

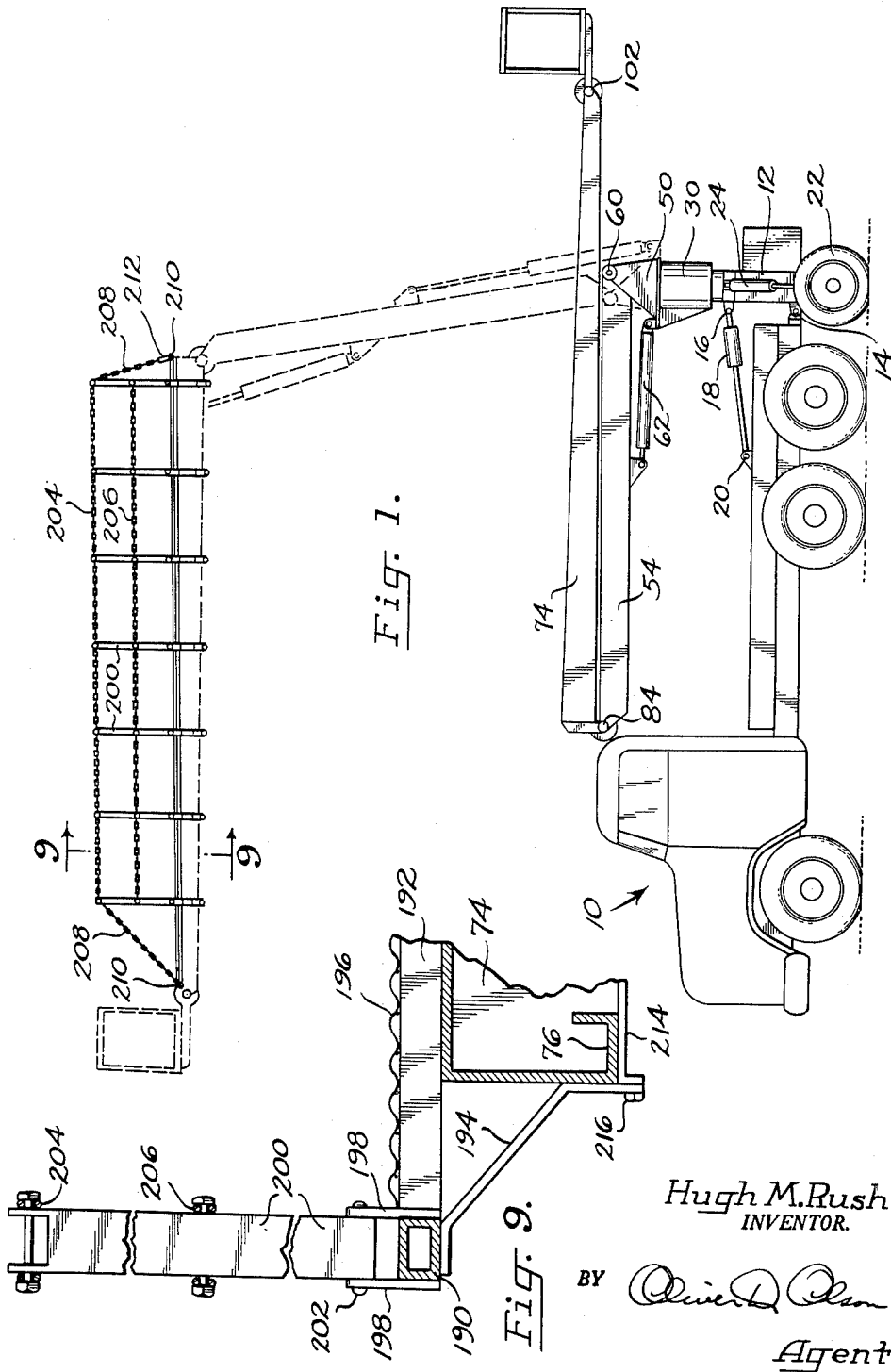
Jan. 8, 1963

H. M. RUSH
FOLDING PERSONNEL LIFT

3,072,215

Filed Aug. 12, 1958

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H. M. RUSH

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FOLDING PERSONNEL LIFT

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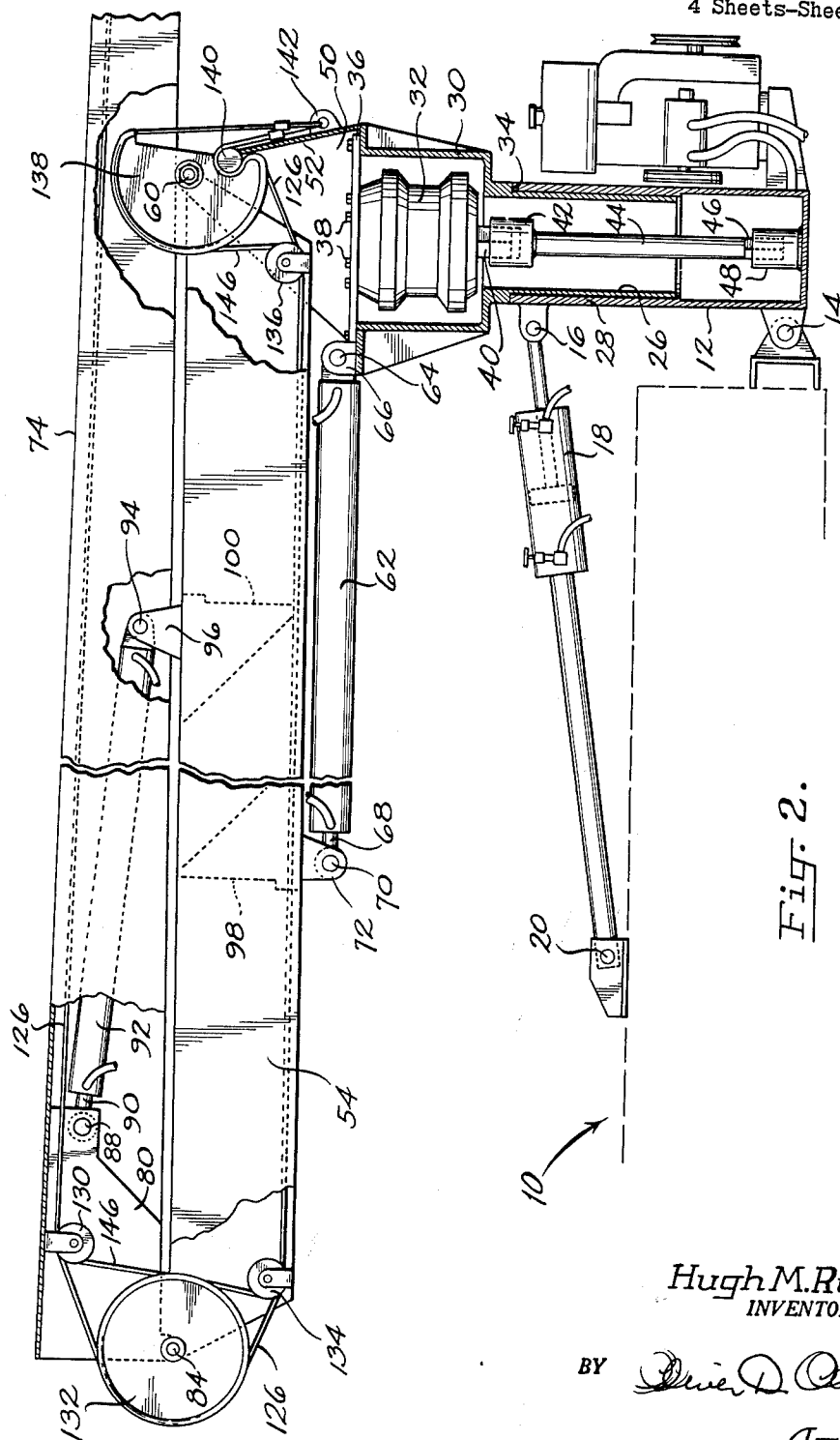


Fig. 2.

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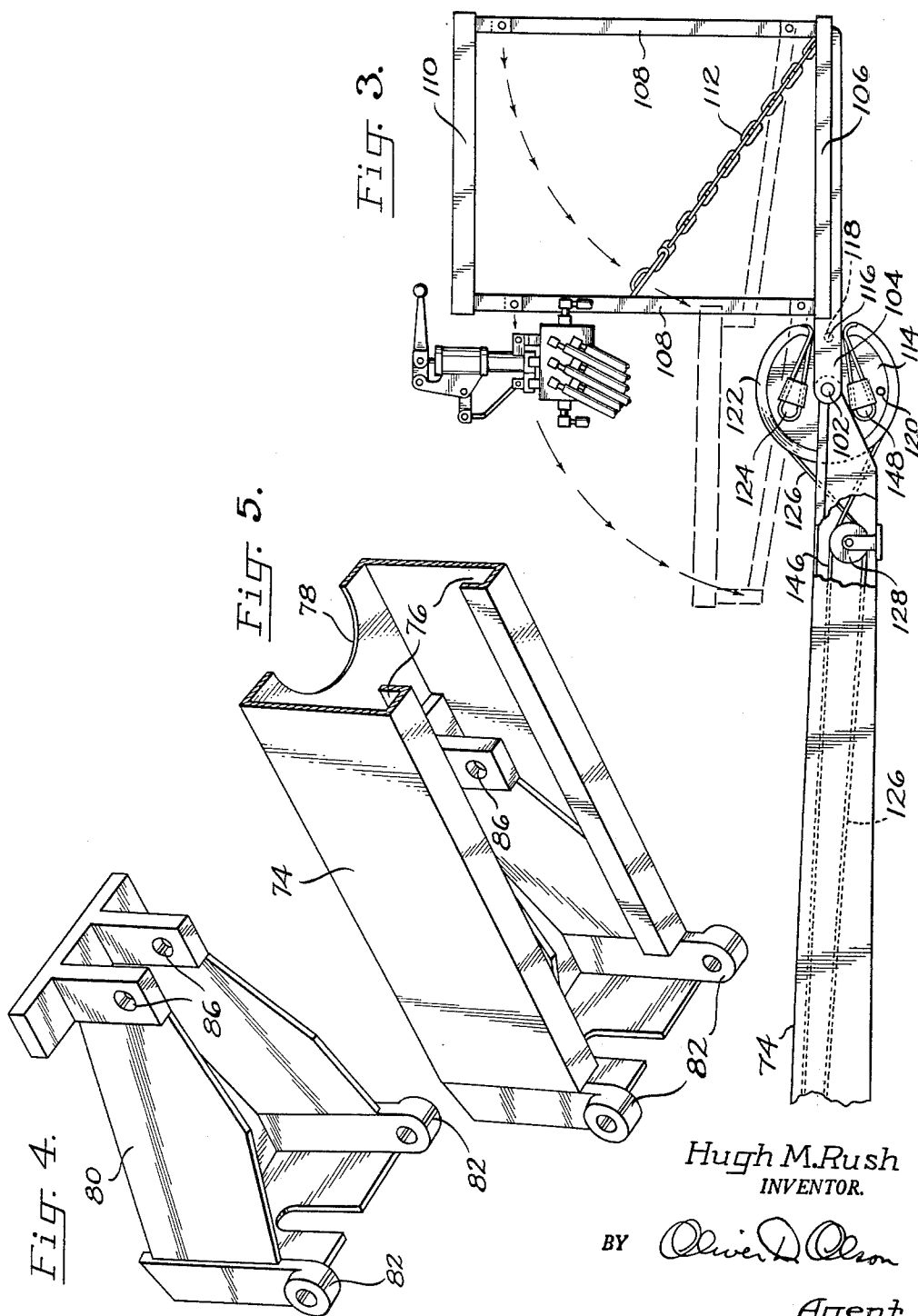
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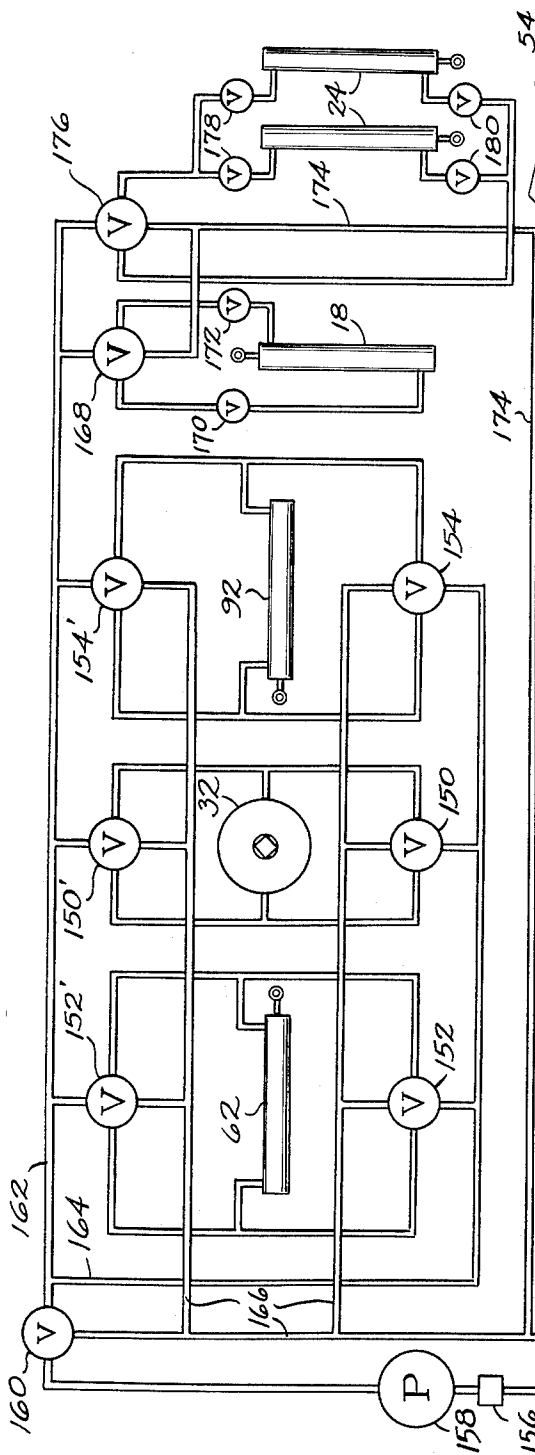
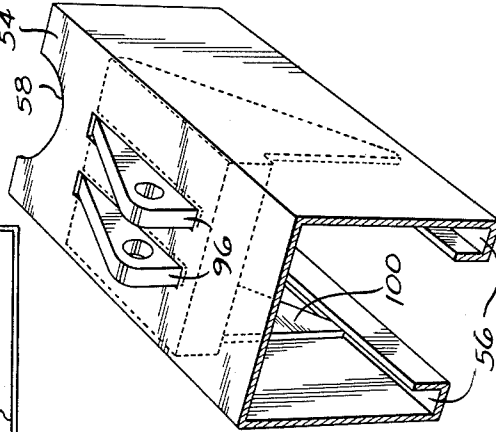
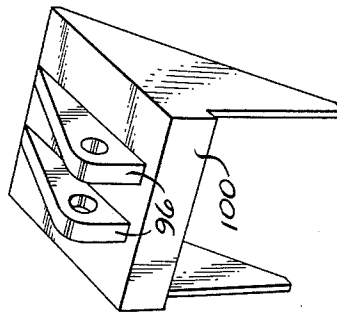
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FOLDING PERSONNEL LIFT

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4 Sheets-Sheet 4



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3,072,215

FOLDING PERSONNEL LIFT

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Filed Aug. 12, 1958, Ser. No. 754,561
5 Claims. (Cl. 182-2)

This invention pertains to extensible boom assemblies, and relates particularly to a folding personnel lift of improved construction.

Although personnel lifts of the folding or telescoping boom types have been provided heretofore in diverse structural forms, various limitations to their use have been imposed by virtue of their structural design. For example, personnel lifts capable of supporting substantial loads and moving them to substantial distances from the point of support, generally are characterized by excessive bulkiness and weight, together with inefficient maneuverability and limited portability. On the other hand, personnel lifts having a greater range of maneuverability and portability generally are so limited in load carrying capacity as to render them unsuitable for practical applications. In all instances, it is generally recognized that such structures provided heretofore are characterized by having a rather low strength to weight ratio, and hence correspondingly low bulk to load ratio.

Accordingly, it is a principal object of the present invention to provide a folding personnel lift construction which affords maximum strength to weight ratio for maximum load capacity and safety with minimum weight and complication of design.

Another important object of this invention is the provision of a folding personnel lift construction which affords maximum ease and versatility of operation for a variety of uses.

Still another important object of the present invention is to provide a folding personnel lift construction which is capable of being collapsed to minimum dimension to enhance its mobility in transport.

Another important object of this invention is the provision of a folding personnel lift in which is incorporated an elongated folding catwalk assembly for use in the manner of an elongated scaffold.

A further important object of the present invention is the provision in a folding personnel lift utilizing pressed steel booms of compact and novel construction and incorporating means for enclosing the operating cables and conduits of the assembly.

A still further important object of this invention is to provide a folding personnel lift construction which includes a simplified automatic leveling system for a personnel station.

Another important object of the present invention is the provision of a folding personnel lift of simplified construction for economical manufacture, which includes a minimum number of assembly parts and which requires a minimum of maintenance and repair.

The foregoing and other objects and advantages of this invention will appear from the following detailed description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a view in side elevation of a personnel lift embodying the features of the present invention;

FIG. 2 is a fragmentary foreshortened view in side elevation of the personnel lift shown in FIG. 1, parts being broken away to disclose details of construction;

FIG. 3 is a fragmentary view in side elevation of the forward end of the upper boom, the same being an extension of FIG. 2;

FIG. 4 is a perspective view showing the construction of a reinforcing nacelle for the rearward end of the upper boom;

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FIG. 5 is a perspective view of a portion of the upper boom showing the nacelle of FIG. 4 installed therein;

FIG. 6 is a perspective view showing the construction of a reinforcing bracket section for the lower boom;

FIG. 7 is a perspective view of a portion of the lower boom showing the bracket of FIG. 6 installed therein;

FIG. 8 is a schematic diagram showing a fluid pressure system for operating the various power components of the personnel lift; and

FIG. 9 is a fragmentary foreshortened sectional view taken along the line 9-9 in FIG. 1 and showing details of construction of a folding catwalk assembly embodying features of this invention.

Referring particularly to FIG. 1 of the drawings, the personnel lift of the present invention is shown in the form of a portable, detachable unit mounted at the rear end of a truck 10. The lift assembly is mounted upon a portable support which includes the hollow base 12 adapted to be attached pivotally adjacent its bottom end to the rear end of the vehicle, on the transverse pivot 14. A pivot 16 at the upper end of the base is connected to one end of an extensible hydraulic ram 18, the opposite end of which is attached to the vehicle forwardly of the rear end of the latter, by pivot 20. The base pivotally supports lateral outriggers which carry traction wheels 22 at their outer ends and which are movable between extended and retracted positions by means of hydraulic rams 24 which interconnect each outrigger and the base 12. The foregoing assembly of base and outriggers is more fully described in the co-pending application of Shannon K. Clements, entitled "Portable Boom Support Attachment for Vehicles," Serial No. 487,268 filed February 10, 1955, and now Patent No. 2,864,625, December 16, 1958.

Mounted on the hollow base 12 through a top opening in the latter is a hollow turntable housing (FIG. 2) which includes a lower cylindrical section 26 which extends freely through the vertical bushing 28 mounted in the base, and an enlarged upper cylindrical section 30 adapted to removably contain a rotary hydraulic motor 32. The shoulder 34 formed between stepped segments of the lower section 26 rests slidably upon the upper end of the bushing for rotation relative thereto.

The hydraulic motor 32 is supported from a plate 36 which is removably secured to the top end of the housing, as by means of bolts 38, thereby facilitating the assembly and disassembly of the motor with respect to the housing. The hydraulic motor includes a rotary shaft 40 which extends downward therefrom for positive connection to the base. For this purpose, it is preferred that the shaft be of square or other non-circular cross section adapted to seat in a similarly shaped socket 42 at one end of a shaft extension 44, the opposite end 46 of which is provided with a square or other non-circular cross section for reception within the socket 48. Thus, by actuation of the hydraulic motor, the latter is caused to rotate relative to its driven shaft, thus causing simultaneous rotation of the housing.

Extending upward from the housing section 30 are a pair of laterally spaced brackets 50 interconnected by a transverse plate 52. The upper ends of the brackets are adapted to pivotally support the lower boom 54. As best shown in FIGS. 2 and 7, this lower boom is formed of pressed steel, suitably of about $\frac{3}{16}$ inch thickness, and is of substantially trapezoidal shape in side view and rectangular in cross section. The spaced sides are interconnected by a top panel, and the lower portions of the sides are bent inward and upward to form a pair of channels 56 in which to support hydraulic lines and the like. These channels also serve to reinforce the longitudinal dimension of the boom. The top panel of the boom preferably is provided with a plurality of longitudinally spaced large openings 58 which function not only to minimize the

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weight of the boom but also to provide access to the interior of the boom for maintenance and repair of the components carried therein. Transverse bearings are provided at the ends of the boom, adjacent the longer dimension. The inner of these ends is positioned between the upstanding brackets 50 with the bearings aligned with openings in the brackets to receive the pivot shaft 60 therethrough.

The elongated cylinder 62 of a hydraulic ram is pivotally connected at one end, by pivot pin 64 to a pair of spaced ears 66 projecting from the housing section 30, and the projecting end of the piston rod 68 of the ram is pivotally connected by means of pivot pin 70 to a pair of spaced ears 72 projecting from the boom 54. The ears 72 preferably are provided as an integral part of a reinforcing bracket which is described in detail hereinafter.

The transverse bearing provided at the outer end of the lower boom is adapted to pivotally connect the upper boom 74. This boom also is made of pressed steel, shaped to substantially rectangular cross section and preferably tapering outwardly to smaller dimension. As in the construction of the lower boom, the sides of the upper boom are bent inward to form the spaced channels 76 (FIG. 5) and the top plate of the upper boom is provided with a plurality of large access openings 78. The inner end of the outer boom is provided with an internal reinforcing structural nacelle 80 mounted within the end of the boom and secured thereto by such means as welding along abutting edges. This nacelle carrier at its outer end a pair of spaced bearings 82 adapted to straddle the bearings at the outer end of the lower boom and to be aligned therewith for reception of the pivot shaft 84. The inner end of the nacelle also is provided with a pair of spaced bearings 86 adapted to receive the pin 88 which pivotally secures the projecting end of the piston rod 90 associated with the elongated cylinder 92 of a second hydraulic ram. The opposite end of the cylinder 92 is pivotally connected, by pivot pin 94 to ears 96 projecting from the top plate of the lower boom 54.

Each of the pair of ears 72 and 96 preferably are formed integrally with a reinforcing bracket 98 and 100, respectively, which, as shown in FIGS. 6 and 7, is substantially triangular in shape, with the ears projecting from the plate which interconnects the spaced side plates. The ears 72 extend through the central opening between the spaced channels 56, while the ears 94 project through slots provided in the top plate of the lower boom. In each case the bracket is secured to the boom as by welding along abutting or adjacent edges.

By the foregoing construction, it will be apparent that the major forces applied to the lower and upper booms are transmitted to the nacelle 78 and to the brackets 98 and 100, thereby permitting the boom to be constructed of minimum cross sectional dimension and weight.

The forward end of the upper boom (FIG. 3) is bifurcated and provided with laterally spaced bearings adapted to receive the shaft 102 rotatably therein. The projecting ends of the shaft extend through apertured brackets 104 projecting from the base platform 106 of a personnel station, whereby to pivotally support the latter on the shaft. In the embodiment illustrated in FIG. 3, the personnel station includes corner uprights 108 pivotally supported at their lower ends on the platform and pivotally interconnected at their upper ends by the guard frame 110. Since the pivotal connections at the bottom and top ends of the uprights extend parallel to the shaft 102, it will be apparent that the uprights are collapsible rearwardly to rest upon the upper boom when not in use. Lengths of chain 112 releasably interconnect the rearward uprights with the platform, to maintain the uprights in extended position.

Means is provided for maintaining the personnel platform in leveled position automatically as the boom assembly is manipulated. In the preferred embodiment

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illustrated, the leveling system includes a pulley 114 mounted rotatably on the shaft 102 between the spaced ends of the bifurcated outer end of the upper boom. The brackets 104 are apertured forwardly of shaft 102, to receive the locking pin 116 therethrough. The locking pin also is adapted to extend through one or the other of two transverse openings 118 or 120 in the pulley 114, for securing the platform and pulley together in either of two positions. Thus, in FIG. 3 of the drawings the collapsible personnel station is shown with its platform 106 secured to the pulley in operative position, with locking pin 116 extending through pulley opening 118. Since the uprights are collapsible, the platform may be retained in this connected position with the pulley. However, when the personnel station is not collapsible, as when it is made of Fiberglas, in the form of a rigid basket, it may be desirable to pivot the platform downwardly, about 90°, for transport. This is accomplished by removing the pin 116 from the position illustrated in FIG. 3, rotating the basket downwardly until the openings in the bracket 104 align with the other opening 120 in the pulley, and replacing the locking pin.

The periphery of the pulley is provided with a circumferential guide groove, provided by laterally spaced radial projecting ribs 122. These ribs are interrupted circumferentially at opposite ends, as illustrated, for purposes of anchoring the terminal ends of leveling cables, as follows: Projecting from one face of the pulley 114 is an anchoring lug 124 adapted to receive the looped end of a cable 126. In the embodiment illustrated this loop is provided by doubling the cable, although it will be understood that the loop may be formed in the end of a single cable. The doubled cable is preferred for the safety factor which it provides. The double length of cable then extends around the terminal end of the rib 122 and thence is reaved along the upper portion of the guide groove, rearwardly under an idler pulley 128 mounted within the upper boom adjacent the forward end, thence through the length of the hollow upper boom, over the rear idler pulley 130 (FIG. 2) mounted within the rearward end of the upper boom, thence around the hinge pulley 132 mounted upon the shaft 84 which pivotally interconnects the upper and lower booms, thence under the idler pulley 134 mounted within the forward end of the lower boom, rearwardly through the length of the lower boom and under the idler pulley 136 mounted adjacent the rearward end of the lower boom, thence under the segment pulley 138 and about the anchoring lugs 140 on the side faces thereof and downwardly to the anchor 142 on the housing. The segment pulley 138 is mounted freely on shaft 60 but is secured against rotation by attachment to the housing wall 52.

A counter-leveling cable 144 also is provided to prevent accidental overturning of the platform 106 in the direction opposite normal load moments, and to this end the looped end of the cable 146 is secured to the anchoring lug 148 projecting from the side face of the forward pulley 114, and the cable drawn around the terminal end of the segment flange 122 and reaved along the under portion of the pulley guide groove, thence over the idler pulleys 128 and 130, but not around the hinge pulley 132, but rather directly under the idler pulleys 134 and 136, and over the segment pulley 138 for anchoring to the housing anchor 142.

Thus, as the lower boom 54 is rotated, for example clockwise about its pivot 60 in FIG. 2, the leveling cables 126 are wrapped about the segment pulley 138, thereby tensioning the cables and causing counterclockwise rotation of the station pulley 114 to the extent which automatically maintains the station platform 106 level. Concurrently with such clockwise rotation of the lower boom, the safety cable 146 is unwound from the segment pulley 138, thereby slackening the cable and permitting the counterclockwise rotation of the station pulley 114.

Similarly, as the upper boom 74 is rotated, for example in the counterclockwise direction about its pivot 84, the idler pulley 130 also is rotated counterclockwise, thereby unwinding the leveling cables from the hinge pulley 132. The slack thus developed in the cable permits proportionate clockwise rotation of the station pulley 114 to maintain the station platform 106 level. During such counterclockwise rotation of the upper boom, the idler pulleys 130 and 134 are moved apart, thereby tensioning the safety cable 146 and causing proportionate clockwise rotation of the station pulley 114.

Controlled movement of the booms is effected by one or more sets of hydraulic valves in the hydraulic supply lines of the turntable motor 32 and the rams 62 and 92. In the embodiment illustrated, there is provided a set of three valves 150, 152 and 154 adjacent the lower end of the lower boom (illustrated only in FIG. 8), each valve being operable selectively by a hand lever. An additional set of valves 150', 152' and 154' also is provided at the personnel station to afford complete control of movement of the latter by an operator located in the work station. Operation of these valves preferably is controlled by a single actuator of the type disclosed in my co-pending application entitled "Single Actuator for a Plurality of Control Devices," Serial No. 590,551, filed June 11, 1956, and now Patent No. 2,877,660.

Referring now to FIG. 8 of the drawings wherein is shown a schematic diagram of the hydraulic system for the boom assembly described hereinbefore, hydraulic fluid is drawn from the supply contained in the hollow base 12, preferably through a filter 156, to the hydraulic pump 158 from which the fluid under pressure is directed through a relief valve 160 and thence to the various control valves and hydraulic motors. For example, it is directed through conduit 162 to any one of the control valves 150', 152' and 154' located at the work station and, alternatively, through conduit 164 to any one of the control valves 150, 152 and 154 located adjacent the lower end of the lower boom. Control valves 150 and 150' are associated with the turntable motor 32, control valves 152 and 152' with the hydraulic ram 62 interconnecting the turntable and the lower boom, and control valves 154 and 154' with the hydraulic ram 92 interconnecting the lower boom and the upper boom. The return for the hydraulic fluid to the reservoir 12 is through conduits 166.

Hydraulic fluid under pressure also is directed from the relief valve 160 through the conduit 162 to the control valve 168 for the hydraulic leveling ram 18. Additional shut-off valves 170, 172 may be employed if desired. The return of hydraulic fluid is through conduit 174.

Similarly, hydraulic fluid pressure is directed from the relief valve 160 through the conduit 162 and the main control valve 176 selectively to opposite ends of the hydraulic rams 24 for the outriggers, the return of hydraulic fluid being through conduit 174 to the reservoir 12. It is preferred that individual shut-off valves 178, 180 also be provided for each of the rams for selectively regulating the degree of extension of each ram, to accommodate adjustment of the outriggers independently of each other, and thus enable leveling of the turntable in the transverse direction of the attached vehicle, when the outriggers are supported upon an inclined or otherwise irregular surface.

Referring now particularly to FIGS. 1 and 9 of the drawings, it is to be noted that means is provided by which the upper boom may be utilized as an elongated scaffold. Mounted upon the upper surface of the boom 74 is an elongated framework comprising the laterally spaced longitudinal members 190 and the longitudinally spaced transverse members 192, secured together as by welding and secured to the upper boom as by means of the angle brackets 194. Supported upon this framework is an elongated strip 196 of expanded metal or other suit-

able material forming the supporting base of a catwalk.

A pair of spaced brackets 198 project upwardly from opposite sides of each of the longitudinal members 190, adjacent each of the transverse members 192, and function to pivotally support the lower ends of the guard rail posts 200, as by means of the pivot pin 202. These posts are interconnected at their upper ends by lengths of chain 204 and at points intermediate their ends by lengths of chain 206. These chains are positioned alternately on opposite sides of adjacent posts 200, to facilitate collapsing of the assembly, and function as guard rails at opposite sides of the catwalk. The assembly of posts and chains is maintained in upright position by means of the end chains 208 which releasably interconnect the end posts 200 and the boom 74. In the embodiment illustrated these end chains are secured at one of their ends to the upper ends of the end posts 200 and at their lower ends releasably to eye-bolts 210 carried by the boom 74 adjacent the opposite ends thereof. A conventional snap hook 212 may be employed to make this releasable connection.

When not in use, the assembly of guard rail posts and chains may be folded against the catwalk strip 196 simply by disconnecting the end chains 208 at one end of the boom and allowing the posts to swing downward, as indicated in dash lines in FIG. 1. When unfolded, on the other hand, there is provided an elongated catwalk which may be used in the manner of a conventional scaffold. It will be understood that access to the catwalk is provided from the working platform 106. This scaffold is completely adjustable, both horizontally and vertically, by appropriate manipulation of the lower boom 54.

Alternatively, the entire catwalk structure may be rendered removable from the boom. In embodiment illustrated this is achieved by interconnecting the depending ends of the brackets 194 with a strap 214 as by means of the bolts 216. The strap engages and extends across the bottom surface of the boom member and functions to clamp the catwalk assembly to the boom member.

Thus it will appear from the foregoing description that the present invention provides a personnel lift construction of compact design capable of being collapsed to minimum size and yet extensible to substantial distances. The boom construction provides maximum strength to weight ratio for maximum load and safety, and the booms further accommodate the enclosure of hydraulic lines and leveling cables for maximum protection. The boom assembly is operable with maximum facility, and a novel leveling system automatically maintains the work level throughout the range of maneuverability of the assembly. The catwalk structure accommodates several persons simultaneously, thus rendering the device admirably suitable for such uses as in the painting of large areas. Further, by virtue of the efficient maneuverability of the device, the catwalk structure is rendered usable inside of buildings having ceilings of various heights. The articulated arrangement of the boom enables the catwalk to be moved to reach over and under obstructions and to support personnel directly over the vehicle to which the boom assembly is attached. Moreover, these advantages are provided in a simplified construction which affords economical manufacture and requires a minimum of maintenance and repair.

It will be apparent to those skilled in the art that various changes may be made in the details of construction described hereinbefore without departing from the spirit of this invention and the scope of the appended claims.

Having now described my invention and the manner in which the same may be used, what I claim as new and desire to secure by Letters Patent is:

1. In a folding boom assembly, a rotatable support, a lower boom mounted pivotally at its inner end on the support, an upper boom, a reinforcing nacelle mounted within the inner end of the upper boom and integral there-

with, first and second pivot means on the nacelle, the first pivot means interconnecting the nacelle and the outer end of the lower boom, reinforcing bracket means mounted within the lower boom intermediate the ends of the latter, a pair of pivot means on the bracket means projecting outwardly through the lower boom in opposite directions, first extensible power means pivotally interconnecting the support and one of the projecting pivot means, and second extensible power means pivotally interconnecting the other projecting pivot means and the second pivot means on the nacelle.

2. A folding boom assembly, comprising a rotatable support, a lower boom mounted pivotally at its inner end on the support, an upper boom, each boom being constructed of pressed metal and bent to form spaced sides and an interconnecting section joined to the sides along one edge of the latter, the opposite edges of the sides being bent inwardly and thence toward the interconnecting section to provide laterally spaced reinforcing channels, a reinforcing nacelle mounted within the inner end of the upper boom and integral therewith, first and second pivot means on the nacelle, the first pivot means interconnecting the nacelle and the outer end of the lower boom, reinforcing bracket means mounted within the lower boom intermediate the ends of the latter, a pair of pivot means on the bracket means projecting outwardly through the lower boom in opposite directions, first extensible power means pivotally interconnecting the support and one of the projecting pivot means, second extensible power means pivotally interconnecting the other projecting pivot means and the second pivot means on the nacelle, a transverse shaft on the outer end of the upper boom, a personnel station mounted pivotally on the shaft and comprising a longitudinal extension of the upper boom, first pulley means rotatably mounted on the shaft, means securing the personnel station to the first pulley means for rotation therewith, second pulley means mounted at the pivot between the lower and upper booms, third pulley means secured to the support, and cable means reaved over said pulley means and operatively connected to the support, whereby to maintain the station level automatically during pivoting of the booms.

3. A folding boom assembly, comprising a base, an upright hollow support rotatably mounted on the base, hydraulic rotary motor means enclosed within and secured fixedly to the support on the axis thereof and having a shaft, means connecting the shaft to the base, a lower boom mounted pivotally at its inner end on the support, an upper boom, each boom being constructed of pressed metal and bent to form spaced sides and an interconnecting section joined to the sides along one edge of the latter, the opposite edges of the sides being bent inwardly and thence toward the interconnected section to provide laterally spaced reinforcing channels, a reinforcing nacelle mounted within the inner end of the upper boom and integral therewith, first and second pivot means on the nacelle, the first pivot means interconnecting the nacelle and the outer end of the lower boom, reinforcing bracket means mounted within the lower boom intermediate the ends of the latter, a pair of pivot means on the bracket means projecting outwardly through the lower boom in opposite directions, first extensible hydraulic power means pivotally interconnecting the support and one of the projecting pivot means, second extensible hydraulic power means pivotally interconnecting the other projecting pivot means and the second pivot means on the nacelle, a transverse shaft on the outer end of the upper boom, a personnel station mounted pivotally on the shaft and comprising a longitudinal extension of the upper

boom, first pulley means mounted on the shaft, means securing the personnel station to the second pulley means for rotation therewith, second pulley means mounted at the pivot between the lower and upper booms, third pulley means secured to the support, and cable means reaved over said pulley means and operatively connected to the support, whereby to maintain the station level automatically during pivoting of the booms.

4. A folding boom assembly, comprising a rotatable support, a lower boom mounted pivotally at its inner end on the support, an upper boom, a reinforcing nacelle mounted within the inner end of the upper boom and integral therewith, first and second pivot means on the nacelle, the first pivot means interconnecting the nacelle and the outer end of the lower boom, reinforcing bracket means mounted within the lower boom intermediate the ends of the latter, a pair of pivot means on the bracket means projecting outwardly through the lower boom in opposite directions, first extensible power means pivotally interconnecting the support and one of the projecting pivot means, second extensible power means pivotally interconnecting the other projecting pivot means and the second pivot means on the nacelle, the pivoted upper boom being capable of adjustment to a substantially horizontal position, a folding catwalk assembly supported along the length of the upper boom and comprising an elongated base, and folding guard rail means extending along the lateral sides of the base.

5. A folding boom assembly, comprising a base, a rotatable support mounted on the base, a lower boom mounted pivotally at its inner end on the support, an upper boom connected pivotally at its inner end to the outer end of the lower boom, first power means interconnecting the inner boom and support for pivoting the inner boom, second power means interconnecting the upper boom and inner boom for pivoting the upper boom, the upper boom being capable of adjustment to a substantially horizontal position, a personnel station supported on the outer end of the upper boom, an elongated catwalk base mounted detachably on the upper boom and extending rearwardly from adjacent the personnel station for access from the latter, guard rail means extending along the lateral sides of the catwalk base and mounted pivotally thereon for adjustment between an upright operative position and a folded position substantially against the catwalk base, and anchor means releasably interconnecting the catwalk base and guard rail means for securing the latter in operative position.

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