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POWER LADDER AND SAFETY DEVICE FOR WORKMAN'S BASKET

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3 Sheets-Sheet 1

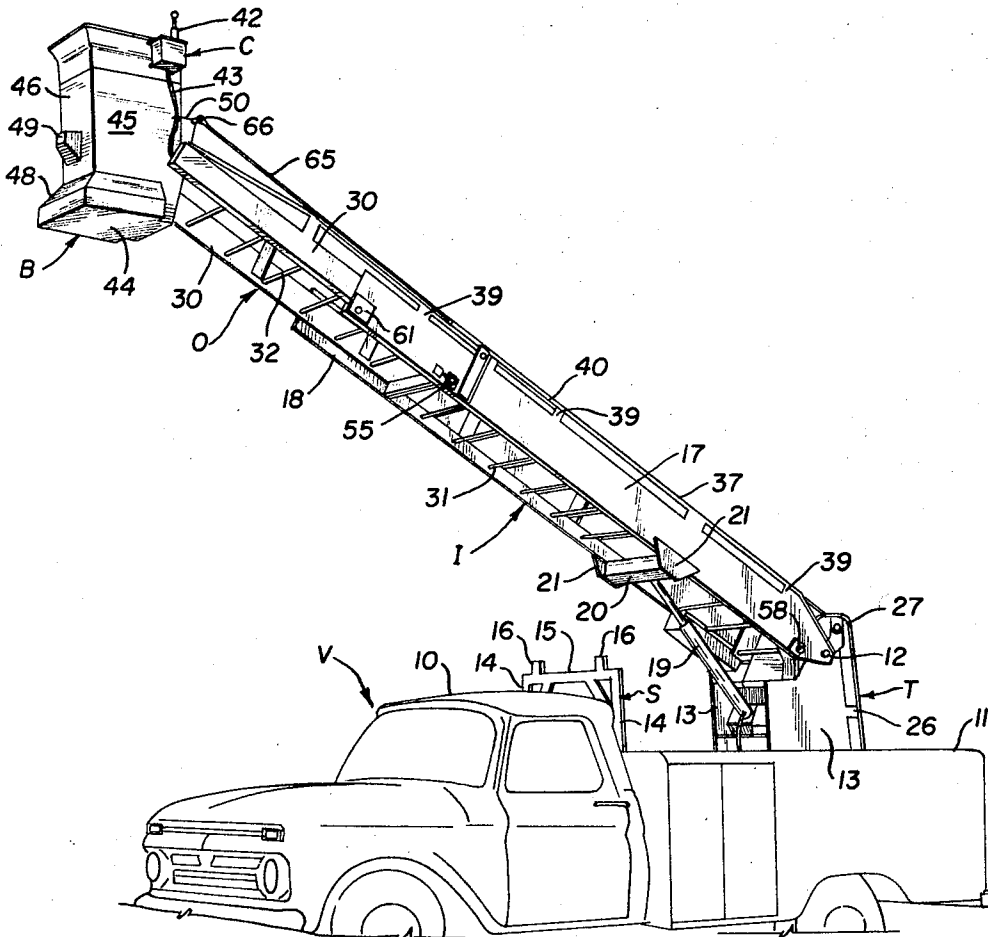


Fig. 1

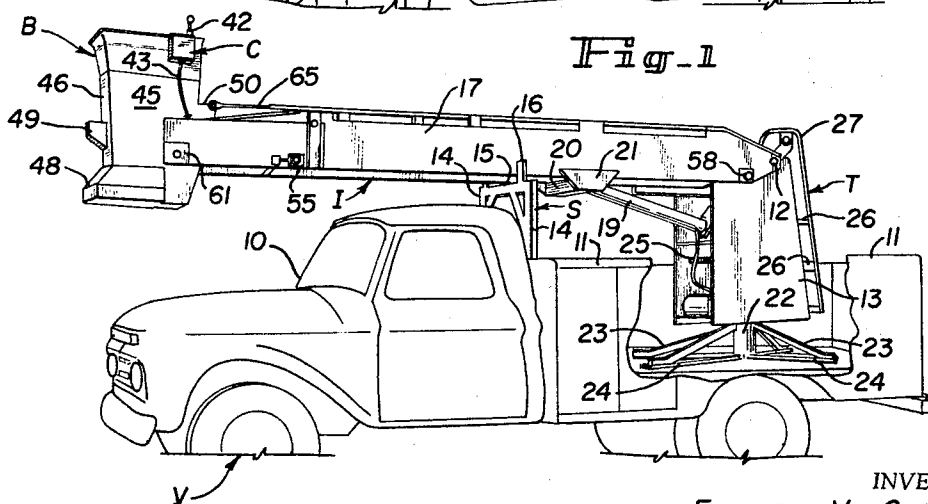


Fig. 2

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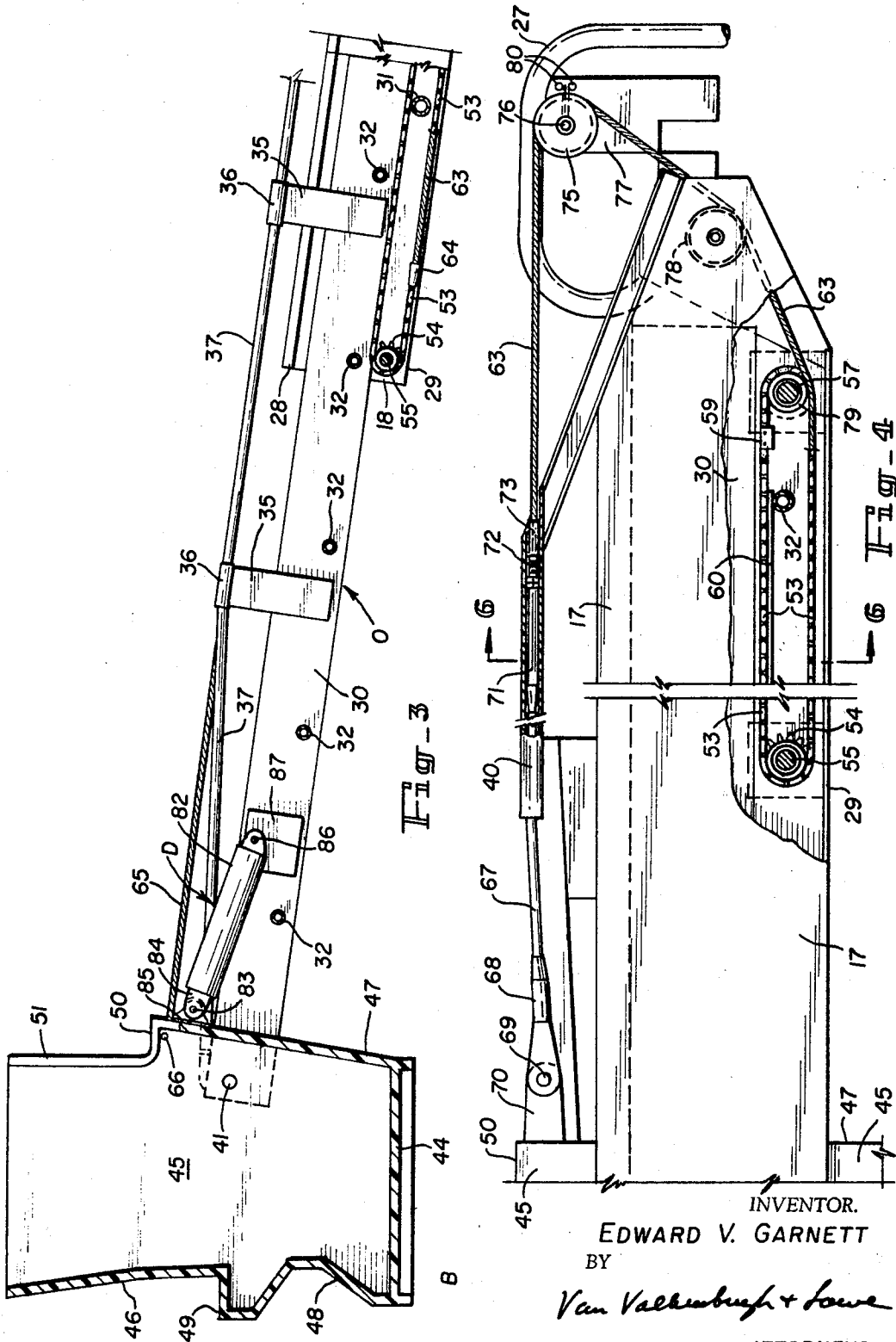
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3 Sheets-Sheet 3

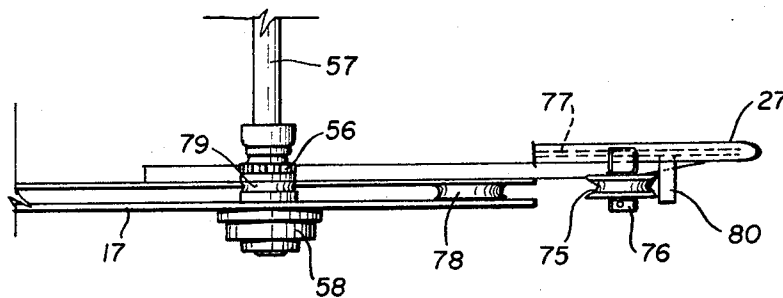


Fig. 5

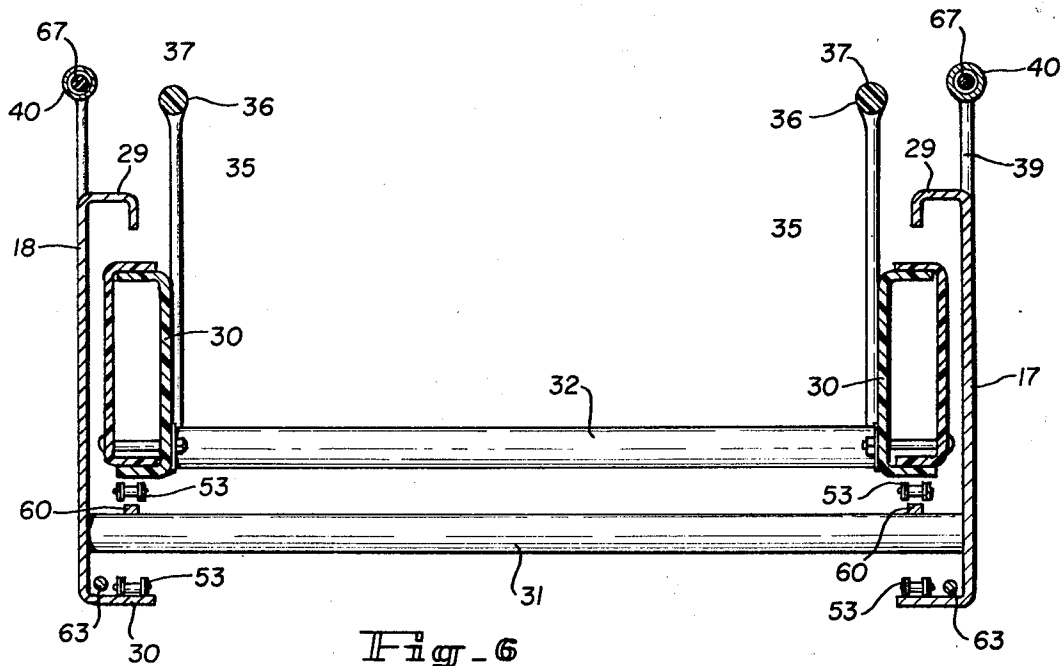


Fig. 6

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POWER LADDER AND SAFETY DEVICE FOR WORKMAN'S BASKET

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ABSTRACT OF THE DISCLOSURE

A line means, such as a cable, having one end connected to a workman's operating support and the opposite end movable with a portion of an extending and retracting device for an outer section of a ladder which is extended and retracted with respect to an inner section, such portion of the extending and retracting device being movable in the opposite direction. A motion opposing device, such as a shock absorber, prevents the workman's support from suddenly tipping, in the event of breakage of the cable. Also, a hollow hand rail forms a guide for a portion of the cable which maintains the workman's support in vertical position. Additional details of the extending and retracting device are also disclosed.

This invention relates to power ladders and also to safety devices for workmen's baskets, such safety devices being particularly useful in connection with baskets mounted on a power ladder, but useful also in connection with workmen's baskets mounted on other types of apparatus on which a workman's basket may be mounted, such as derricks, aerial lifts and the like.

Among the objects of this invention are to provide a novel power ladder; to provide such a power ladder having an extensible and retractable outer section, on the outer end of which a workman's cage or basket is mounted; to provide such a power ladder in which the workman's basket is maintained in an upright position, irrespective of the angularity of the ladder or the position of the extensible and retractable section of the ladder; to provide such a power ladder in which the means for maintaining the workman's basket in an upright position includes a cable; to provide a safety device for such a basket which will prevent the basket from tipping suddenly and tending to throw the operator out, in the event that the cable breaks or a similar mishap occurs; to provide such a safety device which is adapted to be utilized with workmen's baskets or cages which are mounted on other types of apparatus, including derricks, aerial lifts and the like; to provide such a safety device which will operate effectively but will not materially impede the movement of the basket during normal operation of the ladder, aerial lift or the like; to provide such a ladder in which a workman in the basket is adequately insulated against contact with a high voltage line or the like; to provide such a ladder in which the ladder sections are so constructed that the leveling connection to the basket is accurately guided and is protected against damage, particularly when the ladder is in storage position; to provide such a ladder in which the means for extending and retracting an outer section of the ladder cooperates with the basket leveling means; and to provide such a ladder and such a safety device which are relatively easy to construct and efficient and effective in operation.

Additional objects and the novel features of this invention will become apparent from the description which follows, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a three quarter side perspective view of an aerial ladder of this invention, provided with a safety device of this invention and mounted upon a vehicle, showing the ladder in a raised and partially extended position;

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FIG. 2 is a side perspective view of the aerial ladder and vehicle of FIG. 1, showing the ladder in a storage or transport position;

FIG. 3 is a fragmentary, longitudinal section, on an enlarged scale and taken near the opposite edge of the ladder of FIG. 1, showing the inside of the basket and a portion of the outer ends of two sections of the ladder;

FIG. 4 is a fragmentary, condensed side elevation, on a further enlarged scale, of a portion of a slightly modified form of the ladder of FIG. 1, in the retracted position of FIG. 2, showing the outer and inner ends of the ladder sections, with certain portions broken away to show parts otherwise hidden from view;

FIG. 5 is a fragmentary, top plan view of a portion of the structure at the inner end of the ladder, showing particularly sheaves for a cable through which the basket is maintained upright and a drive sprocket for one of a pair of chains by which the outer section of the ladder is extended and retracted; and

FIG. 6 is a transverse section, on a further enlarged scale, taken along line 6—6 of FIG. 4.

As illustrated in FIGS. 1 and 2, a ladder, to which the principles of this invention may be applied, includes an inner section I, which is pivotally mounted at its inner end on a rotatable turret T, and an outer section O, which is extensible from and retractable within the inner section I and at the outer end of which is mounted a workman's basket B. The turret, in turn, may be mounted upon a vehicle V, such as a panel type truck having a cab 10 and a pair of storage panels 11 extending rearwardly from the cab on opposite sides of the truck bed. In order to reach an elevated point at which work is to be done, the workman stands in the basket B, either entering the basket originally or climbing up the ladder to the basket after the basket has been positioned, as by pivoting the inner section I about a pair of pivot pins 12, connected to side plates 13 of the turret T or also to additional supporting and reinforcing members within the turret. The turret T is preferably rotatable to any position around a full circle at any desired time, irrespective of the angular elevation of the inner section I. Simultaneously therewith, or later if desired, the inner section I may be pivoted upwardly or downwardly and the outer section O may be extended from the inner section I until the basket B reaches the desired position. For storage purposes, the outer section O is fully retracted, with a portion of the basket fitting within the outer end of section I, and the turret T rotated until the inner section I is directly above a supporting stand S, then lowered onto the stand, as in FIG. 2. The stand S may include a pair of spaced uprights 14 and an upper cross bar 15 provided with upwardly extending stops 16, which prevent the ladder from shifting laterally during transportation. Thus, the stops 16 are spaced apart a distance slightly greater than the total width of the inner section I between the outer surfaces of its side panels 17 and 18. The elevation of cross bar 15 is preferably such that, with the ladder in storage position, it will extend over the cab 10 but will not interfere with the vision of the driver of the vehicle.

As described above, the ladder of this invention includes many of the features of the ladder disclosed and claimed in my copending application Ser. No. 547,531, filed May 3, 1966, thus including a hydraulic cylinder 19 for pivoting the ladder upwardly and downwardly, the piston rod of the cylinder being connected to a closed box section 20 extending between depending portions 21 of the sides 17 and 18 of the inner section I, as well as a central post 22, about which the turret T is rotatable and which is mounted upon the bed of the truck and maintained in vertical position by angular braces 23, con-

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nected at their inner ends to post 22 and at their outer ends to cross bars 23, with bolts extending through the outer ends of the braces and cross bars through the bed and connected to the frame of the truck beneath the bed. The turret T may be rotated about the post by a motor driven pinion (not shown) engaging a ring gear 25, while the motor for driving the pinion may be either a hydraulic motor or an electric motor, powered through an hydraulic pump or an electric generator driven by a separate gasoline engine mounted within the turret T or from the engine of the vehicle V. In order to permit the operator to climb onto or off the ladder, the turret T is provided with a series of steps 26, as in FIGS. 1 and 2, with a hand rail 27 at the outside of each step. As will be evident, for shifting the ladder from the storage position of FIG. 2 to a use position, the ladder is merely elevated until, upon rotation, the ladder clears the tops of stops 16, after which the turret T may be rotated to any desired position. As will be evident, when operating at either side or to the rear, the outer end of the ladder may be lowered until the basket B rests on the ground. It will be evident, of course, that, in lieu of the hydraulic cylinder 19, angular movement of the ladder may be obtained by a motor driven screw or any other suitable type of drive.

As also disclosed in my aforesaid application Ser. No. 547,431, the sides 17 and 18 of the inner section I, as in FIG. 6, may be formed of steel and provided with an upper flange 28 which extends inwardly and then downwardly, as well as an inwardly extending lower flange 29. The sides 30 of the inner ladder section I may be formed of a fiberglass reinforced plastic, such as a polyester resin, formed integrally as a box section or from a pair of interfitting channels, as shown, secured together by a suitable adhesive, such as an epoxy resin. This hollow plastic beam section not only insulates the basket B from the flow of electric current, but also is resistant to damage by weather, as through water, while the interior of the box section may be filled with a light, expanded polyurethane foam, to prevent water from collecting inside. A spaced series of tubular metal rungs 31 extend between the sides 17 and 18 of inner section I and are attached thereto in a suitable manner, as by welding, while a series of hollow, tubular fiberglass reinforced plastic rungs 32 extend between the insides of beams 30 of the outer section of the ladder, being attached thereto in a suitable manner, as by brackets 33 and bolts 34. A series of plates 35 extend upwardly from the inside edges of the hollow beams 30, at spaced longitudinal positions, and each carries at its top a sleeve 36 through which extends an insulating rod 37, formed of reinforced plastic and attached to the opposite ends of the corresponding hollow beam by a connection 38, as in FIG. 1, at which tension on the rod 37 may be obtained to increase the structural strength of the beam. Rod 37 also provides an insulated hand rail for the outer section O. Each of the sides 17 and 18 of the inner section I is provided with upwardly extending flanges 39, which may be formed integrally therewith, or welded thereto, and to the upper ends of which a tubular hand rail 40 is welded.

The basket B, as in FIGS. 1 to 3, is pivotally mounted between the outer ends of beams 30, as by a pin 41 extending inwardly from each beam, as in FIG. 3, and is provided with a controller C, mounted at the top of the basket for ready access by the user and provided with a control handle 42 which is conveniently adapted to be moved to different positions to cause the turret T to rotate to one side or the other, to cause the ladder to be pivoted upwardly or downwardly by cylinder 19, or to cause the outer ladder section to be extended or retracted. Control cables 43 connect the controller with the various mechanisms by which the above movements are produced, while a similar controller is mounted on or within turret T, or on one of the vehicle panels 11, to enable the position of the basket to be controlled from the vehicle or from

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the ground. The cables 43 extend along the inside of one of hollow beams 30, or within the same, and into a conventional take-up reel (not shown) mounted on the inside of a side plate of ladder section I or within the turret T, to accommodate extension and retraction of the ladder section O. The basket B itself is formed of an insulating material, such as a fiberglass reinforced polyester resin, and has a base 44, side walls 45, a front wall 46 and a rear wall 47. The front and side walls are preferably provided with an offset 48 adjacent the base 44, to accommodate the toes of the operator standing in the basket, while the front wall 46 is provided with a bumper 49, to minimize the possibility of damage to the basket through accidental contact with a line pole, cross bar, or the like. The upper ends of the side walls 45 and front wall 46 also conveniently flare outwardly, to facilitate the operator leaning out of the basket in performing his work. The rear wall is also provided with a forward offset 50, conveniently just above the center of height of the basket, and also an opening 51 which extends downwardly to a point below offset 50, for readier access to the basket by the workman from the ladder. The rear edges of the side walls 45 conform to the contour of the rear wall 47, while the base 44 is spaced above the lower edges of the walls, as shown, to provide a depending rim which will support the basket when placed on the ground.

The outer section O of the ladder is moved inwardly and outwardly by a pair of continuous chains 53, which pass around a pair of idler sprockets 54, mounted on a shaft 55 near the outer end of the ladder section I, and also around a pair of drive sprockets 56, as in FIGS. 4 and 6, near the inner end of the ladder section I and mounted on a drive shaft 57, which is journaled, as in FIGS. 1 and 5, in a bearing 58 at each end. Each chain 53 is attached to a lower corner of the side of the outer section O, adjacent the inner end thereof, as by a bracket 59 of FIG. 4. Also, a guide and support bar 60 is attached, as by welding, to the tops of metal rungs 31, not only to guide the chains during movement of the ladder section O along ladder section I, but also to support the ladder section O. Thus, the guide bars 60 are narrow to fit within the chain and permit the chain rollers to roll along the guide bars, as will be evident from FIG. 6, in which a space is shown between the underside of beams 30 and chains 53, as well as between the rollers of chains 53 and guide bars 60, for clarity of illustration, it being understood that the rollers of the upper reach of chains 53 will engage the guide bars 60 and that beams 30 will rest directly on the chains. As will be evident, when the drive sprockets 56 are rotated to move the upper reach of the chain 53 outwardly, the outer ladder section O will be extended, while when the drive sprockets 56 are rotated in the opposite direction, the upper reach of the chains 53 will be moved inwardly and the outer ladder section O will be retracted. Thus, through a suitable drive motor, either electric or hydraulic, connected to drive shaft 57, but being conventional and therefore not shown, the outer ladder section O may be moved to any desired extended or retracted position. For holding ladder section O laterally, a conventional guide shoe or roller (not shown) may be placed on the inside of each side plate 17 and 18, at the upper end thereof, as at the position of reinforcing plates 61, while a similar conventional guide shoe (not shown) may be mounted at the lower end of each beam 30, on the outside thereof, so that the upper guide shoes or rollers will engage the outside of the corresponding beam 30 and the lower guide shoes or rollers will engage the inside of the respective plate 17 or 18.

In accordance with this invention, a basket leveling device, which maintains the basket in upright position, irrespective of rotation of the turret, inclination of the ladder or extension or retraction of the outer ladder section, is associated with the extension and retraction means and with a fixed point relative thereto, as on turret T. Preferably, such leveling device includes a cable 63, one

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end of which is connected to the lower reach of chain 53, as through a socket 64 of FIG. 3, so that this end of the cable will move with the lower reach of the chain 53, i.e. when the upper reach of the chain 53 is moved outwardly, the lower reach will be moved inwardly and tend to provide slack in the cable 63, but when the upper reach of the cable 53 is moved inwardly, to retract the ladder section O, the lower reach of the chain will be moved outwardly, thus producing a pull on cable 63.

Cable 63 may be connected to basket B through an extension 65 attached to basket B at a laterally extending pin 66 of FIGS. 1 and 2, but preferably through an insulating rod 67, the end of which adjacent basket B, as in the modified form of FIG. 4, is connected to a socket 68, as by a suitable adhesive, in turn pivoted on a pin 69, which is mounted on a bracket 70, attached to the rear wall 47 of the basket, adjacent offset 50 and outside opening 51.

In further accordance with this invention, when either the cables or rods 67 are utilized, each will be received in the corresponding tubular hand rail 40, as in FIG. 6, which serves as a guide therefor, and will move within the hand rail a distance sufficient to maintain the basket in a level position. The insulating rod 67 may be connected at its inner end to a hollow socket 71, in one end of which the inner end of rod 67 is received and connected, as by a suitable adhesive, and the opposite end of which is threaded to receive an adjustment stud 72, integral with or attached to a socket 73, which provides a connection for that end of cable 63. It will be understood, as indicated above, that when the cable 65 of FIGS. 1-3 is utilized, it will form merely a continuation of the cable 63 of FIG. 4.

As will be evident, the movement of the socket 64 and corresponding end of cable 63 will correspond directly to the extension or retraction of the outer ladder section O, so that, without any change in angular position, the basket will be maintained at the same angle with respect to the outer section O. In order to accommodate a change in the angular position of the ladder and still maintain the basket in an upright position, irrespective of the angular position of the ladder, the cable 63 passes over a fixed sheave 75, mounted on a pin 76 extending laterally outwardly from a bracket 77 of the turret T, as well as an intermediate sheave 78 mounted on the inner ladder section I and a guide sheave 79 mounted on drive shaft 57, alongside sprocket 56. A pair of pins 80, as in FIGS. 4 and 5, extend laterally outwardly from bracket 77, to restrain any movement of cable 63 off fixed sheave 75. As will be evident, sheaves 75, 78 and 79 may be positioned so that, when the ladder is moved angularly downwardly and the basket would otherwise tend to tip forwardly, the fixed sheave 75, particularly, produces a pull on the cable, which maintains the basket in an upright position. Similarly, when the ladder is moved angularly upwardly, the basket will otherwise tend to tip rearwardly, but the fixed sheave 75, particularly, tends to produce a slack in the cable which is taken up by the overhanging weight of the basket or the overhanging weight of the basket and the operator therein, or by extension of the ladder section O, when accompanying the same, thereby again maintaining the basket in an upright position. It will be understood, of course, that the angular movements of the ladder are normally such that the cable 63 and rod 67, or cable 63 and its continuation 65, will relatively easily follow the movement of the ladder.

In further accordance with this invention, a safety device is provided, so that, in the event either cable 63 or cable 65 or rod 67 breaks, or the connection between the leveling cable and the chain 53 breaks, the basket will not be tipped suddenly forwardly, tending to throw the operator out of the basket. This is accomplished through the use of a motion opposing device D, which is mounted between a point near the outer end of the outer section

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O and the basket B, as in FIG. 3. Such a device may comprise a shock absorber which includes a cylinder 82 pivoted on a pin 83 extending inwardly from a bracket 84 attached to the inside of one beam 30 of the outer ladder section, and a rod 85 which enters the cylinder 82 and is provided with a conventional air piston, as well as being pivoted on a pin 86 mounted on a bracket 87 attached to the rear wall 47 of the basket, just below the offset 50. A similar motion opposing device D is preferably installed adjacent the opposite side of the basket B but is merely a duplicate of that shown in FIG. 3. As will be evident, through the motion opposing device D, any sudden movement of the basket B is opposed, giving the operator time to climb out of the basket and onto the ladder, in the event that the leveling cable breaks or a similar mishap occurs. Since the pin 41, by which the basket is pivotally connected to the outer end of the outer ladder section O, is adjacent the rear wall of the basket, the weight of the basket and also the operator therein is overhanging, thus producing a tendency for the basket to tip over suddenly, in the event the leveling cable breaks, or a similar mishap occurs. However, through the use of the motion opposing device D, the initial tipping movement will be very slow. Also, the motion opposing device D does not interfere with the normal leveling of the basket. As indicated previously, the basket remains in the same angular relation to the outer section of the ladder, when the outer section is extended or retracted, and it is only when the angular pivotal position of the ladder is being changed that the angular relationship between the basket and the outer section of the ladder should be changed in a corresponding amount. However, a motion opposing device, such as a shock absorber, will accommodate slight movements with a minimum of opposition, but will oppose longer or sharper movement with a much greater force. Thus, a conventional shock absorber is ideal for use at the motion opposing device D.

From the foregoing, it will be evident that the requirements and objects hereinbefore set forth have been fulfilled to a marked degree. Through a cable which is attached to the means for extending and retracting the outer section of the ladder, which cable passes over a fixed sheave on the turret, the workman's basket may be maintained in an upright position at all times, irrespective of extension or retraction or change in the angular position of the ladder. The hollow upper hand rail of the lower ladder section forms a convenient guide for the basket leveling cable. When an insulating rod is substituted for a portion of the basket leveling cable and the outer section of the ladder is also formed primarily of insulating material, grounding of the basket is avoided, so that, if the operator accidentally comes into contact with a high voltage line, there is much less possibility of injury to the operator. Through the use of a motion opposing device between the outer end of the ladder and the basket, any sudden changes in position of the basket are opposed, thus giving the operator sufficient time to climb out of the basket and onto the ladder, in the event the leveling cable breaks. As will be evident, such a leveling device and also such a safety device may be installed in a similar manner on other types of apparatus in which a workman's basket is mounted, such as derricks, aerial lifts and the like.

Although a preferred embodiment of this invention and certain variations thereof have been illustrated and described, it will be understood that other embodiments may exist and various other changes may be made therein, all without departing from the spirit and scope of this invention.

What is claimed is:

1. Apparatus for positioning a workman's operating support in an elevated position, including boom means adapted to be mounted on rotatable supporting means, in turn adapted to be mounted on a vehicle, and comprising:

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- an inner section pivotally mounted at its inner end on said supporting means;
 means for pivoting said inner section upwardly and downwardly;
 an outer section mounted on said inner section for extension and retraction with respect thereof;
 means for extending and retracting said outer section with respect to said inner section and having a portion movable in the opposite direction;
 a workman's operating support mounted on the outer end of said outer section for movement relative thereto; and
 means for maintaining said support in a desired position, including line means having one end connected to said support and the opposite end movable with said oppositely movable portion of said extending and retracting means for said outer section, said line means extending to a point on said supporting means.
2. Apparatus for positioning a workman's operating support as defined in claim 1, including:
 a motion opposing device connected between said support and the outer end of said outer section.
3. Apparatus as defined in claim, 2 wherein:
 said motion opposing device comprises a shock absorber.
4. A power ladder comprising apparatus for positioning a workman's operating support as defined in claim 1, wherein:
 said inner section is an inner ladder section having sides and rungs extending transversely between said sides;
 said outer section is an outer ladder section having sides and rungs extending transversely between said sides;
 said means for extending and retracting said outer section with respect to said inner section includes line means having a portion movable in the same direction as said outer section and another portion movable in the opposite direction; and
 said workman's operating support is pivotally mounted on the outer end of said outer section.
5. In a power ladder as defined in claim 4, wherein:
 said sides of said outer ladder section and the portion of said position maintaining line means adjacent said support are each formed of insulating material.
6. In a power ladder as defined in claim 4, wherein:
 at least one side of said inner ladder section is provided with a hollow hand rail forming a guide for a corresponding portion of said position maintaining line means.
7. A power ladder, as defined in claim 4, wherein:
 said position maintaining line means includes a cable extending around a sheave mounted on said supporting means.
8. A power ladder as defined in claim 4, wherein:
 said extending and retracting line means includes a pair of endless roller chains connected to the inner end of the underside of the respective sides of said outer ladder section and rotatable sprockets for said chains mounted adjacent the outer and inner ends of said inner ladder section;

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- a drive means for said chains is connected to one pair of said sprockets; and
 a guide bar for the upper reach of each of said chains is mounted on said inner ladder section, said guide bars being constructed and arranged to engage said rollers of said chains and to receive the weight of said outer ladder section on said chains.
9. A power ladder as defined in claim 8, wherein:
 said guide bars are attached to the tops of the rungs of said inner ladder section; and
 the lower reach of each of said chains is disposed beneath said rungs.
10. In a power ladder as defined in claim 4, wherein:
 said workman's operating support is a hollow basket formed of insulating material;
 said position maintaining line means includes line means at each side of said inner and outer sections;
 said sides of said outer ladder section and the portion of each said position maintaining line means adjacent said support are each formed of insulating material;
 each side of said inner ladder section is provided with a hollow hand rail forming a guide for a corresponding portion of said position maintaining line means;
 each said position maintaining line means includes a cable extending around a sheave mounted on said supporting means;
 said extending and retracting line means includes a pair of endless roller chains connected to the inner end of the underside of the respective sides of said outer ladder section and rotatable sprockets for said chains mounted adjacent the outer and inner ends of said inner ladder section;
 a drive means for said chains is connected to the inner pair of said sprockets;
 a guide bar for the upper reach of each of said chains is mounted on top of the rungs of said inner ladder section, said guide bars being constructed and arranged to engage said rollers of said chains and to receive the weight of said outer ladder section on said chains;
 said cable of each of said positioning line means is connected to the lower reach of the corresponding chain, beneath said rungs of said inner ladder section; and
 a motion opposing shock absorber is pivotally connected between the outer end of each side of said outer ladder section and the rear of said basket.

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REINALDO P. MACHADO, *Primary Examiner*.