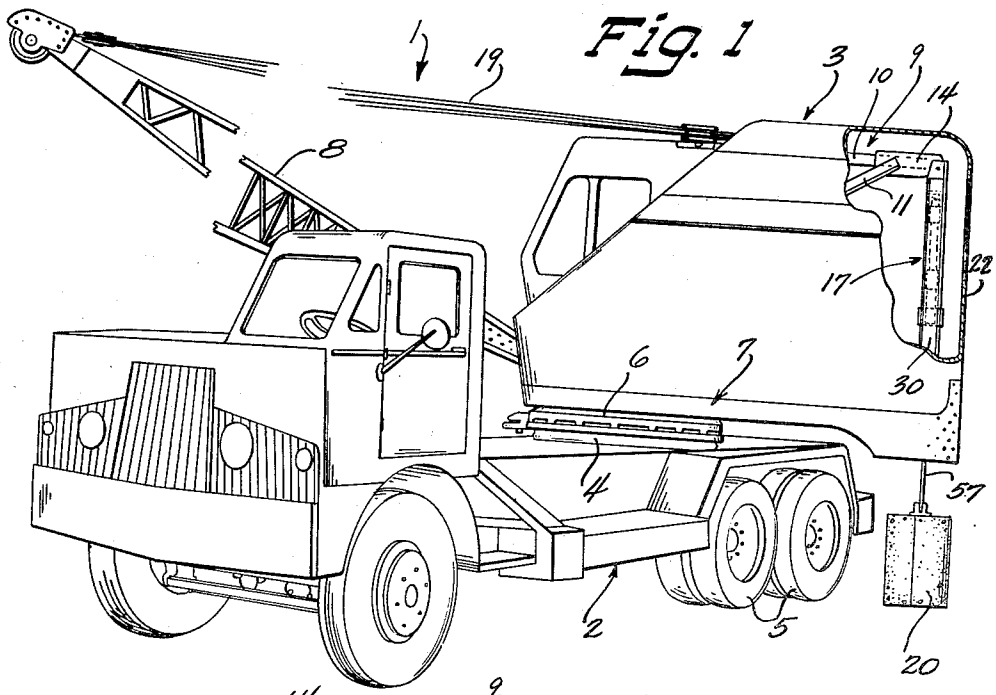
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REMOVABLE COUNTERWEIGHT FOR TRUCK CRANES

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2 Sheets-Sheet 1

Fig. 1



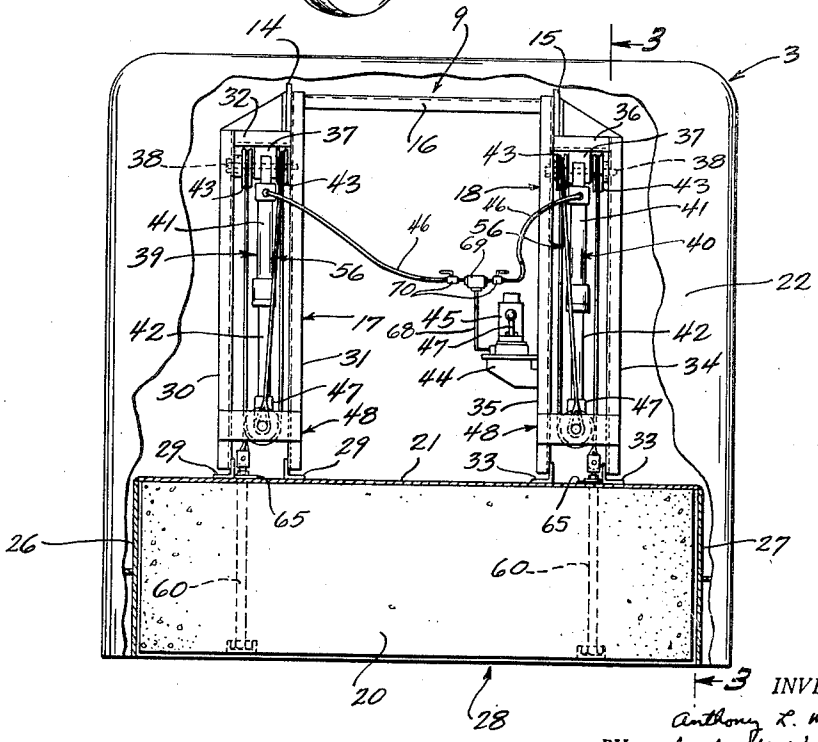


Fig. 2

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2 Sheets-Sheet 2

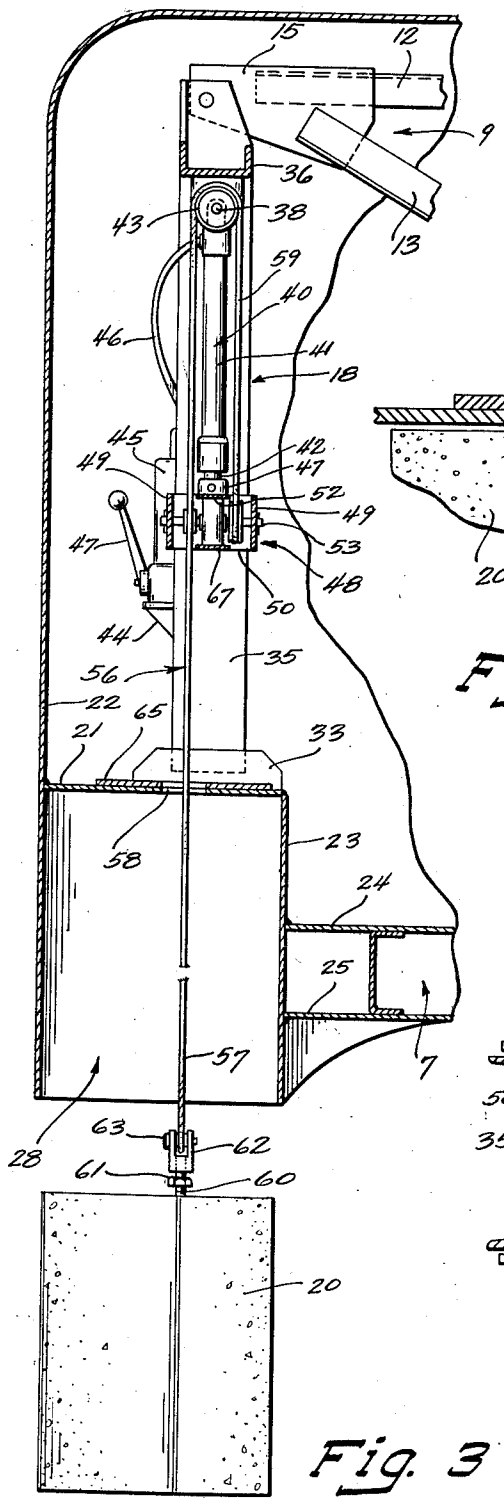


Fig. 3

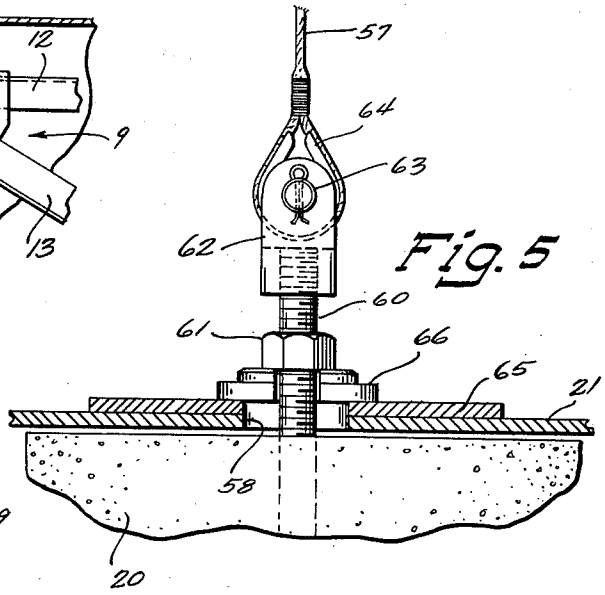


Fig. 5

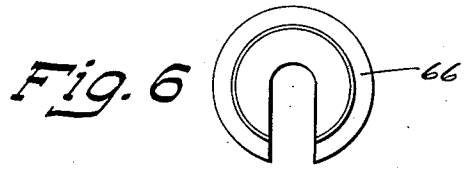


Fig. 6

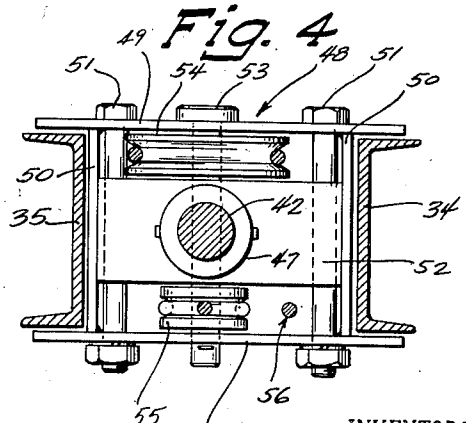


Fig. 4

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Patented Apr. 6, 1954

2,674,378

UNITED STATES PATENT OFFICE

2,674,378

REMOVABLE COUNTERWEIGHT FOR TRUCK CRANES

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Application December 10, 1951, Serial No. 260,838

6 Claims. (Cl. 212—49)

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This invention relates to revolving truck cranes and similar apparatus having booms with sufficient reach to require substantial counterweight and it more specifically resides in an apparatus of this class having a mobile undercarriage upon which is mounted a rotatable platform deck that carries a boom at one end thereof, a gantry frame and machinery for support and manipulation of the boom, together with a removable counterweight received beneath the platform deck at the end thereof opposite the end to which the boom is attached, which counterweight overhangs the undercarriage upon rotation of the platform to a desired predetermined position to permit free uninterrupted vertical descent and ascent of the counterweight to and from the ground and working position, and which platform carries hoist and hoist line means attachable to the counterweight to impart guided vertical movement thereto.

Booms of considerable length and of substantial load capacities are often employed in cranes and similar apparatus mounted on automotive vehicles or other mobile instrumentalities so as to be adapted for transport over paved highways. In such cranes moments resulting from boom loads reach such values as to give rise to a need for large counterweights.

To effect a partial counterbalance it is feasible to mount much of the machinery, carried by the cab, well to the rear of the cab platform. This is seldom sufficient and additional counterweights of considerable mass must be added to the crane cab at the end opposite that to which the boom is mounted. The total weight of larger cranes then reaches such values as to exceed wheel loadings permitted by highway authorities. To remedy this undesirable result, removable counterweights which may be transported in separate vehicles have been employed so that the overall weight of the equipment may be reduced for the purposes of over the road transport.

It is an object of this invention to provide a removable counterweight for cranes and the like that may be removed, reinstalled and loaded and unloaded to and from separate vehicles with a minimum of difficulty.

It is another object of this invention to provide for a means of removal and reinstallation of a counterweight in which the movement of the counterweight from and to installed position is substantially vertical.

It is another object of this invention to provide hoisting apparatus for use in conjunction with a removable counterweight that transmits the load of the counterweight during removal and

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reinstallation to gantry members that serve as well as anchorage means for the boom stays.

These and other objects and advantages of this invention will appear in the description to follow. In the description reference is made to the accompanying drawings forming a part thereof in which there is shown by way of illustration and not of limitation one specific embodiment in which this invention may be practiced.

In the drawings:

Fig. 1 is a view in perspective with parts broken away of an instance of a truck crane in which this invention may be embodied and in which the cab of the crane is shown rotated to the counterweight manipulating position,

Fig. 2 is a rear view in elevation with parts broken away and in section of the crane cab shown in Fig. 1 with the counterweight raised to working position,

Fig. 3 is a fragmentary side view in elevation and in section of the rear portion of the crane cab shown in Figs. 1 and 2 viewed through the plane 3—3 in Fig. 2 and with the counterweight in lowered position,

Fig. 4 is a top view of one of the guide assemblies carried by the piston rams of the hydraulic hoists shown in Figs. 1, 2 and 3,

Fig. 5 is a fragmentary side view in elevation of means for securing the counterweight in raised position, and

Fig. 6 is a top plan view of a counterweight suspending collar that forms part of the means for securing the counterweight in working position.

Referring now to the drawings, there is shown in Fig. 1, a truck crane 1 consisting of a truck chassis 2 that acts as a mobile undercarriage upon which is mounted a fully revolvable cab 3 that may be swung to any angle with respect to the truck chassis 2. The swinging mounting of the cab 3 is provided by a roller track 4 secured to the truck chassis 2 in a position above the axles of the rear wheels 5. Above the roller track 4 in supporting relation to the cab 3 is a roller assembly 6. A machinery platform or deck 7 forming the base of the cab 3 is mounted directly upon the roller assembly 6 to provide a support for the machinery and structural elements that comprise the cab 3.

Extending from the forward end of the cab 3 is an inclined boom 8, pivotally mounted at its lower inner end on the machinery platform 7. A gantry or A frame 9 is secured to and extends upwardly from the machinery platform 7 in known manner, the shell of the cab 3 being shown broken away in Figs. 1, 2 and 3 to expose

portions of the frame 9. Thus, in Fig. 1 the rearward portions of a tension member 10 and a compression member 11 that form a part of frame 9 appear and in Fig. 3 there are shown like portions of a pair of corresponding members 12 and 13. The members 10 and 11 are each secured to a gusset plate 14 and the members 12 and 13 are likewise each secured to a gusset plate 15.

Extending between the plates 14 and 15 is a horizontal cross brace 16 that is shown in Fig. 2 and extending downwardly from each of the plates 14 and 15 to an attachment with the platform 7 is a pair of vertical tension members, generally designated by the reference numerals 17 and 18. The vertical members 17 and 18 serve not only as members of frame 9 but are adapted to fulfill an additional function which will be more particularly hereinafter described. To complete the supporting structure for the boom 8, a boom stay in the form of a multiple reaved boom hoist line 19 joins the outer end of the boom 8 with the A frame 9, the line 19 being adapted to be hauled in and payed out so as to elevate and depress the boom as is desired.

Referring now more specifically to Figs. 2 and 3, it will appear that a horizontal elevated deck plate 21 extends nearly across the entire width of the cab 3 and runs forwardly from the rear outer shell 22 of the cab 3 to an attachment with a vertical plate 23 secured to two horizontal plates 24 and 25 of the deck proper of platform 7. A pair of vertical end plates 26 and 27, welded at the ends of the horizontal deck plate 21, complete an open bottomed counterweight housing 28 that is adapted to receive a counterweight 20. The counterweight housing 28 forms a part of the rear of the machinery platform 7 to which the members 17 and 18 that form a portion of the A frame 9 are secured by means of angle braces 29—29, 33—33.

As appears more clearly in Figs. 2 and 4 the vertical member 17 is made up of an outwardly facing channel member 30 and an inwardly facing channel member 31 that are spaced from one another to form a shaft. A brace 32 spaces the channels 30, 31 near the top thereof and the channel 31 extends above the brace 32 to connect to the gusset 14. In similar fashion member 18 is formed of an outwardly facing channel member 34 and an inwardly facing channel member 35 that are spaced to form a similar shaft. An upper cross brace 36 spaces the channels 34, 35 from one another and the channel 35 extends upward to connect to the gusset 15.

Secured to the underside of each of the cross braces 32 and 36 is one of a pair of hoist support brackets 37. Passing horizontally through the brackets 37 and the respective vertical channel members 30, 31 and 34, 35 that flank the brackets 37 are a pair of mounting pins 38 that carry downwardly hanging reciprocating hydraulic hoist motors 39 and 40. The left side hoist motor 39, as viewed in Fig. 2 is disposed in the shaft between the spaced channels 30, 31 and the right hand hoist motor 40 is disposed in like manner in the shaft between the channels 34, 35. Forming the body of each of the hoists 39, 40 is a cylinder 41 that is pivotally fastened at its upper end to the respective pin 38 and carried in each cylinder 41 is a piston ram 42 that may be extended downwardly and retracted upwardly with respect to its associated cylinder 41. Also carried upon the pins 38 are sets of loosely mounted freely rotatable sheaves 43 which serve as hoist line reaving guides.

A hydraulic actuating system, for the operation of the hydraulic hoist motors 39, 40 includes a control unit 45 containing a pump and sump for hydraulic fluid, which is mounted on a shelf 44 secured to vertical channel 35. An inlet-outlet pipe 68 extends from the base of the unit 45 and terminates in a T connection 69 at its opposite end. Joined to the connection 69 are a pair of independently operable control valves 70 that provide for a control of the fluid flow in hydraulic fluid lines 46 that lead from each of the valves 70 to the upper head of each of the cylinders 41. A control lever 47 on the control unit 45 is movable to a position in which fluid is forced by pump action into the cylinders 41 to force the piston rams 42 downwardly in unison, movable into another position in which fluid is locked in the cylinders 41, and movable to a position in which fluid is permitted to flow in a reverse direction into the sump at a controlled rate of flow. In event that it is desired not to move the rams 42 in unison the appropriate valve 70 may be closed and operation of the lever 47 will affect movement of the chosen ram 42.

Secured to the lower end of each piston ram 42 is a collar 47 which bears against and is rigidly joined to a vertical travel guide assembly, generally designated by the numeral 48, as appears more clearly in Figs. 3 and 4. As shown therein the assemblies 48 are made up of a pair of side plates 49 that extend between and overlap a portion of the channel members 34, 35, the plates 49 being spaced from one another by a pair of end plates 50 and a pair of through bolts 51. A top plate 52 through which the piston ram 42 passes and a bottom plate 67, shown in Fig. 3, that abuts the bottom end of the ram 42 extend between the end plates 50 to complete a box like frame for the guide assembly 48. Carried by the frame of the assembly 48 is a horizontally disposed pin 53 that extends through the side plates 49 and the piston ram 42. Mounted on the pin 53 so as to rotate freely is a sheave 54 disposed alongside one of the side plates 49 and near the opposite plate 49 the pin 53 carries a becket thimble 55.

Each of the thimbles 55 serves to anchor an end of one of a pair of hoist lines 56 to a respective guide assembly 48, one of which hoist lines 56 is associated with the left hand hoist and reaving sheaves 43 carried by the vertical tension member 17, and the other of which hoist lines 56 is associated with the right hand hoist and reaving sheaves 43 carried by the member 18. Each hoist line 56 extends upwardly from its respective thimble 55 toward the upper sheave set and thence over a sheave 43 and downwardly toward the respective guide member 48 to pass about the respective sheave 54 and again upwardly. The lines 56 then pass about the remaining upper sheave 43 and drop downwardly to terminate in live end portions 57 that are in alignment with openings 58 in the deck plates 21. The openings 58 permit the live end portions 57 to pass into and through the counterweight housing 28 as the hoist lines 56 are paid out or drawn in in response to hoist action. That portion of each of the hoisting lines 56 that extends between and passes over the associated sheaves 43, 54 to the thimble 55 may be termed a windlass portion 59. The number of parts of hoist line that comprise the windlass portion 59 determine the mechanical advantage and the distance of ascent or descent of the live end por-

tion 57 for a given movement of the associated piston ram 42. As a piston ram 42 is extended outwardly from its associated cylinder 56 the guide member 48 carried at the end thereof is slideably guided by the vertical channels between which it is embraced and the live end 57 is drawn upwardly. A reversed motion of the ram 42 shortens line stored in the windlass portion 59 and the live end portion 57 is payed out.

A counterweight 20, formed in any convenient manner, preferably as a single continuous mass is provided of such size and configuration as to be received within the open bottomed housing 28 when lifted to raised position as shown in Fig. 2. Embedded within and extending vertically through and above the counterweight 20 are a pair of lifting rods 60 spaced to align with the live end portions 57 of the hoist lines 56 and with the openings 58 in the deck plate 21 through which the lines 56 may be extended. Mounted on each of the upward extensions of the rods 60 is one of a pair of counterweight suspending nuts 61 that are in free threaded engagement with the rods 60 so as to admit vertical adjustment. Threadingly secured to the top of each of the rods 60 is one of a pair of shackles 62 provided with removable pins 63—63 which pass through the clevis portions thereof. The pins 63 of the shackles 62 engage thimbles 63 in eyes 64 formed at the live ends 57 of the respective hoist lines 56. By removal and insertion of the pins 63 the counterweight 20 may be detached from and attached to the hoisting apparatus.

Fastened securely to the deck plate 21 are a pair of reinforcing brace plates 65 that cover the areas of the deck plate 21 in the close vicinity of the two openings 58 which pass through not only the deck plate 21 but the respective reinforcing plates 65 as well. Adapted to be placed atop the two reinforcing plates 65 are a pair of slotted collars 66 of a configuration as shown in Figs. 5 and 6. The base diameter of the collars 66 is greater than that of the openings 58 and by placing the collars 66 each over an opening 58 with the slots thereof receiving the respective rods 60 that have been passed upwardly through the respective openings 58 the openings are blocked so as to prevent downward movement of the nuts 61. In this way the counterweight 20 may be supported not by the hoisting apparatus but by the deck plate 21 that forms a portion of the machinery platform 7.

Thus the counterweight 20 may be secured within the housing 28 during the periods of crane operation, with the weight being borne on the nuts 61 and the collars 66 as shown in Fig. 5. The hydraulic hoist apparatus in this condition is not required to suspend the weight 20. By turning the nuts 61 downward the counterweight 20 may be raised until the top thereof abuts the underside of the deck plate 21 eliminating looseness, as shown in Fig. 2.

To lower the counterweight 20 the cab 3 is rotated to such a position with respect to the truck chassis 2 that the housing 28 and the weight 20 overhang beyond the chassis 2. One such position is shown in Fig. 1 wherein the counterweight 20 is shown lowered below the housing 28.

With such an overhang it becomes possible to raise and lower the counterweight 20 with a direct vertical movement between the working position and a lowered position on the pavement. Sliding friction such as is encountered in the use of supporting rods and rails employed for horizontal movements of the weight is eliminated and handling of the weight may be accomplished with ease.

In lowering the weight 20, after the rotation of the cab 3 to an overhanging position, the nuts 61 are first turned to raise them thus transferring the counterweight load to the hoist lines 56. The collars 66 are then removed from the openings 58 and by operation of the hydraulic system the piston rams 42 are contracted to within the hoist cylinders 41 to effect a paying out of the windlass portions 59 of the hoist lines 56. The live ends 57 of the hoist lines 56 are thus extended and the weight 20 will emerge from the housing 28 and will be lowered to the pavement. By unshackling the removable pins 63 from the thimbles 64 the weight is freed of the hoist apparatus and may be dealt with as a unit separate from the truck crane 1 usually with the aid of the crane boom itself.

As the weight 20 is raised and lowered by the hoist lines 56 the load is supported by the vertical members 17 and 18 acting in compression. The channels 30, 31 and 34, 35 of the members 17 and 18 are preferably prestressed under a tension during assembly of the A frame 9 prior to placing of load thereon. In this way working distortion of the cantilever truss that is formed by the platform 7 and the A frame members leading forwardly from the upper ends of the members 17, 18 is minimized. When it is desired to raise or lower the counterweight 20 the boom 8 is not loaded and the stress on the members 17, 18 imposed by the boom 8 is relatively small. Therefore, the vertical members 17, 18 are not then impaired in their capacity to sustain the loading imposed thereon by the hoisting of the counterweight 20.

We claim:

1. In an apparatus of the class described an automotive chassis, a rotatable machinery platform mounted upon said chassis including a counterweight supporting portion at one end having a gap adapted to pass a hoist line therethrough, a counterweight shaped to be received in working position beneath said supporting portion of said platform for uninterrupted vertical descent therefrom upon rotation of said platform to a predetermined position, hoisting means carried by said platform including a hoist line guide disposed above the gap in said supporting portion of said platform, a counterweight hoist line having a live end adapted to be drawn in and payed out by said hoisting means extending downwardly from said hoist line guide for passage through said gap in said supporting portion of said platform, connecting means for joining the live end of said hoist line to said counterweight having a flange spaced upwardly from said counterweight of dimension to pass through said gap, and a collar having a dimension greater than that of said gap being adapted to be positioned over said gap to rest upon said supporting portion of said platform and beneath said flange to block passage of said flange through said gap.

2. In an apparatus of the class described an automotive chassis, a rotatable machinery platform mounted upon said chassis, an open bottomed counterweight housing at one end of said platform forming a part thereof and having a counterweight supporting portion, a counterweight shaped to be received in working position by said housing, said counterweight when in working position overhanging said chassis for uninterrupted vertical descent upon rotation of said

platform to an overhanging position, hoisting means carried by said platform including a pair of hoist line guides disposed above said counterweight housing, a pair of counterweight hoist lines each joined to and adapted to be drawn in and payed out by said hoisting means, each of said hoisting lines extending respectively downwardly from one of said respective hoist line guides to a vertically moveable live end for connection with said counterweight, a pair of connecting means for joining the live ends of said hoist lines to said counterweight each including a sidewardly extending flange spaced above said counterweight supporting portion of said housing when said counterweight is received in working position by said housing, and a removable collar means adapted to rest upon said supporting portion and beneath said flanges to block descent of said flanges and connecting means for supporting said counterweight in working position.

3. In an apparatus of the class described an automotive chassis, a rotatable machinery platform mounted on said chassis, a tiltable boom mounted at one end of said platform, a boom supporting gantry rising from and carried by said platform including a pair of normally tensioned vertical members secured at the end of said platform opposite the end to which said boom is mounted, a counterweight shaped to be received in working position beneath said platform and below said vertical members adapted to be raised to and lowered from working position, hoist means carried by said platform, a pair of hoist line reaving guide member sets each respectively including an anchoring member and a vertically moveable guide engaging a respective vertical member for guided ascent and descent joined to said hoist means to be raised and lowered thereby, a pair of counterweight hoist lines each respectively carried by a respective guide member set, each hoist line being secured at one end to the respective anchoring member and extending therefrom between and about the respective reaving guide members to form a windlass portion and leading from said windlass portion to a vertically falling live end, a pair of connecting means each for joining the live end of one of said hoist lines to said counterweight and having a threaded shank with a sidewardly extending flange threadedly secured thereto, and a removable collar for each of said connecting means adapted to rest upon said platform and beneath the respective flange to block descent of the flange and associated connecting means to support said counterweight in working position.

4. In an apparatus of the class described a mobile undercarriage, a rotatable machinery platform mounted on said chassis, a tiltable boom mounted at one end of said platform, a boom supporting gantry rising from and carried by said platform including a pair of transversely spaced vertical members secured at the end of said platform opposite the end to which said boom is mounted, a counterweight shaped to be received in working position beneath said platform and below said vertical members adapted to be raised to and lowered from working position, a pair of independently operable hydraulic hoists each joined to the upper extremity of said vertical members and comprising a cylinder and a piston ram extendable and retractable with respect to the cylinder, a set of hoist line reaving guide members for each of said hoists each set including an anchoring member and a vertically moveable guide confined to vertical ascent and descent by slidable engagement with the associated vertical member, said moveable guides being joined to said piston rams of said hydraulic hoists, and a counterweight hoist line for each of said hoists carried by said reaving guide members and each secured at one end to the respective anchoring member and extending therefrom between and about the respective reaving guide members to form a windlass portion and leading from said windlass portion to a vertically falling live end coupled to said counterweight.

5. In a removable counterweight for a crane the combination comprising a machinery platform having a deck plate with an opening therein adapted to pass a hoist line therethrough, a counterweight shaped to be received in working position beneath said platform and below said opening, a hoisting rod fastened to and extending upward from said counterweight adapted to extend through said opening when said counterweight is in working position, a hoist, a hoist line running from said hoist to a detachable connection with said rod adapted to be drawn up and paid out in response to said hoist, a weight suspending nut threadedly secured on said rod and of dimension to pass through said opening, and a collar having a dimension greater than that of said opening, said collar being adapted to be positioned over said opening and beneath said nut to block passage of said nut through said opening.

6. In an apparatus of the class described a mobile undercarriage, a rotatable machinery platform mounted on said chassis, a tiltable boom mounted at one end of said platform, a boom supporting gantry rising from and carried by said platform including a pair of transversely spaced vertical members secured at the end of said platform opposite the end to which said boom is mounted, a counterweight shaped to be received in working position beneath the end of said platform from which said vertical members rise adapted to be raised to and lowered from working position, a pair of hydraulic hoists each joined to one of said vertical members and comprising a cylinder ranged alongside the respective vertical member and a piston ram extendable and retractable therefrom alongside the respective vertical member, a set of hoist line reaving guide members for each of said hoists each set including anchoring means and a vertically movable guide confined to vertical ascent and descent by slidable engagement with the associated vertical member, said guides being joined to said hoists for movement in response to extending or retracting movement of said rams and to guide movement thereof, and a counterweight hoist line for each of said hoists each secured at one end to one of said anchoring means and extending between and about the respective reaving guide members and leading therefrom to a vertically falling live end coupled to said counterweight.

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