

Oct. 9, 1962

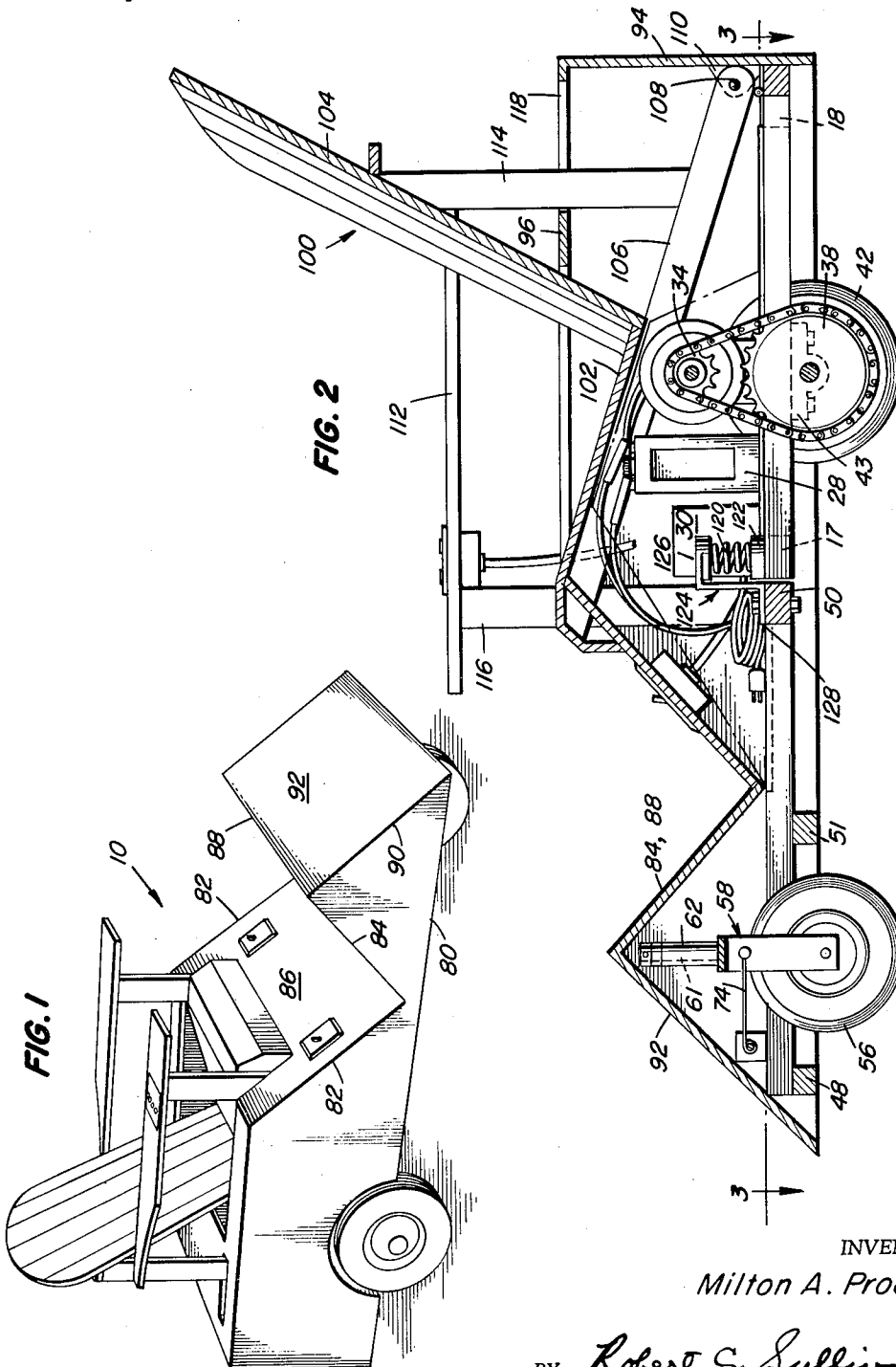
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3,057,425

SELF-PROPELLED ELECTRIC WHEELCHAIR

Filed April 28, 1961

2 Sheets-Sheet 1



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FIG. 4

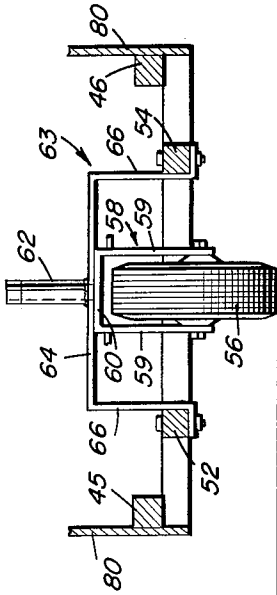


FIG. 3

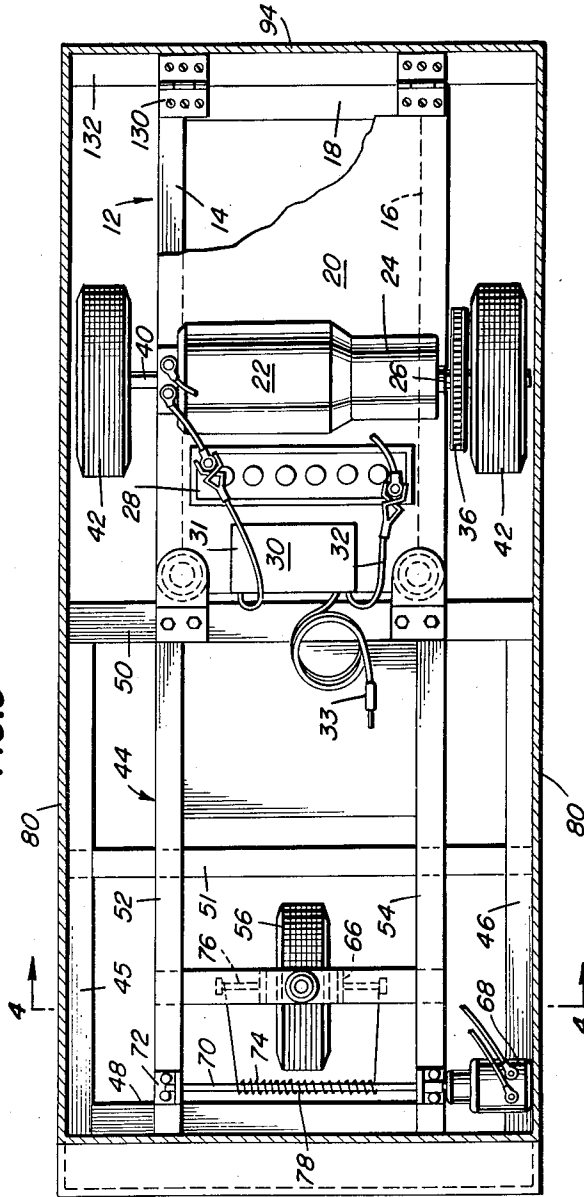
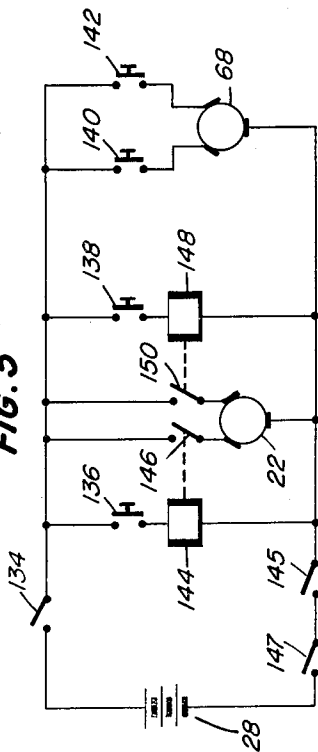


FIG. 5



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3,057,425

SELF-PROPELLED ELECTRIC WHEELCHAIR
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Filed Apr. 28, 1961, Ser. No. 106,205
5 Claims. (Cl. 180-27)

This invention relates to self-propelled electrically operated wheel chairs and more particularly to an electric wheelchair which is electrically steered.

While it has been known to provide power operated wheelchairs for use by disabled persons, so far as I know, the self-propelled wheelchairs of the prior art all require the use of a steering wheel or the like which must be manually turned by the occupant of the chair to steer the chair in the desired direction.

Certain types of disabled persons, such as paraplegics, and certain types of polio victims, as well as victims of muscular dystrophy, for example, are frequently so incapacitated in their hand and arm regions that they are incapable of manipulating the mechanical steering mechanisms of self-propelled power wheelchairs of the prior art.

Another disadvantage of wheelchairs of the prior art is that they frequently have their center of gravity located too high with consequent danger that the chair will tip over.

Still another disadvantage of the prior art wheelchairs is that they are so constructed as to be unsuitable for movement over irregular terrain, and communicate irregularities of the terrain to the occupant of the chair.

Accordingly, it is an object of this invention to provide an electrically operated wheelchair whose operation and direction of movement may be controlled by a severely disabled person with a minimum of exertion.

It is another object of this invention to provide an electric wheelchair having an electrically operated steering mechanism which is completely controlled by pushbutton switches and which does not require the manipulation of a steering wheel or the like.

Still a further object of the invention is to provide a self-propelled wheelchair for use by disabled persons which has a low center of gravity and is unlikely to tip over.

Still a further object of the invention is to provide an electrically operated wheelchair in which the occupant's seat and the ground-engaging steering wheel of the chair are floatingly mounted by a spring suspension with respect to the chassis section of the vehicle on which the drive wheels and the power drive mechanism are mounted, to thereby provide a comfortable ride even over irregular terrain.

In achievement of these objectives, there is provided in accordance with this invention an electrically propelled and electrically steered wheelchair which is operated completely by pushbuttons for both forward and reverse movement of the vehicle and for steering movement of the vehicle. The wheelchair also has its propulsion motor, speed reduction gear, and electric storage battery positioned beneath the seat to provide a low center of gravity which minimizes danger of tipping of the chair. The wheelchair also includes a spring suspension of the seat and body of the chair with respect to the chassis section on which the driving mechanism is mounted, to thereby provide comfortable riding qualities even over rough terrain.

Further objects and advantages of the invention will become apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a power operated wheelchair in accordance with the invention;

FIG. 2 is a view in longitudinal section of the wheelchair of FIG. 1;

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FIG. 3 is a view in horizontal section along line 3—3 of FIG. 2;

FIG. 4 is a view in vertical section along line 4—4 of FIG. 3; and

FIG. 5 is a wiring diagram of the electrical circuit connections of the electrically operated wheelchair.

Referring now to the drawings, the wheelchair of the invention is generally indicated at 10 and includes a rear chassis section generally indicated at 12 formed by a pair of longitudinally extending strips 14 and 16, cross-pieces 17 and 18, respectively, extending between the front and rear ends of stringers 14 and 16, and a platform 20 secured to the upper surface of stringers 14 and 16 and extending for substantially the entire length of stringers 14 and 16.

An electric propulsion motor 22 is supported on platform 20 and drives a high ratio gear reduction 24 having an output shaft 26. Motor 22 is energized by a multi-cell electric storage battery 28 through an electrical circuit shown in FIG. 5, as will be described in more detail hereinafter, battery 28 being mounted on platform 20 forwardly of motor 22. A battery charger 30 is also supported on platform 20 adjacent storage battery 28 and includes clamp-on output leads 31 and 32 which are connected to the terminals of the battery 28, and also a two-wire plug-in electric cord 33 which is connected to a suitable source of alternating current power, such as a 110-volt household power supply, to supply input power to battery charger 30 when the battery 28 is being charged.

The output shaft 26 of gear reduction 24 drives a toothed sprocket 34 about which is trained a drive chain 36. Drive chain 36 drives a sprocket 38 mounted on an axle 40 which supports a pair of oppositely disposed wheels 42. Axle 40 is supported by bearing brackets 43 mounted on the under surface of the longitudinal stringers 12 and 16.

The chassis of the electric wheelchair also includes a forward chassis section generally indicated at 44 which is separate from the rear chassis section 12 previously described, and which is formed by longitudinal stringers 45 and 46 connected at their forward and rear ends by cross pieces 48 and 50. To provide further support, a cross piece 51 extends between stringers 45 and 46 intermediate their length. A second pair of longitudinal stringers 52 and 54 extends between the end cross members 48 and 50 in laterally spaced relation to each other intermediate the transverse width of the forward chassis section 44.

A forward or front wheel 56 is supported for pivotal movement to impart steering movement to the vehicle. As best seen in FIG. 4, wheel 56 is carried by a yoke member 58 which includes vertical arms 59 and an upper cross piece 60. A stud 61 extends upwardly from cross piece 60 of yoke member 58. The stud 61 is received in a hollow bushing 62 carried by the upper cross portion 64 of a bracket generally indicated at 63. Bracket 63 includes vertical legs 66 the lower ends of which are bent at right angles and secured by bolts or the like to the under surface of longitudinal stringers 52 and 54.

An electric steering motor 68 is provided for imparting a steering movement to front wheel 56, motor 68 being mounted adjacent the forward portion of the front chassis section 44 between the laterally spaced stringer members 46 and 54. An elongated shaft 70 is rotatably driven by the output shaft of steering motor 68, the opposite end of shaft 70 being suitably supported by a bearing bracket 72 mounted at the forward end of longitudinal stringer 52. In order to transmit the rotary motion of shaft 70 to front wheel 56 to impart steering movement to wheel 56, a wire cable or the like is helically wound about shaft 70, the opposite ends of cable 74 be-

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ing connected to studs 76 extending laterally from the opposite vertical arms 59 of yoke 58 which supports wheel 56. The mid-point of helically wound cable 74 is rigidly attached to shaft 60 as by soldering or welding as indicated by the spot 78. Steering motor 68 is reversible and can be driven to rotate shaft 70 either in a clockwise or counterclockwise direction. If shaft 70 is rotated in a clockwise direction by motor 58 the cable 74 will unwind at one of its ends and wind up at the other of its ends to cause the wheel 56 to swing in a clockwise direction with respect to the view of FIG. 3, while if shaft 70 is rotated in a counterclockwise direction by motor 58, wheel 56 is caused to swing in a counterclockwise direction.

The body of the vehicle is rigidly secured to the forward chassis section 44 and includes opposite side walls generally indicated at 80 which are each cut way in a V-formation along the inclined lines 82 and 84 to form a support for a rearwardly inclined panel 86 and for a forwardly inclined panel 88 which serves as a foot rest for the occupant of the chair. The opposite side walls 80 are also each cut along an inclined line 90 to support an inclined forward panel 92. The emergency and On-Off switches for the electrical circuit to be hereinafter described are mounted on the inclined panel 86 of the vehicle body.

The vehicle body also includes a rear wall 94 and a top wall 96 which lies in a horizontal plane. The top wall 96 and inclined panel 86 are cut away to receive a chair or seat generally indicated at 100 which in the embodiment shown is of the lawn chair type, including a seat portion 102 and an inclined back portion 104. The chair is supported by a pair of oppositely disposed lever arms 106 which lie beneath and are connected to the seat portion 102 of the chair, each lever arm 106 being pivotally connected at a point 108 to a bracket 110 mounted on the inner surface of rear wall 94 of the body structure. The chair also includes a pair of oppositely disposed horizontal arms 112 rigidly attached to seat 100 and which are connected at the rear ends thereof to vertical brace members 114. The lower ends of vertical brace members 114 are connected to the lever arms 106 rearwardly of the seat 100. A pair of laterally spaced vertical support legs 116 are connected to the horizontal arms 112 of the seat 100 at the forward portion of the seat, the lower ends of legs 116 resting on the rear cross member 50 of the forward chassis section 44. It will be noted that seat 100 is entirely supported by forward chassis section 44. Thus, the levers 106 which are connected to the underneath of the seat are pivotally connected to the rear wall 94 of the vehicle body which, in turn, is rigid with respect to the front chassis section 44. Also, the support legs 116 at the front of seat 100 rest upon cross piece 50 which forms a part of forward chassis section 44.

In order to accommodate pivotal movement of vertical brace members 114 of the seat structure when the seat 100 is swung about its pivotal connection 108, the top wall 96 of the vehicle body is slotted as indicated at 118 in FIG. 2. The seat 100 may be swung about its pivotal connection 108 to provide access to the battery 28, battery charger 30, motor 22, and speed reduction gear 24 which are all positioned beneath the seat 100.

The location of the propulsion motor 22, reduction gear 24, and battery 28 beneath the seat structure 100 lowers the center of gravity of the vehicle and thereby minimizes any tendency of the vehicle to tip over.

To provide smooth riding qualities for the vehicle, the front and rear chassis sections 12 and 44 are connected to each other by a spring suspension which includes a pair of oppositely disposed spring members 120 the lower ends of which rest on bearing members 122 secured to the forward portion of rear chassis section 12. The upper end of each spring 120 abuts against an upper horizontal arm 126 of one of the laterally spaced brackets 124, the lower horizontal arm 128 of which is secured by bolts

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to the cross-member 50 of the forward chassis section 44. At the rear of the rear chassis section 12, the cross member 18 of chassis section 12 is connected by hinges 130 to a cross piece 132 secured to the inside surface of the rear wall 94 of the vehicle body. Thus, the rear chassis section 12 is connected to the forward chassis section 44 at one end by springs 120 and at the opposite end by hinges 130 which permit a swinging movement of the rear chassis section 12 with respect to the vehicle body and with respect to seat 100, both of which are supported by the forward chassis section 44.

An important feature of the construction is the provision of pushbutton controls mounted on one of the arms 112 of the seat structure to permit the occupant of the wheelchair to have complete control of the direction of movement of the vehicle by simple manipulation of four pushbuttons. The electrical operation of the vehicle will be described with reference to the circuit diagram of FIGURE 5. As will be seen in FIG. 5, the electrical circuit includes the storage battery 28 which is connected through an On-Off switch 134 to one side of each of four pushbuttons 136, 138, 140, 142. Two emergency cut-off switches 145 and 147 are connected in the return line to battery 28 opposite to that in which the normal On-Off switch 134 is connected, to permit interrupting the electric power supply to the vehicle in case On-Off switch 134 fails to function properly. One of the emergency switches is located on panel 86, while the other emergency switch is located on panel 88. The switches 145 and 147 are operated by foot pressure, with actuation of either switch 145 or 147 being effective to open the electrical power circuit of the vehicle in case of emergency.

Pushbutton 136 is connected across the battery 28 in series with a relay coil 144 which controls contact 146 in the circuit of propulsion motor 22. Pushbutton 138 is connected across battery 28 in series with a relay coil 148 which controls a contact 150 in the circuit of electric propulsion motor 22. Propulsion motor 22 is of the reversible type and includes internal winding connections such that when contact 146 is closed by the energization of relay coil 144 through closure of pushbutton 136 the propulsion motor 22 will operate in one direction, say the forward direction, to propel the wheelchair forwardly; and if contact 150 is closed by energization of relay coil 148 through pushbutton 138, propulsion motor 22 is energized in the opposite direction to drive the wheelchair in reverse direction. Similarly, electric steering motor 68 is of the reversible type and includes internal winding connections such that when pushbutton 140 is closed steering motor 68 is energized by battery 28 to rotate shaft 70 in one direction, say the clockwise direction, and when pushbutton 142 is closed, steering motor 68 is energized by battery 28 to drive shaft 70 in the opposite direction, say a counterclockwise direction.

Since the four pushbuttons 136, 138, 140, 142 which respectively control the forward and reverse movements of the vehicle and the clockwise and counterclockwise steering movement of steering wheel 56, are all mounted in closely adjacent relation to each other on one of the arms 112 of the seat structure, it can be seen that an occupant of the wheelchair, even though he may be badly disabled and unable to manipulate a conventional steering mechanism, may completely control the direction of movement of the wheelchair by manipulation of the four pushbuttons 136, 138, 140, 142. All of the pushbutton switches 136, 138, 140, 142 are of the type in which the electrical circuit is completed only as long as manual pressure is exerted on the switch, with the circuit opening as soon as manual pressure is released. While the pushbuttons have been shown mounted on the arm of the chair for hand operation, obviously they could be mounted on one of the inclined panels 86 or 88 for operation by foot, if this type of operation should be desirable, and the expression "manually-operated switches" is intended to cover both hand and foot-operated switches.

It can be seen from the foregoing that there is provided in accordance with this invention an improved wheelchair for use by seriously disabled persons which permits the disabled user of the chair to have complete control of the direction of movement of the chair by a simple manipulation of four pushbuttons. Furthermore, the wheelchair has the advantage that the vehicle body and seat supporting structure are floatingly mounted with respect to the rear chassis section on which the drive mechanism is supported. Also, the chair has a low center of gravity which makes tipping of the chair very unlikely.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as my invention is:

1. A self-propelled vehicle comprising a vehicle body including seat means, drive wheel means supporting said vehicle body for movement, a first electric motor means in driving engagement with said drive wheel means, front wheel means supporting said vehicle body, a yoke means pivotally supported by said vehicle and mounting said front wheel means for steering movement, a second electric motor means, an elongated shaft rotatably driven by said second electric motor means, cable means wound about said shaft and having the opposite ends thereof connected to opposite sides of said yoke means whereby rotation of said shaft by said second electric motor means causes corresponding pivotal movement of said yoke means to impart steering movement to said front wheel means, an electric power supply carried by said vehicle, and manually operated switch means connecting said power supply to said first and second electric motor means for separately controlling the direction of rotation of said first and second electric motor means.

2. A self-propelled electric wheelchair comprising a chassis including front and rear chassis sections, drive wheels mounted on said rear chassis section, an electric propulsion motor mounted on said rear chassis section and operatively connected to said drive wheels, an electric storage battery mounted on said chassis and operatively connected to said electric propulsion motor, ground-engaging front wheel means mounted on said front chassis section, an electric steering motor operatively connected to said front wheel means for imparting steering movement to said front wheel means, means connecting said electric steering motor to said electric storage battery, a vehicle body including seat means supported by said front chassis section, and spring suspension means connecting said front and rear chassis sections to each other.

3. A self-propelled electric wheelchair comprising a chassis including front and rear chassis sections, drive wheels mounted on said rear chassis section, an electric propulsion motor mounted on said rear chassis section and operatively connected to said drive wheels, an electric storage battery mounted on said chassis and operatively connected to said electric propulsion motor, a single ground-engaging front wheel mounted on said front chassis

section, an electric steering motor operatively connected to said front wheel for imparting steering movement to said front wheel, means connecting said electric steering motor to said electric storage battery, a vehicle body including seat means supported by said front chassis section, and spring suspension means connecting said front and rear chassis sections to each other.

4. A self-propelled electric wheelchair comprising a chassis including front and rear chassis sections, drive wheels mounted on said rear chassis section, an electric propulsion motor mounted on said rear chassis section and operatively connected to said drive wheels, an electric storage battery mounted on said chassis and operatively connected to said electric propulsion motor, ground-engaging front wheel means mounted on said front chassis section, an electric steering motor operatively connected to said front wheel means for imparting steering movement to said front wheel means, means connecting said electric steering motor to said electric storage battery, a vehicle body supported by said front chassis section and overlying said rear chassis section, a seat means pivotally supported within said vehicle body in overlying relation to said rear chassis section, said seat means being movable about its pivotal support to provide access to space beneath said seat means, and spring suspension means connecting said front and rear chassis sections to each other.

5. A self-propelled electric wheelchair comprising a chassis including front and rear chassis sections, drive wheels mounted on said rear chassis section, an electric propulsion motor mounted on said rear chassis section and operatively connected to said drive wheels, an electric storage battery mounted on said chassis and operatively connected to said electric propulsion motor, ground-engaging front wheel means mounted on front chassis section, a yoke means pivotally connected to said front chassis section and mounting said front wheel means for steering movement, an electric steering motor, an elongated shaft rotatably driven by said electric steering motor, cable means wound about said shaft and having the opposite ends thereof connected to opposite sides of said yoke means whereby rotation of said shaft by said steering motor causes corresponding pivotal movement of said yoke means to impart steering movement to said front wheel means, means connecting said electric steering motor to said electric storage battery, a vehicle body supported by said front chassis section and overlying said rear chassis section, a seat means pivotally supported within said vehicle body in overlying relation to said rear chassis section, said seat means being movable about its pivotal support to provide access to space beneath said seat means, and spring suspension means connecting said front and rear chassis sections to each other.

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