ABSTRACT: A power ladder movable over the ground and supporting a tower on which a carriage is movably mounted. The carriage supports an operator and it has control units that can be manipulated by the operator for raising and lowering it and for holding it at any desired elevation along the length of the tower.
POWER LADDER WITH A TOWER AND A CARRIAGE MOVABLE THEREON

Cross-Reference To Related Application
A copending patent application on a power ladder has been filed by me in the U.S. Pat. Office on Dec. 28, 1966, Ser. No. 605,347 now U.S. Pat. No. 3,422,271. The mechanism in the pending case is the same as that in the present case, but the specific claims in my application, Ser. No. 605,347, are directed to a power source with control units in the carriage for propelling and steering the power ladder over the ground. In the present case the claims will be directed specifically to the power source with other control units in the carriage for causing it to travel up and down the tower and to stop at any desired point along its line of travel.

BACKGROUND OF THE INVENTION
1. Field of the Invention
In the picking of fruit in an orchard, it is difficult to pick the fruit which is near to the tops of the trees. The use of ladders is cumbersome and time consuming and may be harmful to the trees. Moreover it is tiring for the fruit picker to climb up and down ladders all day. A power ladder that can be moved over the ground and be positioned near a tree is desirable, the device being provided with an upstanding tower on which a carriage can be moved up and down and support the operator so that he can be lifted to a desired height for the picking of fruit. The controls for moving the carriage along the tower are in the carriage itself so that the operator can manipulate them at will.

2. Description of Prior Art
The U.S. Pat. to John E. Grant, No. 2,969,849, issued Jan. 31, 1961, discloses an orchard vehicle, but the boom must be of the telescoping type in order that as the boom is swung into the desired inclined position, the operator-supporting carriage at the outer end of the telescoping portion can be extended or retracted so as to position the operator at the desired point with respect to the tree. Also means is provided for keeping the operator's platform in a horizontal position regardless of the inclination of the boom. In the present invention the base has forwardly extending arms that can straddle a tree trunk and the fixed tower is inclined forwardly so that as the carriage lifts the operator toward the tree top, it will move him toward the center of the tree where the branches are shorter and this will enable him to continue picking fruit.

SUMMARY OF THE INVENTION
An object of my invention is to provide a power ladder that can be steered as it travels over the ground and the fixed tower is inclined so that its upper end will be nearer the center of the tree than its lower end. This will cause the movable carriage on the tower to move closer to the tree center as the carriage is moved upwardly on the tower. The control means for the carriage is mounted on the carriage so that the operator can control the raising and lowering thereof while riding thereon.

A further object of my invention is to provide an endless chain that has a portion extending throughout the length of the tower and another portion passed around a sprocket mounted in the carriage. The sprocket is operatively connected to a brake that normally prevents rotation of the sprocket so that a movement of the chain in one direction will raise the carriage because the chain cannot rotate the sprocket. The operator can release the brake for permitting the sprocket to rotate and gravity will pull the carriage down along the tower and the freed sprocket will rotate as it travels along the endless chain. The operator can stop or slow down the descent of the carriage by applying the brake to stop further rotation of the sprocket or by partially applying the brake to reduce the speed of descent. The carriage can be lowered on the tower even in case of a power failure and this would prevent the operator from becoming stranded with the carriage at or near the top of the tower.
FIGS. 1 and 2 show a motor and gear train housing H, mounted on the casting A' and an enlarged horizontal section through the housing is shown in FIG. 3, and is taken along the line 3–3 of FIG. 1. A partition 10 extends between the sides of the housing H, and carries a plurality of bearings which in turn rotatably support shafts. A motor shaft 11 extends through a bearing 12 and has a gear 13 keyed to it at the free end of the shaft. A motor J of any desired type rotates the shaft 11 and gear 13. The gear 13 meshes with another gear 14 which in turn is keyed to a shaft 15. The shaft 15 is rotatably carried by a bearing 16 and has a pulley 17, keyed thereto. A pulley 18 is mounted on the shaft 11.

A diagrammatic vertical section through the housing H is shown in FIG. 4. The two shafts 11 and 15 with their pulleys 18 and 17, respectively, are indicated. A double-grooved pulley 19 is shown mounted on a shaft 20 which in turn is rotatably mounted on the end of an arm of a bellcrank lever 21. The bellcrank lever is pivotally mounted at 22. A V-belt 23 is loosely passed around the pulley 18 and around one of the grooves of the double-grooved pulley. Another V-belt 24 is loosely passed around the pulley 17 and around the other groove of the same double-grooved pulley. When the double-grooved pulley 19 is in the full line or neutral position shown in FIG. 4, the loose belts 23 and 24 will impart no rotary motion to the pulley 19 from either of the pulleys 17 and 18 although both pulleys are continuously rotated in opposite directions as soon as the motor J operates. If the bellcrank lever 21 is swung counterclockwise about the pivot 23 from the full-line vertical position to the dot-dash line position shown in FIG. 4, the V-belt 24 will be tightened about the two pulleys 17 and 19 and the pulley 17 will impart a rotative movement to the double-grooved pulley 19 in one direction while the V-belt 23 will still remain slack. If the operator wishes the double-grooved pulley 19 to rotate in the opposite direction he swings the bellcrank lever in a clockwise direction about the pivot 22 in order to swing the double-grooved pulley 19 from its neutral full line position into one where the V-belt 23 will become tight and the V-belt 24 will remain slack. The pulley 18 will now rotate the double-grooved pulley 19 in the opposite direction.

The horizontal section 3–3 on FIG. 1 is taken below the double-grooved pulley 19 and, therefore, this pulley and its shaft 20 are shown by dot-dash lines in FIG. 3 because they are above the plane of the section. Another pair of gears 25 and 26 are keyed to shafts 27 and 28, respectively, which in turn rotate in bearings 29 and 30 that are supported by the partition 10. The shaft 27 has a pulley 31, keyed thereto while the shaft 28 has a pulley 32 keyed thereto, see also FIG. 4. A second double-grooved pulley 33 is rotatably mounted on an arm of another bellcrank lever 34, the latter being swingingly mounted at 35. The shaft 36 for the double-grooved pulley 33 is shown by dot-dash lines in FIG. 3 and it parallels the shaft 20 that supports the double-grooved pulley 19. The double-grooved pulley 33 is normally in neutral position and is not rotated. The bellcrank lever 34 can be swung for causing either the pulley 31 to rotate the pulley 33 in one direction or for causing the pulley 32 to rotate the pulley 33 in the opposite direction by means of belts 43 and 44. FIG. 3 shows the shaft 20 operatively connected to a telescoping shaft 37 by a universal joint 38 and shows the shaft 36 operatively connected to a second telescoping shaft 39 by a universal joint 40. Referring to FIG. 2, it will be seen that the shaft 37 extends to the right-hand drive wheels D' and is operatively connected thereto while the shaft 39 extends to the left-hand drive wheels D, and is operatively connected to them. FIG. 1 shows the telescoping shaft 39 with its outer end connected by a universal joint 41 to a shaft 42 that extends into the gear housing C. The housing carries the proper gearing, not shown, that operatively connects the shaft 42 to the drive wheels D. A rotation of the shaft 39 in the direction shown will drive the wheels D, forwardly, and a rotation of the shaft 39 in the opposite direction will drive the wheels rearwardly. The shaft 37 is operatively connected to the drive wheels D' in like manner and this requires no further detailed description.

The controls for swinging the bellcrank levers 21 and 34 are mounted in the carriage F and I will now describe the novel means for operating the bellcrank 34. Since the means for swinging the bellcrank 34 is identical to the means for swinging the bellcrank 21, a description of the operation of the one is sufficient for both. In the diagrammatic view of FIG. 7, I show a cable mechanism for operating the bellcrank 34. A cable 45 has one end secured to the top of the tower E and then the cable is passed around an idler pulley 46 that is rotatably carried by the carriage F, see also FIG. 1. A control lever K for the left-hand driven wheels D, is pivotally mounted at 47 on the carriage and it carries two pulleys, one pulley 48 being rotatably mounted below the pivot 47 and the other pulley 49 being rotatably mounted above the pivot. The cable 45 extends from the pulley 46 and is passed around the pulley 48 on the lever K. From there the cable is passed around another idler pulley 50, that is mounted on the carriage F, and then the cable extends down along the tower E to the bellcrank lever 34 to which it is attached. The cable 45 continues downwardly from the bellcrank lever to an idler pulley 51 that is rotatably mounted at the lower end of the tower.

From the lower pulley 51, the cable 45 extends upwardly to another idler pulley 52 that is rotatably mounted on the carriage and the cable then is passed around another pulley 49 on the control lever K, see FIG. 7. From here the cable is passed around another pulley 53, rotatably mounted on the carriage, and then extends upwardly along the tower E and has its end secured to the top of the tower. This cable mechanism permits the carriage to be raised or lowered on the tower in a manner hereinafter set forth without affecting the swinging of the bellcrank lever 34. During any movement of the carriage F along the tower E, the pulleys 46, 48, 50, 52, 49 and 53, will merely ride along the adjacent portions of the cable 45 without pulling on the cable.

When the control lever K is in neutral position as shown in FIG. 7, the bellcrank lever 34 will remain in neutral position and the endless V-belts 43 and 44 will remain slack so as not to impart any rotative motion to the double-grooved pulley 33 even though the pulley 31 is rotating in one direction and the pulley 32 is rotating in the opposite direction, assuming that the motor J in FIG. 3 is operating. If now the operator who is sitting on the rear 54 of the carriage wishes the left drive wheel D to move forward, he presses forwardly on the handle 55 of the lever K to swing the lever in a counterclockwise movement about its pivot 47. This will move the upper pulley 49 to the left in FIG. 7 and will move the lower pulley 48 on the lever K to the right. This movement will cause the portion of the cable 45 extending from the pulley 48 through the pulleys 50, 51, 52 and 49 to move and the particular portion of the cable extending from the pulley 50 down to the pulley 51 will be moved downwardly and will swing the bellcrank lever 34 in a counterclockwise direction about its pivot 35. The double-grooved pulley 33 will be swung to the left and will tighten the endless V-belt 43 while the endless V-belt 44 will still remain loose on the pulleys. The tightened belt 43 will transmit rotary motion from the pulley 31 to the double-grooved pulley 33 and the latter will rotate the shaft 36, see FIG. 3, and through the universal joint 40 and the shaft 39 will rotate the drive wheels D in a forward direction. Of course, a swinging of the control lever K to the rear would have just the reverse effect and would cause the drive wheels D to rotate in a rearward direction. In this manner the operator has complete control over the drive wheels D and can cause them to operate regardless of the position of the carriage F on the tower E and even if the carriage is also in motion caused by the mechanism presently to be described.

The cable control mechanism for operating the bellcrank lever 21, in FIG. 4, is identical to the mechanism shown in FIG. 7. A portion of the cable mechanism for operating the bellcrank 21 is shown in FIG. 10, and parts that are similar to those in FIG. 7 will be given corresponding reference numerals and letters except that these will be primed. The other control lever K', see FIG. 2, when swung forwardly by means of its handle 58' will cause the drive wheels D' to rotate in a
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forward direction. The opposite is true when the control lever K' is swung rearwardly. This will cause the drive wheels D' to rotate in a rearward direction. When both control levers K and K' are swung rearwardly, the drive wheels D and D' will carry the base A in a forward direction. A steering of the carriage will be made possible by swinging either lever K or K' forwardly or rearwardly independently of the other and if a sharp turning movement is desired, one lever can be swung forwardly while the other at the same time can be swung rearwardly. The castor wheel G will allow a sharp turning movement of the base A.

I will now describe the means for raising the carriage F on the tower E. FIGS. 1 and 11, show the tower E provided with a sprocket wheel 56 at its top and with another sprocket wheel 57 at its bottom, see also FIG. 5. The carriage F carries a main sprocket 58, see FIG. 6 that is keyed to a shaft 59 which in turn is rotatably supported by the carriage. In addition the carriage F has two idler sprockets 60 and 61 and an endless chain 63 extends the entire length of the tower E and is passed around the tower sprockets 56 and 57, and around the carriage idler sprockets 60 and 61 as well as around the master sprocket 58. It will be apparent that if the shaft 59 for the master sprocket is held against rotation by a means to be described later, and the endless chain 63 is moved by the rotating tower sprockets 56 and 57 so that the left-hand reach of the chain will move upwardly and the right-hand reach of the chain will move downwardly, the carriage F will be moved upwardly along the tower E by the left-hand reach of the chain as it moves upwardly. The lower tower sprocket 57 is a drive sprocket and is shown in FIG. 3.

The lower drive sprocket 57 is keyed to a shaft 64 that projects from a gear reduction casing indicated generally at L in FIG. 3. The output shaft 64 for the gear reduction L rotates at a much slower speed than the input shaft 65. In the diagrammatic view of FIG. 11, as well as FIG. 3, the input shaft 65 is shown provided with a pulley 66 that is received in the motor and gear housing H. The pulley 66 and shaft 65 will make 60 revolutions for 1 revolution of the output shaft 64 and drive sprocket 57. I do not wish to be confined to any exact speed ratio between the two shafts.

The pulley 66 can be operatively connected to a drive pulley 67 by a V-belt 68 when an idler pulley 69 which is mounted on a lever 70, is moved upwardly by the upward swing of the lever, see FIG. 11. The endless belt 68 is passed around the three pulleys 66, 67 and 69, and a tension spring 71 normally pulls downwardly on the lever 70 to swing it around. The operator wishes to move the pulley 67 a sufficient distance to put slack in the belt 68 and prevent it from rotatively connecting the pulley 67 to the pulley 66. If desired two belts 68 may be used and the pulleys 66, 67 and 69 provided with double grooves to receive the two belts. The pulley 67 is mounted on the shaft 28 and will be rotated by the shaft as soon as the motor J is started.

The manually controlled means for swinging the lever 70 counterclockwise so as to move the pulley 69 and take up the slack in the belt 68 so that the pulley 66 will be rotated by the pulley 67, is shown diagrammatically in FIG. 8. A cable 73 has one end secured to the top of the lever E, and it extends downwardly along the tower to the carriage F, where it is passed around a pulley 74 that is rotatably carried by the carriage. From here the cable 73 extends forwardly in the carriage to another pulley 75 that is positioned above a foot pedal M. FIG. 1 shows the pedal pivotally mounted at 76 on a platform N that is supported by the carriage. The pedal carries a pulley 77 and the cable 73 is passed around it. FIG. 8 further shows the cable extending up to another idler pulley 78 and then on to another pulley 79 in the carriage and then down along the tower to the lever 70, where the other end of the cable is fastened.

When the operator while sitting on the seat 54 wishes to move the carriage F upwardly on the tower E, he depresses the foot pedal M in order to move the pulley 77 downwardly, see the diagrammatic view of FIG. 8. This movement of the pulley will pull on the portion of the cable 73, extending from the pulley 77 to the lever 70 and will raise the lever against the tension of the spring 71. The upward swinging movement of the lever 70 will raise the pulley 69 and take up the slack in the endless V-belt 68. The device described thus far is constantly being rotated by the shaft 22 so long as the motor J is operating and, therefore, the tightening of the belt 68 will operatively connect the pulley 66 to the drive pulley 67 and cause it to rotate. FIG. 3 shows how the pulley 66 rotates the shaft 64 and how the gear reduction L causes the shaft 64 and the lower drive sprocket 57 to rotate at a much slower speed. The sprocket 57 in FIG. 1 will rotate clockwise and will cause the left-hand reach of the sprocket chain 63 to move upwardly. As previously stated, the left-hand reach of the sprocket chain 63 has a portion passed around the master sprocket 58 that is mounted on the shaft 59 in the carriage F, see FIG. 6, and the master sprocket is normally held from rotating. Therefore, as the left-hand reach of the sprocket chain 63 moves upwardly, it will lift the carriage F and move it upwardly along the tower E.

I will now describe the brake means that normally prevents the master sprocket 58 from rotating. The shaft 59 to which the master sprocket 58 is keyed, see FIG. 6, also has a brake drum P, keyed thereto, see also the diagrammatic view of FIG. 8. A brake bank Q partially encircles the brake drum and one end of the band is anchored at P0 while the other end is connected to a brake rod B1. The free end of the rod is pivoted to a bellcrank lever 82 and is connected to the carriage F. A push rod 83 operatively connects the bellcrank lever 82 to an arm 84 of a second foot pedal R, see also FIG. 2. I show the brake release pedal R on the right-hand side of the seat 54 and the carriage lifting pedal M on the left-hand side although the positions of the two pedals may be reversed without departing from the spirit of the invention. The brake release pedal R is pivotally mounted at 85 on the platform N. A tension spring 86 is connected to the bellcrank lever 82 and to the carriage F and yields urge the bellcrank to rotate counterclockwise in FIG. 9. This will cause the bellcrank 82 to pull on the rod 81 and bind the brake band Q about the brake drum P so as to prevent the latter from rotating. This in turn will prevent the shaft 59 from rotating and will hold the master sprocket 58 from rotating. So long as the master sprocket is held from rotating, any upward movement of the left-hand reach of the endless sprocket chain 63, will lift the carriage F along the tower E.

The operator controls the upward movement of the carriage F by merely pressing downwardly on the foot pedal M, see FIG. 1. This will operatively connect the pulley 66 to the drive pulley 67, see FIG. 8 and will cause the tension to be taken up so that the chain 63 will raise the carriage. As soon as the operator frees the pedal M, the carriage will remain in the position into which it has been raised because the worm gear, not shown, in the gear housing L, will prevent the lower sprocket 57 from rotating in a counterclockwise direction.

The operator can control the downward movement of the carriage F along the tower and it requires no motor power for moving the carriage down. The advantage of this will be seen in the event of a power failure with the carriage in a raised position on the tower. When the operator wishes to lower the carriage on the tower, he merely depresses the foot pedal R to release the brake band Q from the brake drum P. The width of the carriage F will now cause it to move downwardly along the tower and the main sprocket 58 will be free to rotate and travel along the nonmoving chain 63. The rotation of the main sprocket will rotate its shaft 59 and the brake drum P. The speed of the downward movement of the carriage depends upon how much friction there is between the brake band and the brake drum. The carriage can be brought to a stop at any desired point along the tower by the operator merely freeing the foot pedal R and permitting the tension spring 86 to rotate the bellcrank lever 82 for again tightening the brake band Q about the brake drum P.

It will be seen from the description of the various parts of the mechanism that the operator can move the device as well
as steer it by manipulating the hand levers K and K', and this can be accomplished whether the carriage is moving along the tower in either direction or is standing still on the tower. Also the raising of the carriage can be accomplished by depressing the foot pedal M, and operating the mechanism shown in FIG. 8, in the manner already described. The lowering of the carriage is effected by depressing the other foot pedal R which operates the mechanism illustrated in FIG. 9.

I claim:

1. A power ladder including a base and an upstanding tower carried thereby having upper and lower sprockets;
   a. a carriage movable up and down on said tower;
   b. a sprocket rotatably mounted in said carriage;
   c. an endless chain passed around the two tower sprockets and having one of its reaches passed around said carriage sprocket;
   d. braking means mounted in the carriage for normally preventing rotation of said carriage sprocket;
   e. means operatively connecting the lower tower sprocket to a power source so that the sprocket will be rotated and will move the reach, connected to the carriage sprocket, upwardly;
   f. whereby the carriage will be moved upwardly along the tower since the brake will prevent the carriage sprocket from rotating and the locked carriage sprocket and carriage will be moved upwardly with the upwardly moving chain reach; and
   g. said braking means including manually controlled means for releasing the braking means for permitting said carriage sprocket to rotate.

2. A power ladder including a base and an upstanding tower carried thereby having upper and lower sprockets;
   a. a carriage movable up and down on said tower;
   b. a sprocket rotatably mounted in said carriage;
   c. an endless chain passed around the two tower sprockets and having one of its reaches passed around said carriage sprocket;
   d. braking means mounted in the carriage for normally preventing rotation of said carriage sprocket;
   e. means operatively connecting the lower tower sprocket to a power source so that the sprocket will be rotated and will move the reach, connected to the carriage sprocket, upwardly;
   f. whereby the carriage will be moved upwardly along the tower since the brake will prevent the carriage sprocket from rotating and the locked carriage sprocket and carriage will be moved upwardly with the upwardly moving chain reach;
   g. the means that operatively connects one of said tower sprockets to said power source includes a cable having one end connected to the top of the tower;
   h. a first idler pulley movably mounted in said carriage and having said cable passed around it;
   i. a drive pulley;
   j. a second idler pulley operatively connected to said lower tower sprocket for rotating it;
   k. a third idler pulley mounted on a swingable arm, the other end of said cable being connected to said arm;
   l. a belt loosely passed around said drive pulley and said second and third idler pulleys so the second idler pulley will not be rotated by said drive pulley; and
   m. manual means in said carriage for moving said first idler pulley for acting on said cable for swinging said arm and moving said third idler pulley for taking up slack in said belt, thus causing said drive pulley to rotate said second idler pulley and said lower tower sprocket for moving said endless chain to raise said carriage on said tower.

3. The combination as set forth in claim 2 and in which:
   a. the operative connection between said second idler pulley and said lower tower sprocket will permit said sprocket to rotate in only one direction for lifting said carriage on said tower and will prevent said lower tower sprocket from rotating in the reverse direction;
   b. whereby when said lower tower sprocket stops rotating, said endless chain will stop moving and said carriage will be held on the tower in the position into which it has been raised.

4. The combination as set forth in claim 3 and in which:
   a. manually controlled brake releasing means is mounted in said carriage for freeing said braking means to the desired extent for freeing said carriage sprocket for permitting it to rotate and move along the adjacent portion of said endless chain;
   b. whereby the weight of the carriage will cause it to move downwardly along said tower, the carriage sprocket being free to rotate and travel along said chain until said brake is again applied or said carriage descends to the bottom of said tower.

5. The combination as set forth in claim 2 and in which the manual means in said carriage for moving said first idler pulley includes a foot-actuated pedal on which said first idler pulley is rotatably mounted, said foot pedal being depressible by an operator in the carriage for causing the first idler pulley to act on said cable for swinging said arm.

6. The combination as set forth in claim 4 and in which:
   a. the manually controlled brake-releasing means includes a brake drum operatively connected to said carriage sprocket;
   b. a spring biased brake band encircling said drum and normally preventing it from rotating; and
   c. a foot pedal operatively connected to said brake band and being mounted in said carriage, said pedal when manually depressed freeing said brake band from said drum for permitting the latter to be rotated by said carriage sprocket as said carriage moves downwardly on the tower by gravity.