parallel relation. For this purpose there are provided sets of transverse links each indicated by the numeral 32, see FIGURES 1 and 3, which are pivoted to each other at their adjacent ends as by a vertically extending pivot rod 34 at both the top and bottom and the front and back portions of the side frame members. The outer ends of these transverse links 32 in turn are pivoted to the side frame members as by the vertically extending rods 36. The arrangement is such that as the pivot rods 34 at the front and rear ends of the side frame members are displaced longitudinally thereof, the angular relationship between the transverse links 32 will be varied to in turn vary the distance between the side frame members 16. Thus, the side frame members may be moved to their maximum distance apart when the links are in a straight line as shown in FIGURE 1, thus providing the maximum width for the apparatus. On the other hand, upon maximum displacement of the rods 34 longitudinally of the device, the links 32 will be moved into their most acute angular relationship, thus bringing the side frame members to their closest proximity to each other and thus effecting the reduction of the width of the apparatus to its minimum.

It will be appreciated that inasmuch as the various pairs of supporting and driving units 20, 22 and 24 are connected to the two side frame members, they likewise will be moved towards and from each other during the above-mentioned operation.

In order to rigidly connect together the front and rear central pivot rods 34 for simultaneous movement during the lateral adjustment of the frame members, these rods are connected at their upper and lower ends and at any other conventient place desired there along by the longitudinally extending connecting members 38 and 40 through which these rods extend, so that upon shifting

one of the rods 34, the other rod will also be simultaneously moved therewith and through the associated transverse links 32 will impart the desired lateral movement to the side frame members relative to each other.

A manually operated control means is provided for effecting and controlling the longitudinal shifting of the central vertical pivot rods 34 to thereby laterally adjust the width of the apparatus. For a description and understanding of this manual control means attention is now directed specifically to FIGURES 1–4 in conjunction with FIGURES 13 and 14. Secured against axial displacement and journalled in suitable brackets 42 and 44 depending from the upper frame member 38 is a manually operated shaft 46 provided with a handle 48 thereon and which is also provided with suitable threads 50 upon which travels an internally threaded member or nut 52. A pair of connecting rods 54 have one end of each pivoted to the travelling nut 52, with their other ends being pivoted to the transverse links 32 journalled upon the vertical pivot shafts 36. It will thus be apparent that as the rod 46 is rotated, movement of the travelling nut 52 there along will through the connecting rods 54 impart pivoting movement to the previously mentioned links 32. This in turn will effect a lateral adjustment of the width of the apparatus as previously set forth.

The connection of the travelling nut to the transverse links 32 will be best apparent from a consideration of FIGURE 3 in conjunction with FIGURE 2.

In place of the handcrank 48 shown in FIGURES 2 and 3, there may be provided the modified manually operating means shown in FIGURE 18. In this modification an upstanding bracket 60 extending to any convenient location and rising from the frame member 38 has attached thereto a flexible cable assembly indicated generally by the numeral 62 and which has an operating flexible shaft 64 connected in any suitable manner to the shaft 46 for operation of the same. A handle 66 is secured thereto which handle is positioned for convenient operation by the occupant of the device to effect rotation of the actuating shaft 46 and thus control the lateral extension or collapsing of the apparatus.

As will be best apparent from a consideration of FIGURES 1, 2 and 4, in conjunction with FIGURE 13, it will be observed that the upper longitudinal side frame members 26 each have a plurality of upstanding support brackets 70 upon which are journalled supporting rollers 72. These rollers are received within the channel members 74 which constitute a part of the seat supporting frame or platform 12 previously mentioned. In this manner, the seat assembly by means of this platform is mounted upon the side frame members for longitudinal travel there along. In order that this seat platform may likewise be capable of lateral adjustment in synchronization with the lateral adjustment of the side frame members, a similar arrangement, see FIGURES 2, 13 and 14 is provided in which the two channel members 74 are interconnected at each end thereof by a pair of pivoted links 76 corresponding to the previously mentioned links 32. The links 76 at their adjacent ends are pivoted to a travelling nut 78 which is threadedly engaged upon an externally threaded sleeve 80. Thus, when this sleeve is held against axial displacement but is rotated, the travelling nut will travel longitudinally therealong and will effect pivoting of the transverse links 76 to thus laterally expand or collapse the seat carriage assembly or platform of the apparatus. Means are provided for synchronizing the operation of the sets of links 76 and 32.

For that purpose, as will be seen from a comparison of FIGURES 13 and 14, the externally threaded sleeve 80 has a hollow splined axial bore therethrough as at 82 which bore may extend entirely through the sleeve if desired, or may be terminated therein at any suitable distance from the right end thereof as viewed in FIGURE 13. Received in this splined bore is the correspondingly shaped extremity of a splined shaft or axle 84 which is journalled in and extends through a suitable bearing member 86 appropriately mounted upon the frame member 38. The shaft 84 is freely rotatable but is held against axial movement by any suitable means, not shown. A driven sprocket wheel 88 on this shaft 84 is connected by a sprocket chain 90 to a driving sprocket wheel 92 on the extremity of the shaft 46. The other end of the threaded sleeve 80 is journalled upon the end portion of a stub axle 94 carried by a bracket 96 likewise mounted upon the member 38. As so far described, it will now be apparent that the externally threaded sleeve 80 is free to move both axially upon the supporting stationary and rotating shafts 94 and 84 or to rotate upon the shaft 94 upon rotation of the splined shaft 84. However, means are provided for controllably effecting the axial displacement of this sleeve upon its two supporting shafts.

For this purpose there is secured to the sleeve 80 adjacent one end thereof in any suitable manner a lug 98 which is fixed to the sleeve against axial displacement thereon but is rotatable relative thereto. Secured to this lug are the opposite ends of an endless cable 100 which is entrained over an idler drum 102 and a driving drum 104. The arrangement is such that upon rotation of the drum 104, the cable will be caused to move in either direction as desired and thus will axially shift and adjust the position of the sleeve 80 with respect to its driving shaft 84. In this manner it will be observed that the entire seat carriage assembly or platform can be moved longitudinally with respect to the side frame elements upon which it is supported by manipulating this cable assembly in the manner described, and this adjustment or shifting of the seat assembly may be effected regardless of the laterally adjusted position of the side frame members and even during adjustment of the latter, and without interfering with the propulsion of the device by means to be subsequently set forth. At the same time, through the sprocket chain gearing, it is evident that upon operation of the shaft 46 both the side frame elements and the seat assembly or platform will be simultaneously, regardless of the relative longitudinal position of the seat platform upon the side frame members, laterally adjusted.

Supporting and driving units and control means

Attention is now directed specifically to FIGURES 1, 3–6, 15–17 and 19 for an understanding of the construction and operation of the supporting and driving units 20, 22 and 24 of this apparatus. Since the units are of substantially identical construction, the showing and description in detail of one unit will suffice for an understanding of this phase of the invention.

Each of the pair of units 20, 22 and 24 consists of a pair of endless belt and wheel assemblies. Each assembly as shown more clearly in FIGURE 5 consists of an endless belt or tread 120 which is entrained over a pair of wheels or pulleys 122 which latter are journalled on stub axles 124 carried by pairs of beam members 126. As will be noted from FIGURE 4, the endless belt or tread 120 is preferably provided with a V-shaped medial longitudinally extending rib 127 on its inside surface which rides in the pulley groove 128 of the wheel member 122 so as to thereby maintain the belt in proper position thereon. Upon the interior end of the stub axles 124 of the unit 20 and at both sides of the machine there are provided front and rear pulleys 130 and 136 about which are entrained driving belts 132 which also are engaged upon corresponding pulleys 134 carried by the adjacent stub axles of the pair of units 22 and 24. Further, the beams 126 of the adjacent units 22 and 24 are pivotally secured to the beams of the central units 20 in order that the front and rear units 22 and 24 may be pivotally mounted for rotation about horizontal axes of the central units 20 and whereby the treads of the front and rear units may likewise be driven from those of the central units.

By means of these stub axles it is thus evident that the plurality of central, forward and rear driving and supporting units are pivotally and drivingly connected to each other while the central unit itself supports the entire framework of the conveyance.

From FIGURE 1 it will be observed that the rear stub axles **124** of the forward tread unit **22** constitute the pivotal connections of the beams **126** of the units **22** and **20**. Consequently there is a continuous driving connection between the treads of the units **20** and **22** for simultaneous operation. However, the beams **126** of the central and rear units **20** and **24** are connected by pivot pins **131** which are spaced intermediate the adjacent stub axles of these units. The arrangement is such that a driving connection between the central and rear unit treads is established only when the beams **126** of the units lie in a straight line, as in FIGURE 15 since the belts **132** of the units **20**, **24** will be slack and disconnect the driving engagement when the unit **24** is pivoted out of alignment as in FIGURE 1.

As shown more clearly in FIGURE 3, the rear or driving stub axles **124** of the central units **20** on opposite sides of the machine are telescopingly connected together. Thus, universal joints **140** connected to the inside of the stub axles are in turn connected by a telescoping axially sliding splined sleeve and shaft connection **142** to further universal joints **144**, which latter are in turn connected to the propelling or propulsion means of this apparatus to be subsequently set forth. Thus, there will be no interruption to the positive driving connection of the source of power to the supporting and driving units during and regardless of the lateral adjustment of the two side frame members of the apparatus as the device is varied in its width from a minimum to a maximum.

However, the forward stub axles **124** of the central pair of units **20** and the forward and rearward pair of units **22** and **24** do not require the provision of this means since each unit of the forward and rearward set of units is itself directly pivotally mounted upon the adjacent end of the corresponding unit of the central pair of units for transverse or lateral movement therewith.

As previously mentioned, means are provided for effecting a vertical tilting or swinging movement of the forward or rearward units with respect to their mounting upon the beams **126** of the central pair of units. Thus, by means of pivotal connections **150** one end of a link **152** is secured through a mid-portion of the beam **126** of each forward and each rearward unit **22** or **24** to effect raising and lowering of the latter. The other extremity of each link **152** is pivoted as at **154** to the end of a crank arm **156**, and each of the other ends of the crank arm **156** is rigidly secured to a disk **158**, see FIGURES 6 and 19, upon a manual unit regulating device indicated generally by the numeral **160**. The arrangement is such that by proper rotation of the device **160**, the crank arms will be raised or lowered and thus through their connection to the beams **126** of the front and/or rear units will raise and lower the latter as desired.

It is important that the pair of side units of the front pair of units **22** or the corresponding pair of side units of the rear pair of units **24** shall be raised or lowered simultaneously and to the same extent in order to prevent tipping of the machine. For that purpose, the control means **160** of each of the front and rear units **22** and **24** are coupled together by a synchronizing mechanism which is shown more particularly in FIGURES 6 and 19. This synchronizing mechanism includes a pair of drums **162** and **164** mounted upon the same arbor with the disk **158**, these drums being journalled or supported by any suitable mounting means such as the bracket means indicated diagrammatically and generally by the numeral **166** in FIGURES 6 and 19. Cables **168** and **170** have their terminal portions secured to the respective drums **162** and **164** of the corresponding pair of control means **160**, being also entrained over idler pulleys as at **171** disposed upon each of the vertical pivot axles or shafts **34** and **36** as previously mentioned. It will be noted that the cables are reversely wound on the drums of one control means with respect to those on the corresponding other control means on the other side of the machine so that upon rotation of one control means by means of a crank handle **172** connected thereto, the two cables **168** and **170** will be either wound or unwound from the respective drums of that control means and will be reversely unwound and wound upon the respective drums of the other corresponding control means **160**. The same arrangement is duplicated for the two control means **160** for the rear units **24**. This will insure that by operating the handle **172** both of the control means will rotate in the same direction to thus simultaneously and to the same extent raise or lower the pair of lever arms **156** and thus lift or lower the corresponding front or rear driving and supporting units attached thereto.

It should be noted that the pair of control means for the front units **22** is identical with that of the rear unit **24** as so far described. This permits either the front or rear units **22** or **24** to be independently raised or lowered to any of the positions indicated in the drawings and particularly to positions inclined either upwardly or downwardly with respect to the plane through that of the central units as indicated in FIGURE 16. In normal operation, as when the device is travelling over a relatively smooth surface such as a floor, or the ground or the like, the normal position of the device is for the front and rear units **22** and **24** to be raised either wholly or in part as indicated in FIGURE 1 but preferably with both of the units tilted into a substantially vertical position as shown in FIGURE 17. However, when the device is travelling over a smooth or polished surface such as a floor or the like, and which it is desired not to mar by travel of the threads over this surface, a caster wheel assembly indicated generally by the numeral **180** is lowered thus lifting the front end of the conveyance from the surface and thus lifting the treads from the surface so that the device is supported solely by the rear portion of the treads of the pair of central units **20** and by the caster wheel assembly **180**.

When the device is travelling upwardly or downwardly upon an incline or upon level ground where additional traction is deemed to be necessary, all of the units are disposed substantially in the same plane as indicated in FIGURE 15. This has the effect of producing a much greater wheel base to thus stably support the conveyance and the occupant in a comfortable and safe position, as well as increasing the traction obtained through the driving of all of the three pairs of supporting and driving units.

As so far described, it will be understood that the front and rear units **22** and **24** may be independently tilted by the corresponding control means **160** thereof, with the two units of each pair being maintained in a synchronized relation through the cable system previously described. However, there is also provided a means for simultaneously interlocking the control members **160** of the front and rear pair of units at any desired stage of their movement in order to thereafter simultaneously but reversely manipulate and tilt the two units. For this purpose, there is provided a driving sprocket **182** on the control means **160** of one pair of units such as the control means for the forward unit **22**, and a further sprocket **184** similarly provided upon the control unit **160** of the rear pair of units. An endless sprocket chain **186** is entrained over these sprockets as shown in FIGURE 6. However, the sprockets of one pair of units such as the sprocket **182** of the forward pair of units **22** is provided with a conventional dog-type of clutch or coupling means indicated generally by the numeral **188** so that this sprocket may be selectively

engaged or disengaged from the drum or arbor of the control means **160**. The clutch **188** is normally disengaged, so that the front and rear control members **160** are independently operable, but may be manually actuated to engaged positions, by any suitable means, not shown.

The manipulation of the apparatus for ascending inclines will now be described. When travelling over substantially level surfaces, both the front and rear tread units **22** and **24** are raised as in FIGURE 1 or FIGURE 17, although the treads of the front units **22** rotate synchronously with those of the central units **20**.

When the apparatus reaches the incline to be ascended such as stairs or the like, the operator raises the castor **180** and through the control members **160** of the forward units **22** manually lowers the latter until their treads rest upon the bottom of the stairs. The treads of the central units **20** now rest upon the level surface and the device is now in the position shown in FIGURE 16 or FIGURE 1.

Now the rear unit **24** is manually lowered by its control member **160** until it rests upon the level surface. The clutch **188** is now manually engaged, thus interlocking the two control members **160** of the front and rear units together by the sprocket chain **186**. It will be understood that the cables **168, 170** of the opposite treads of the front and rear units will maintain the corresponding pairs of treads of the units synchronized.

The propulsion means, power or manual is now engaged and by the joint traction efforts of the front and central units **22** and **20** the conveyance begins to climb the stairs or incline.

As the treads of the central unit **20** begin to ascend the incline, the central unit and the conveyance frame begin to tilt from the horizontal position into the same inclination as that of the stairs and of the front unit **22**. Obviously, it is desirable that the treads of the units **22** and **20** shall be aligned when climbing or descending stairs in order to absorb bumps and shocks to the conveyance and occupant.

Owing to the interlock of the front and rear units as the body begins to tilt, the treads gradually move into alignment with those of the front unit. This results in a relative downward tilting of the frame unit **22**, towards alignment with the central unit **20** caused by the interlocking chain **186** with a corresponding relative upward tilting of the rear unit **24** relative to the central unit.

This continues until the front and central units are aligned and now on the stairs with the rear unit lying flat on the floor at the foot of the stairs.

Now the seat assembly **12** is manually shifted forwardly upon the conveyance by the manual adjusting drums **104**.

The interlock of the front and rear units is now released by disengaging the clutch **188**. The propulsion means is used to ascend the stairs, the rear unit being manually lowered to maintain stabilizing contact with the floor until the entire apparatus is on the stair with the front, central and rear units being aligned as in FIGURE 15. At this time power is applied to all three units to effect maximum stability and traction in ascending the stairs.

At the top of the stairs, the front units **22** are manually lowered to the horizontal position, the seat assembly is manually moved back to its original position, and the interlock is again engaged.

As the conveyance tilts from its climbing position to its horizontal position, the upward tilting of the front units relative to the central units will cause downward tilting of the rear units to maintain a stabilizing contact with the stairs.

When the central units **20** are again horizontal the interlock is disengaged and as the conveyance moves forward the rear units are lifted to the raised position.

A similar but reverse procedure is followed for descending stairs.

Power and manual propulsion system

For an illustration and description of the power and manual propulsion system of this conveyance and its operation attention is now directed more particularly to FIGURES 1–5, 11 and 12. Mounted upon a suitable bracket or support **200** carried by any suitable portion of the collapsible framework of the conveyance as for example by a vertical member **31**, see FIGURE 11, is a source of power such as an electric motor **202**. This latter through suitable connections and controls not shown derives its power from an electric storage battery **204** likewise suitably mounted upon the framework as upon the lower beam member **40**. Associated with the battery **204** is a conventional type of battery charger **206** by means of which the battery charger may be plugged into a convenient electric outlet in order to maintain the battery in a charged condition when the device is stationary. The electric motor through a shaft **208** and a worm gear **210** is geared to and drives a gear **212** mounted on an axle **214** to which is fixed a driven sprocket **216** as shown best in FIGURE 12. Although the sprocket **216** is keyed to the shaft **214**, the driving gear **212** is rotatably mounted upon this shaft but is selectively connected to the sprocket for driving the latter by means of a set of clutch or coupling pins **218** slidably received in bores **220** in the sprocket gear and slidable therethrough for engagement in corresponding bores **222** in the gear **212**. A clutch pin control means consisting of a drum or plate **224** is slidably engaged upon the shaft **214** and by means of a conventional type of manually operated yoke **226** having a pivotal mounting at any suitable portion of the frame of the device by means of a fulcrum or pivot pin **228** is manipulated by its handle **230**. This serves to selectively engage or disengage the clutch pins **218** thereby selectively locking or releasing the driving gear **212** from the sprocket gear **216**.

The sprocket gear in turn is connected by a sprocket chain **232** to a sprocket gear **234** fixedly secured to one of the previously mentioned telescoping shafts which connect the rear stub axles **124** of the rear end of the central pair of units **20**. Thus, when the manually operated clutch is engaged, the electric motor is directly connected to and drives the central pair of units **20** and through the previously described connections likewise imparts power to the units of the forward and rearward units **22** and **24**. It will be observed by the previously mentioned telescoping connection of the stub axles, that this drive is maintained during all positions of lateral adjustment of the side frame members of the device.

In order to effect manual propulsion of the conveyance for any reason there are provided a pair of manually operated hand levers **240** whose upper ends have handles **242** disposed conveniently on opposite sides of the conveyance to be engaged by the hands of the user. The hand levers **240** are each connected through an adjustable, reversible ratchet mechanism **244** of any conventional design and having a reverse control means **246** to a shaft **248**. The shafts **248** in turn are each connected by a universal joint coupling **249** and through telescoping sleeves **251** with the universal joints **253**, which latter in turn are connected to the opposite ends of the shaft **214**. Thus, when the hand levers are oscillated back and forth, upon appropriate adjustment of their ratchet mechanisms **244**, they will impart rotation in one direction to the shaft **214** and through the fixed connection of the latter to the sprocket **261** will in turn impart drive to the driving sprocket **234** and the associated endless treads of the units **20, 22** and **24**. This operation is possible by merely disengaging the clutch pin **218** from the power driving gear **212**, this being the position shown in full lines in FIGURE 12.

Brake and steering mechanism

A combined brake and steering mechanism is provided to afford the operator complete and safe control of the device in as foolproof a manner as possible. For a description of this brake and steering mechanism, attention is again directed to FIGURES 1–5, 11 and 12. Secured to the upper end of each of the manually operated propulsion levers **240** is a handgrip lever **260** pivoted thereto and connected as by a conventional flexible cable means **262** to a conventional brake and clutch unit **264** mounted upon and secured to the stub axles or the associated wheels or pulleys **122** or **136**. Since the brake drum arrangement is of a known and conventional design and does not in itself form any part of the invention claimed herein, a description of the details of this brake mechanism is deemed to be unnecessary. The arrangement is such, however, that the brake will be normally released and the clutch normally engaged so that upon squeezing of the appropriate brake or steering lever **260**, the corresponding clutch will be disengaged and the brage drum of that unit will be actuated to stop rotation of the associated stub axle. This will accordingly stop movement of the treads on that side. If both of the brakes are simultaneously actuated, then a true braking action is imparted to the vehicle which is applied to all of the treads which are engaged in supporting and driving the vehicle. On the other hand, if only one of the brake grip levers is engaged, only the treads on that side of the vehicle will be stopped, while the others will continue operating and therefore the device will turn in the direction of the stopped treads. Thus complete control of steering and braking of the vehicle is effected by a single control system.

There is further provided a safety measure to automatically apply the brakes and disengage the clutches upon sudden and excessive movement of the device downwardly upon an inclined surface as when either ascending or descending the same. For a description of this safety attachment attention is directed specifically to FIGURE 11. Here it will be seen that in addition to the previously mentioned flexible brake, clutch and steering cable **262** which is connected to the mechanism **264** there is also provided an actuating rod **270** whose forward end extends through a suitable guide **272**. A spring **274** yieldingly urges this rod **270** into the brake releasing and clutch engaging position. At its forward end this rod has an angulated terminal portion as at **276** provided with an actuating shoe or pad **278** thereon. A further lever **280** is pivoted as at **282** to a suitable support and has an angulated end portion **284** likewise provided with a shoe or pad **286** thereon. At its other end, the lever **280** is provided with a fork **288** which straddles a pin **290** carried by the rod **270**. The two members **276** and **280** are disposed on opposite sides of the manual propulsion lever **240** and are spaced from this lever and are so positioned that in the normal operation of this lever the shoes **278** and **286** will not be engaged. However, if the lever is pushed all the way either forward as shown in full lines or backward as shown in dotted lines in FIGURE 11, it will bear against one of the shoes **278** or **286** and through the members **276** and **280** will impart movement to the rod **270** to thus disengage the clutches and set the brakes. The result of this arrangement is that with the occupant gripping the levers and the device either going up or down a stair, any sudden or undesired movement of the device will automatically and naturally result in the operator pushing the lever forward in descending or pulling back on the lever if the device is ascending. This movement will automatically actuate the rod **270** to set the brakes.

Trailer attachment

As previously described, the conveyance is operated by an electric motor powered from a storage battery carried thereby. While this arrangement is ideally adapted for indoor use, it considerably limits the range of movement of the device outdoors owing to the limitations imposed by the capacity of the storage battery. It is desired naturally to use as light a battery as possible and for that reason the capacity of the storage battery is therefore usually quite limited. In order to particularly adapt the device for a wide range of operations outdoors, there is provided a trailer unit indicated generally by the numeral **300**. This unit may be selectively coupled to or disengaged from the conveyance as desired and has as its primary function to render the range of movement of the conveyance completely independent of the limitations imposed by the size of the storage battery **204**.

Referring now to FIGURES 2, 7–10 it will be seen that the trailer unit **300** consists of a suitable platform or other framework or supporting structure **302** to which are suitably pivotally connected a pair of forwardly extending drawbars each indicated at **304**. Each drawbar is V-shaped having upwardly and downwardly inclined arms provided with parallel flat apertured terminal portions **306** and **308** at the top and bottom thereof. The pivotal connection of this drawbar assembly is shown at **310** in FIGURE 8. The apertured ends **306** and **308** of the drawbars are releasably engageable upon upstanding hooks **312** and **314** which are carried by the rearward pair of top and bottom transverse links **32**. As suggested in FIGURE 8 the drawbars can be selectively engaged or disengaged from their attachment to the links of the conveyance framework by vertical movement through lifting or lowering of the trailer attachment.

In order to effect this vertical travel to engage or disengage the drawbars from their connection with the conveyance frame, there is provided a set of vertically adjustable supporting legs each of which is indicated by the numeral **316**. Each leg is provided with a caster wheel assembly **318** to facilitate its travel over the floor or other supporting surface. Normally, when the device is coupled to the conveyance, the legs are raised so that the entire weight of the trailer unit is carried by the drawbars **304** in the manner shown in FIGURE 2. However, when it is desired to disengage the trailer unit from the conveyance and then support the trailer unit independently upon the floor or other surface, the legs **316** are lowered thus lifting the drawbars off of their mounting hooks **312** and **314** into the position shown in FIGURE 8, whereupon the trailer unit is capable of independent mobility upon its supporting legs and casters.

In order to effect raising and lowering of the legs simultaneously there is provided the actuating mechanism shown in FIGURES 8–10. This mechanism consists of an endless sprocket chain **320** which is entrained about the series of sprockets **322** each of which is mounted on one of the legs **316**. The legs themselves are threaded as shown in FIGURES 8 and 9 and are threadedly engaged in the bores **324** extending through the platform or base **302**. Thus as the legs are rotated, they will be raised or lowered relative to the base to effect the desired lifting or lowering operation. To one of these legs, upon its upwardly extending extremity above the base **302** there is connected a flexible control shaft **330** having a control handle **332** disposed convenient the occupant of the conveyance as by mounting on a bracket **334** as shown in FIGURE 2. Thus, manual rotation of the shaft **330** will positively rotate one of the legs, while the sprocket chain connection between the legs will simultaneously vertically adjust all of these legs in unison.

Obviously, any desired means may be provided to effect the simultaneous adjustment of the series of legs. In the arrangement shown in this invention, each of the legs is provided with a pair of longitudinal keyways or slots **340** therein and the previously mentioned sprocket gears **322** are provided with keys, ribs or tongues as at **342** which are slidably received in these sprockets. Thus, although the sprockets are compelled to rotate with the legs, they are capable of axial sliding movement thereon.

The sprockets themselves are confined between upper and lower retaining brackets 344 and 346 as shown in FIGURE 9, which are mounted upon the appropriate portions of the platform or base 302 as by brackets 348. In this manner, rotation of the sprockets by the chain will impart rotation to the legs thus raising and lowering the latter relative to the platform, while the sprockets are retained against any movement relative to the platform by virtue of their mounting in the retaining bracket assembly.

As shown best in FIGURE 7, there is provided a means for maintaining the storage battery of the conveyance in a charged condition. This means consists of an internal combustion engine 350 of any suitable type which is mounted upon the platform or base 302 and which through a coupling 352 drives a dynamo or generator 354. This generator-engine combination through suitable detachable conections designated generally and diagrammatically at 356, serves to maintain the storage battery in a charged condition. However, when the inconvenience of operating this battery charging plant is to be avoided, as when using the conveyance indoors, the trailer unit can be simply and easily disconnected from the conveyance, whereupon the self-contained power plant will operate the conveyance, being retained in a charged condition by the battery charger as previously described.

As previously mentioned in connection with the tread units and their control means, the caster assembly 180 may be utilized when it is desired to avoid engagement of the endless tracks of the units with the floor or other smooth surface. For this purpose, as shown particularly in FIGURES 2 and 4 there is provided preferably a single caster wheel unit 360 disposed upon the longitudinal medial plane of the device and having a vertically extending stem or neck 362 which is slidably received in suitable guides in the frame members 38 and 40. The caster assembly is thus vertically slidable in its mounting. A spring, not shown, may be utilized to retain the caster in its raised and inoperative position. An actuating cam 364 controlled by a manual operating lever 366 suitably mounted upon the device engages the shoulder portion 368 of the caster assembly tothereby force the latter downwardly from its inoperative position to the operative position shown in FIGURE 17.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A power operated stair climbing conveyance comprising a mobile frame with a chair seat mounted thereon and including transversely spaced longitudinal frame side members, a plurality of pairs of support and driving units mounted upon said frame side members and including forward, central and rear pairs of units, each pair of units having its units disposed upon the exterior outer surfaces of said frame side members with each unit being mounted solely upon one frame side member, adjustable connecting means extending transversely between and secured to said frame side members and connecting the latter for controlled movement towards and from each other whereby to vary the width of said conveyance, operating means connected to said connecting means and actuating the latter, a power source mounted upon said frame, driving means disposed between said frame side members and connecting said power source to each unit of a pair of units and connecting said central pair of units to said forward and rear pairs of units, said driving means remaining connected to said central pair of units during actuation of said connecting means by said operating means.

2. The combination of claim 1 including means mounting said forward and rear pairs of units on said frame side members for positioning in different attitudes relative to the central pair of units, control means connected to said forward and rear pairs of units for adjustably varying said attitudes thereby adapting said conveyance to movement from a horizontal surface to, from and upon an inclined surface.

3. The combination of claim 2 including an interconnecting means attached to said control means and maintaining a predetermined synchronized relation between the attitudes of said units.

4. The combination of claim 3 wherein the maintenance of a driving connection between said central units and the other units is dependent upon and responsive to a predetermined attitude of said other units to said central units.

5. A power operated conveyance of the wheel chair type comprising a mobile frame having provision for supporting thereon a person in sitting position, said frame including a pair of frame side members each having rotatable support means thereon, adjustable extensible means secured to and disposed between said frame side members and operable to vary the spacing therebetween and the width of said conveyance, operating means connected to said extensible means for adjusting the spacing of said frame side members, said adjustable extensible means comprising pairs of links extending transversely between and having the outer end of each link secured to a frame side member, the inner ends of each pair of links being pivotally connected and secured to longitudinally extending and shiftable connecting members, said operating means comprising a control shaft rotatably mounted in said frame between said frame side members, a mechanical connection between said control shaft and said longitudinally extending connecting means.

6. A conveyance of the wheel chair type including a mobile frame with a chair assembly mounted thereon and having a pair of frame side members each provided with a rotatable support, a drive means mounted upon said frame and including a telescoping driven shaft extending transversely between said frame side members and connected at its opposite ends to said rotatable supports for driving the latter, adjusting means extending transversely between and pivotally connected to said frame side members for rigidly but adjustably securing the latter together in a fixed but adjustable spaced relation, said adjusting means comprising a pair of links having one end of each pivoted to a frame side member and having their other ends pivotally connected together, manually operable actuated means connected to said pair of links for effecting relative pivoting of the latter and lateral adjustment of said frame side members.

7. The combination of claim 6 wherein said chair assembly includes a pair of support rails, means for laterally adjusting said support rails, connecting means for effecting simultaneous operation of said lateral adjusting means upon operation of said frame side member adjusting means.

8. The combination of claim 7 including further means for effecting longitudinal movement of said support rails longitudinally of said frame side members independently of the lateral adjustment of the latter.

9. The combination of claim 6 wherein said drive means includes a telescopingly adjustable drive shaft journaled in said frame side members, means connecting said drive and driven shaft, means connected to said driving shaft for effecting rotation thereof.

10. The combination of claim 9 including a power plant mounted on said mobile frame and connected to said driving shaft.

11. A stair climbing conveyance comprising a mobile frame with means for supporting a person thereon in sitting position, a plurality of pairs of tread units connected to said frame in supporting and transporting relation, each tread unit consisting of an endless track and wheel assembly, said plurality of pairs of units comprising

a central pair of units mounted upon the opposite sides of said frame and supporting the latter, forward and rearward pairs of units positioned fore and aft of said central units, means mounting said forward and rearward units upon said central unit for pivotal movement about transverse axes at the front and rear ends respectively of said central unit to faciliate negotiating inclines by said conveyance, control mechanism connected to said forward and rearward units for controlling pivotal movement thereof about said transverse axes, driving means connecting said forward units to said central units for simultaneous operation of the former from the latter and a further driving means connecting said rearward units to said central units for operation of the former from the latter only when the rearward and central units are substantially aligned.

12. A stair climbing conveyance comprising a mobile frame with means for supporting a person thereon in sitting position, a plurality of pairs of tread units connected to said frame in supporting and transporting relation, each tread unit consisting of an endless track and wheel assembly, said plurality of pairs of units comprising a central pair of units mounted upon the opposite sides of said frame and supporting the latter, forward and rearward pairs of units positioned fore and aft of said central units, means mounting said forward and rearward units upon said central unit for pivotal movement about transverse axes at the front and rear ends respectively of said central unit to facilitate negotiating inclines by said conveyance, control mechanism connected to said forward and rearward units for controlling pivotal movement thereof about said transverse axes, said control means comprising a pair of tilting shafts mounted in said mobile frame at opposite ends thereof, a pair of linkages connecting each tilting shaft with the associated tread units.

13. A power operated conveyance of the wheel chair type comprising a mobile frame mounted upon supporting and propelling means, driving means operatively connected to said supporting and propelling means, an electric motor mounted upon said frame and connected to said driving means, a storage battery on said frame connected to said motor, a demountable support unit, means detachably coupling said support unit to said frame and supporting it at one end thereof and overhanging the latter, an electric generator on said support unit coupled to said storage battery for charging the latter and an engine on said support unit drivingly connected to said generator, said support unit comprising a supporting base upon which said engine and generator are mounted, a plurality of support legs mounted upon said base, means for effecting simultaneous lifting and lowering of said support legs.

14. The combination of claim 13 including manual operating means mounted upon said mobile frame and connected to said lifting and lowering means.

15. The combination of claim 13 wherein said lifting and lowering means comprises a gear slidably but non-rotatably journaled on each leg and rotatably but non-slidably mounted on said support base, connecting means engaging all of said gears, means threadedly connecting each leg to said support base.

16. The combination of claim 5 wherein said control shaft has a screw thread, said mechanical connection comprising an internally threaded member engaged upon and movable along said screw thread, connecting rods connecting said internally threaded member to said longitudinally extending connecting members.

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