May 17, 1966 B. L. LONNGREN 3,251,479

REMOVABLE COUNTERWEIGHT APPARATUS

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Fig. 1

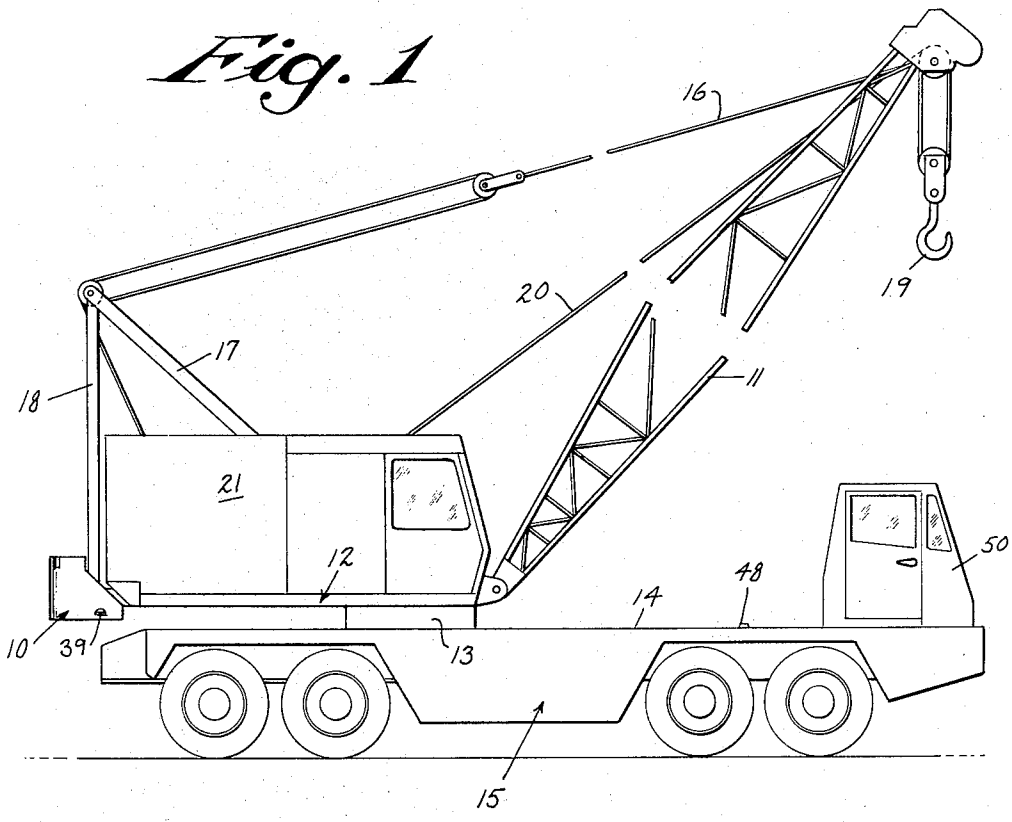
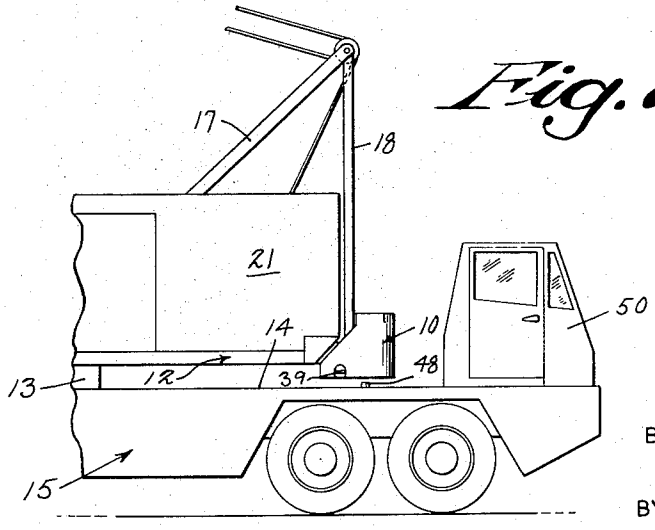


Fig. 2



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Fig. 3

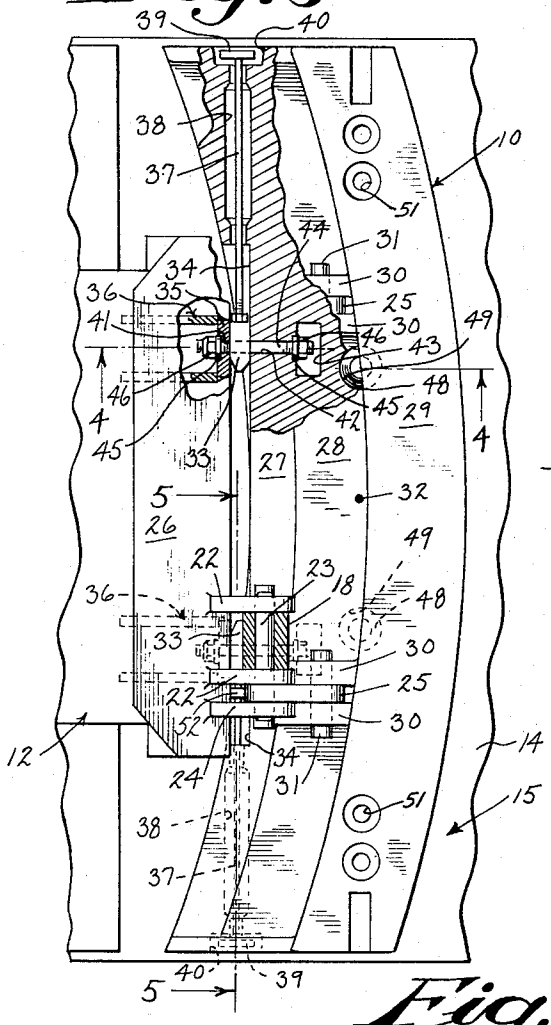


Fig. 4

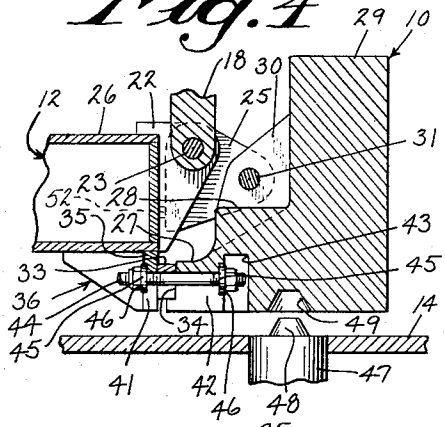


Fig. 6

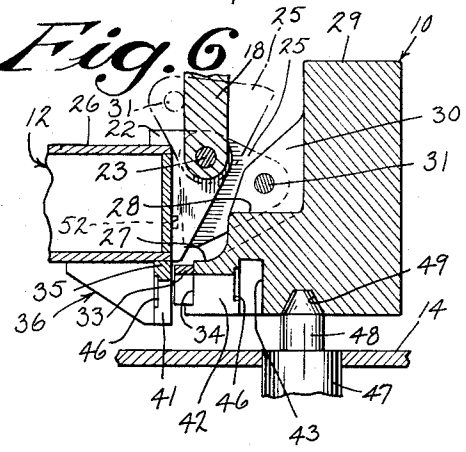
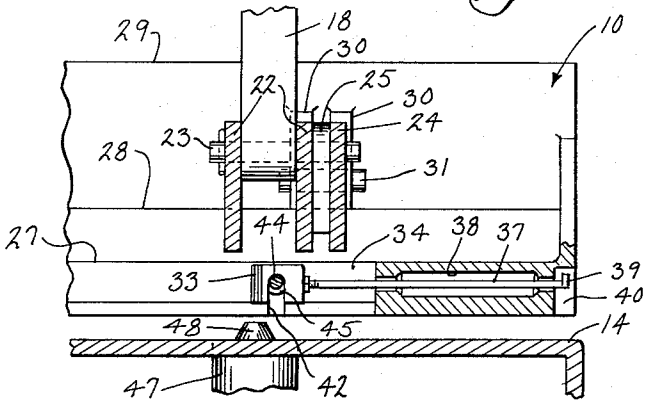


Fig. 5



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REMOVABLE COUNTERWEIGHT APPARATUS

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Filed Feb. 17, 1964, Ser. No. 345,379
9 Claims. (Cl. 212—49)

This invention relates to revolving cranes, excavators, and similar equipment having extending booms which require substantial counterweight, and it more particularly resides in an improved removable counterweight apparatus for such equipment.

The booms and power hoist equipment of excavators, cranes, and the like are often mounted on a mobile undercarriage, such as a pneumatic tired truck chassis, to afford an easily transportable unit. The boom is generally supported at its foot upon one end of a machinery platform which also mounts the power hoist equipment, and such platform is in turn supported on a turntable so that the boom may be rotated through a full circle for reach in any direction relative to the supporting chassis. It is necessary to counterbalance the boom and load carried thereby and this is accomplished in part by placing the power hoist equipment at an opposite end of the machinery platform remote from the boom with the turntable supporting the platform at some intermediate point. This, however, will provide only a partial counterbalancing of the booms with large reaches and it is then necessary to provide massive counterweights which generally are supported at the opposite end of the machinery platform.

The added counterweights will in many instances result in a total weight of equipment which will load the wheels of the truck chassis beyond permissible levels for travel over paved highways. For enhanced mobility of such units it has been the practice to provide for removal of the counterweight to permit the transportation of the removed counterweight on separate trucks. It is most desirable that the counterweight be capable of removal with a minimum of time and effort so that the down time of the equipment occasioned by the removal is small. However, when the crane, excavator, or the like, is in operation the counterweight must be positively supported upon the platform and secured against swinging or swaying. Furthermore, the mobile unit may be the only hoisting equipment available at a particular site so that separate hoisting equipment should not be necessary to remove the counterweight from the track chassis to the separate transportation means provided for the counterweight.

The removable counterweight apparatus of this invention meets the foregoing requirements by providing a removable mounting means which supports the counterweight from the machinery platform and which is normally restrained against removal by the weight of the supported counterweight. Lift means are provided in the supporting chassis to support the counterweight when it is desired to remove the same so that the mounting means is no longer restrained and may be removed to free the counterweight. Means are also provided to retain the counterweight against the platform during operation of the crane so that the counterweight becomes a substantially rigid extension of the machinery platform. When the counterweight is to be removed from the truck chassis, provision is made to permit the platform, and thus the boom, to rotate without interference to position the boom above the freed counterweight whereby the crane itself may be used to remove the counterweight from the chassis.

Accordingly, it is an object of this invention to provide an improved removable counterweight apparatus for a crane, excavator, or similar equipment, which is normally

positively secured to the equipment but which may be readily removed when desired.

It is another object of this invention to provide such a removable counterweight apparatus for a mobile crane, excavator, or the like, which is transferable to an auxiliary transport unit without the aid of auxiliary power hoist equipment.

It is a further object of this invention to provide such a removable counterweight apparatus including a counterweight adapted to be supported on a machinery platform of the crane, excavator, or the like, by removable mounting means normally restrained against removal by the weight of the supported counterweight but which is rendered removable by integral lift means which may support the counterweight to permit removal of the mounting means.

It is also an object of this invention to provide such a removable counterweight apparatus including a counterweight adapted to be mounted on a rotatable machinery platform and which apparatus does not interfere with the rotation of the platform after the counterweight has been removed from the platform.

The foregoing and other objects will appear in the description to follow. In the description, reference is made to the accompanying drawings which form a part hereof and in which there is shown by way of illustration a specific embodiment in which this invention may be practiced. This embodiment will be described in sufficient detail to enable those skilled in the art to practice this invention, but it is to be understood that other embodiments of the invention may be used and that structural changes may be made in the embodiment described without departing from the scope of the invention. Consequently, the following detailed description is not to be taken in a limiting sense; instead, the scope of the present invention is best defined by the appended claims.

In the drawings:

FIG. 1 is a side view in elevation of a mobile truck mounted crane including the removable counterweight apparatus of this invention;

FIG. 2 is a partial side view in elevation of the mobile crane of FIG. 1 with the boom and associated equipment rotated 180° to place the counterweight adjacent the truck cab;

FIG. 3 is a top plan view of the removable counterweight with a portion thereof broken away for clarity;

FIG. 4 is a view in vertical section taken in the plane of the line 4—4 of FIG. 3;

FIG. 5 is a view in vertical section taken in the plane of the line 5—5 of FIG. 3; and

FIG. 6 is a view in vertical section similar to FIG. 4 but illustrating the counterweight in a raised position for its removal.

Referring to FIG. 1, a counterweight **10** is shown associated wtih a truck mounted crane of generally known construction. A boom **11** is pivotally supported at its foot upon one end of a machinery platform **12** mounted on a turntable **13** which in turn is supported on the bed **14** of a truck chasis **15**. The boom **11** is held in a desired oblique position by a boom cable **16** supported by an A-frame comprised of a compression member **17** and a tension member **18** both connected ultimately to the machinery platform **12**. A hook **19** is supported from the free end of the boom **11** by a hoist cable **20**. Power hoist machinery (not shown) of known construction and operation is mounted on the platform **12** and is enclosed by a crane cab **21**. The power hoist machinery is operative to control the cables **16** and **20** to raise and lower the boom **11** or the hook **19** is desired. In a well known manner, the platform **12** is adapted to be rotated on the turntable **13** through a full 360° to position the hook **19** at any desired position relative to the truck chassis **15**.

Referring to FIGS. 3 and 5, the pair of tension members 18 forming a portion of the A-frames are each disposed at their bottom ends between a pair of brackets 22 forming a clevis. The lower end of each tension member 18 has a bore which may be aligned with similar openings in the brackets 22 to receive a pin 23. Each pin 23 also extends through another bracket 24 spaced laterally outwardly of the brackets 22 and which receives a link 25 between it and the opposing bracket 22. The brackets 22 and 24 are secured to a lateral plate 26 which forms a part of the machinery platform 12 and it will be appreciated that the pins 23 restrain the tension members 18 and support the links 25. The pins 23 may be axially restrained by cotter pins.

The counterweight 10, which may be viewed in vertical section in FIGS. 4 and 6, is formed by casting to have a pair of steps 27 and 28 leading up to a main body portion 29. The innermost vertical surface of the first step 27 is defined by an arc of a circle having its center at the center of rotation of the turntable 13 and the other vertical surfaces of the step 28 and the main body portion 29 are formed parallel to such innermost surface to result in a generally arcuate shaped counterweight. A pair of clevises 30 are formed integral with the counterweight 10 rising from the second step 28 to join with the main body 29. The second step 28 is relieved in the clevises 30 to accommodate the links 25, and a free end of each link 25 is received within a respective clevis 30. The links 25 and clevises 30 have horizontal bores which may be aligned to receive latch pins 31.

With the latch pins 31 in place, the counterweight 10 is suspended from the links 25 and the links 25 bear against stops 52 on the platform 12. The weight of the counterweight 10 will bind the latch pins 31 between the links 25 and the clevises 30 so that the pins 31 cannot be removed as long as the pins 31 support the weight of the counterweight. If the counterweight 10 were not otherwise restrained, the counterweight 10 would be free to hang from the link 25 and assume a position in which its center of gravity would be below the latch pins 31. Since the center of gravity 32 of the counterweight 10 is offset to the outside of the latch pins 31, the counterweight 10 would tend to rotate from an upright position in a clockwise direction as viewed in FIG. 4. To maintain the counterweight 10 in an upright position, a pair of bearing blocks 33 are disposed between planar surfaces of recesses 34 formed in the vertical face of the first step 27 and bearing plates 35 which form a part of cage structures 36 that depend from the machinery platform 12. When suspended from the latch pins 31, the counterweight 10 bears against the bearing blocks 33 which in turn bear against the bearing plates 35 to maintain the counterweight 10 upright.

As may be seen in FIG. 5, the bearing blocks 33 are generally U-shaped with their openings directed downwardly, and each bearing block 33 is attached to a rod 37 which is loosely journaled through a lateral bore 38 provided in the counterweight 10. The rods 37 terminate in handles 39 recessible in pockets 40 formed in the outer side surfaces of the counterweight 10. The bearing plates 35 of the depending cages 36 are also provided with downwardly extending slots 41 which may be aligned with the openings in the bearing blocks 33 and which may also be aligned with similar slots 42 in the lowest step 27 of the counterweight 10. The slots 42 extend into pockets 43 which are adapted to receive a nut and washer of retaining blots 44 whose shanks extend through the slots 41 and 42 in the bearing plates 35 and step 27, respectively, and through the openings in the bearing blocks 33.

The bearing blocks 33 function as compression members between the counterweight 10 and the bearing plates 35 of the cage 36. The bolts 44 are employed to retain the counterweight 10, the bearing blocks 33, and the bearing plates 35 in intimate contact during rotation of the platform 12 and under conditions of shock loading on

the structure so that the counterweight 10 becomes a rigid extension of the machinery platform 12 when attached. Washers 45 surrounding the bolts 44 are seated in cooperating recesses 46 in the pockets 43 and in the bearing plates 35 so that the bolts 44 will not be permitted to fall down through the otherwise open bottom of the counterweight 10, the bearing block 33, and the bearing plate 35, until the bolts 44 are loosened.

The truck chassis 15 is provided with a pair of jacks in the form of hydraulic cylinders 47 having the top of their piston rods 48 generally flush with the level of the bed 14 when retracted. The underside of the counterweight 10 is provided with a pair of recesses 49 which may be positioned over the piston rods 48 of the hydraulic jacks 47 by rotating the machinery platform 12 so as to have the boom 11 extend over the rear of the truck chassis 15 and have the counterweight 10 adjacent the truck cab 50. It will be noted that the recesses 49 are in substantial alignment with the center of gravity 32 of the counterweight 10.

During the normal operation of the mobile crane, the counterweight 10 is supported from the latch pins 31 and bears against the bearing plates 35 through the medium of the bearing block 33. It acts to offset the weight of the boom 11 and loads on the hook 19. To remove the counterweight prior to transportation of the mobile crane to another site, it is first necessary to swing the rear end of the crane cab 21 to a position where it overhangs a side of the truck chassis 15. The purpose of this is to give access from below to the bolts 44. The nuts on the bolts 44 are loosened in a sufficient amount to permit the washers 45 to be removed from the cooperating recesses 46 so that the bolts 44 can be removed simply by drawing them down through the slots 41 and 42 and the openings in the bearing blocks 33. Removal of the bolts 44 will not effect the relative position of the counterweight 10, the bearing blocks 33, and the bearing plates 35 since the offset weight of the counterweight 10 is sufficient to bind the bearing blocks 33 between the counterweight 10 and the bearing plates 35. Obviously, the latch pins 31 must be removed to complete the removal of the counterweight 10. However, the weight of the counterweight 10 will sufficiently bind the latch pins 31 that their removal is prohibited unless the weight of the counterweight 10 is removed from the latch pins 31. In the same manner the bearing block 33 cannot be removed until the weight of the counterweight 10 is removed.

The machinery platform 12 is next swung to position the recesses 49 in the bottom surface of the counterweight 10 above the piston rods 48 of the hydraulic jacks 47. The hydraulic jacks 47 are actuated by any suitable control (not shown) in known manner to have the piston rods 48 seat in the recesses 49 in the counterweight 10 and lift the counterweight 10 a small distance; for example, one inch. The counterweight is lifted sufficiently to have the jacks 47 support the weight of the counterweight 10 and the links 25 pivot to accommodate the lifting movement of the counterweight 10. By so doing, the load is removed from the latch pins 31 and they may be then removed.

Once the latch pins 31 have been removed, the counterweight is free of the machinery platform 12. However, if there is no other hoisting equipment at the site there would be no means of removing the counterweight from its position on the truck chassis 15 and the fact that it was removed from the machinery platform would be to no avail. Thus, the boom 11 is permitted to function to lift the counterweight 10 from the truck chassis 15. In order to accomplish this, it is necessary that the machinery platform 12 be capable of rotation through 180°, without interference with the removed counterweight 10, to position the hook 19 above the counterweight 10. It is first necessary to remove the links 25 from between the clevises 30 and this is accomplised by rotating the links 25 upward-

ly about the pins **23** to assume a noninterfering position above the clevises **30**, as shown in FIG. 6. The links **25** may be retained in the noninterfering position by replacing the pins **31** in the links **25** behind the tension members **18**. Additionally, it is necessary to remove the bearing blocks **33** since they normally lie in the path of travel of the bearing plates **35** as the machinery platform **12** is rotated. With the counterweight **10** removed, the bearing blocks **33** are withdrawn within the recesses **34** by pulling the handles **39** outwardly. The bearing blocks **33**, when retracted, fall entirely behind the cylindrical vertical surface of the lower step **27** and in such position offer no interference to the rotation of the machinery platform. The machinery platform **12** has its bottom surface above the level of the first step **27** and will, therefore, also clear the counterweight **10**. Additional counterweights may be mounted on the counterweight **10**, and bores **51** are provided in the counterweight **10** for the purpose of receiving bolts which can support such additional counterweights.

It will be appreciated from the above description that the removable counterweight apparatus of this invention provides for positive mounting of the counterweight including restraint against independent movement. Yet, the counterweight is easily removable when desired and can be transferred to separate transporting equipment without the need of equipment not contained in the mobile crane, excavator, or the like.

I claim:

1. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: a link pivotally supported upon an opposite end of said platform and having a free end movable in a vertical plane; a counterweight adapted to be suspended from said link; removable mounting means joining said counterweight to said free end of said link and being normally restrained against removal by the weight of said counterweight; and actuable lift means mounted on said chassis and adapted when actuated to support the weight of said counterweight for removal of said mounting means to free said counterweight.

2. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a tiltable boom mounted upon one end of said platform, the combination comprising: a link pivotally supported upon an opposite end of said platform and having a free end movable in a vertical plane; a counterweight adapted for detachable mounting at said opposite end of said platform and including a clevis adapted to receive said free end of said link; a removable latch pin joining said link and said clevis to support said counterweight, said pin being normally restrained against removal by the weight of said counterweight; and actuable lift means mounted on said chassis and adapted when actuated to engage said counterweight to lift the same and remove the weight of said counterweight from said pin, whereby said pin may be removed to free said counterweight.

3. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: a link pivotally supported upon an opposite end of said platform and having a free end pivotable through a vertical arc; a counterweight adapted for detachable mounting at said opposite end of said platform and including a clevis adapted to receive said free end of said link; a latch pin joining said clevis to said free end of said link, said pin being normally restrained against removal by the weight of said supported counterweight; said counterweight having its center of gravity falling outside of a vertical plane through said pin so that a portion of said counterweight bears against said opposite end of said platform; releasable means restraining said portion of said counterweight against said opposite end of said platform to prevent swinging of said counterweight about said pin; and actuable jack means mounted on said chassis, said counterweight being positionable over said jack means by rotating said platform to have said jack means raise said counterweight once said releasable means has been removed to remove the weight of said counterweight from said pin, whereby said pin may be removed to free said counterweight.

4. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: links pivotally supported upon an opposite end of said platform and each having a free end pivotable in a vertical plane; a counterweight adapted for detachable mounting at said opposite end of said platform and including clevises each adapted to receive said free end of one of said links, said links and said clevises having horizontal bores which may be brought into alignment; a removable latch pin journaled through the bores in each cooperating link and clevis to suspend said counterweight, said pins being normally held against removal between said links and clevises by the suspended weight of said counterweight; a bearing plate mounted at said opposite end of said platform, said counterweight having its center of gravity horizontally offset from said pins to have a portion of said suspended counterweight bear against said bearing plate; releasable means holding said counterweight against said bearing plate to prevent swinging of said counterweight; and actuable jack means mounted on said chassis below said counterweight and adapted to lift said counterweight when said releasable means has been removed to free said pin and permit its removal.

5. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: a counterweight adapted for detachable mounting at said opposite end of said platform; removable mounting means adapted to support said counterweight from said opposite end of said platform, said mounting means being normally restrained against removal by the weight of said supported counterweight; a bearing plate mounted on said opposite end of said platform; said counterweight having a portion thereof tending to bear against said bearing plate; a bearing block adapted to be disposed between said bearing plate and said portion of said counterweight, said bearing block being withdrawable to a side of said counterweight to leave a space between said counterweight and said bearing plate; and actuable jack means mounted on said chassis and adapted when actuated to support said counterweight to remove the weight from said mounting means and to free said bearing block, whereby said mounting means may be removed to free said counterweight and said platform may be swung through an arc without interference with said counterweight to position said boom above said counterweight for removal of the same from said chassis.

6. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: a link pivotally supported upon an opposite end of said platform and having a free end movable in a vertical plane, a counterweight adapted for detachable mounting at said opposite end of said platform and including a clevis adapted to receive said free end of said link; a removable latch pin joining said link and said clevis to suspend said counterweight, said pin being normally restrained against removal by the weight of said suspended counterweight; a bearing plate mounted on said opposite end of said platform, said counterweight having its center of gravity horizontally offset from said pin so that a portion of said

counterweight tends to bear against said bearing plate when suspended; a bearing block supported by said counterweight and movable between an extended position in which said bearing block is intimately disposed between said portion of said counterweight and said bearing plate and a retracted position in which said bearing block is withdrawn to leave a free space between said portion of said counterweight and said bearing plate; and actuable jack means mounted on said chassis and adapted when actuated to lift said counterweight and support the same to free said bearing block for movement to its retracted position, whereby said pin may be removed and said platform may be swung through an arc without interference with said counterweight to position said boom above said counterweight for removal of the same from said chassis.

7. In an apparatus of the class described having a chassis, a rotatable machinery platform mounted on said chassis, and a boom mounted upon one end of said platform, the combination comprising: links pivotally supported upon an opposite end of said platform and each having a free end pivotable in a vertical plane; a counterweight adapted for detachable mounting at said opposite end of said platform and including clevises each adapted to receive said free end of one of said links, said links and said clevises having horizontal bores which may be brought into alignment; a removable latch pin received in the bores in each cooperating link and clevis to suspend said counterweight, said pins being normally held against removal between said links and clevises by the suspended weight of said counterweight; bearing plates depending from said opposite end of said platform, said counterweight having its center of gravity located to the outside of a vertical plane through said latch pins whereby said counterweight tends to rotate when suspended to bear against said bearing plate; bearing blocks supported by said counterweight and adapted to be movable between an extended position in which said bearing blocks are disposed between said counterweight and said bearing plates and a retracted position in which said bearing blocks are withdrawn into recesses in said counterweight; releasable means adapted to retain said counterweight

and said bearing blocks against said bearing plates; and actuable jacks mounted on said chassis beneath the level of a bottom of said counterweight, said jacks being adapted when actuated to lift said counterweight and support the same to free said bearing blocks for withdrawal to their retracted position once said releasable means have been removed, whereby said pins may be removed and said platform may be rotated without interference with said bearing blocks to position said boom over the free counterweight for removal of the counterweight from said chassis.

8. The combination of claim **7** wherein the surface of said counterweight adjacent said opposite end of said platform is defined by an arc of a circle having its center substantially at the center of rotation of said platform, said recesses for said bearing blocks are formed in said surface, and said bearing blocks are connected to rods journaled through laterally extending bores in said counterweight and said rods terminate in handles disposed to the outside of said counterweight, whereby said bearing blocks may be withdrawn into said recesses to a position behind said surface of said counterweight.

9. The combination of claim **7** wherein said bearing blocks are U-shaped with their opening directed downwardly, said bearing plates and said counterweight have aligned downwardly opening slots, and said releasable means comprises bolts connecting said counterweight, said bearing blocks, and said bearing plates and which are removable after loosening by withdrawal through said slots and said openings in said bearing blocks.

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