AUXILIARY SUPPORT FOR CRANES
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ABSTRACT OF THE DISCLOSURE
There is disclosed a load handling assembly having a lower works and an upper works rotatably mounted thereon. An auxiliary generally circular support is disposed about the lower works and is supported from the ground in the normal load handling situation. A boom is carried by the circular support which acts to increase the angle between the boom raising lines. A counterweight is carried by the circular support and means are provided which interconnect the counterweight and the boom so that the counterweight is raised from the support when the boom is loaded.

BACKGROUND OF THE INVENTION
This invention relates to load handling assemblies such as material handling cranes. More particularly, there is provided a generally horizontal circular auxiliary support disposed about the lower works of the crane for increasing the lifting capacity of the assembly. When the crane is in position to handle a load, the auxiliary support is supported by the underlying ground surface by the use of wooden blocks, hydraulic jacks or the like.

It is known in the prior art as shown in U.S. Patent 2,910,189, to provide a horizontal generally circular auxiliary support on which the load handling boom is mounted. This arrangement is effective to increase the load handling capacity of a crane for two reasons. First, the load necessary to tip the crane is increased because the axis of tipping is disposed farther forwardly than the wheel axis which is the tipping axis without the auxiliary support. The reason this movement of the tipping axis increases the load necessary to tip the crane is that the center of gravity of the crane is further from the tipping axis.

The second reason that the lifting capacity of the crane is increased is that the entire mass of the crane is disposed on one side of the tipping axis while the boom and the load are on the other side thereof. This is in contrast to the normal track crane wherein a portion of the crane mass is forward of the tipping axis. Another advantage of the use of the auxiliary support is that the angle between the boom centerline and the briddles used to raise and lower the boom is increased. This maximizes the forces necessary to elevate the boom about the boom pivot because of the increased force vector normal to the boom.

SUMMARY OF THE INVENTION
The load handling assembly of the invention is directed toward a further increase in the load handling capacity of a crane of given size. This is accomplished by the use of a movable counterweight normally supported by the annular support. When the boom is loaded the movable counterweight is raised off of the annular support by a means interconnecting the boom point and the counterweight. This operation acts to offset a portion of the load being hoisted.

By the use of the auxiliary support, the movable counterweight and an additional mast, to be explained more fully hereinafter, the lifting capacity of a given size crane may be increased from two to four times the normal maximum rating. For example, a crane having a normal maximum rating of 150 tons was modified in accordance with the principles of the invention and thereafter successfully lifted loads in the range of 300 tons.

It is accordingly an object of the invention to provide a load handling assembly such as a crane or the like with increased lifting capacity.

Another object of the invention is to provide components that can be added to a conventional crane to increase the load lifting capacity thereof at minimal cost. Still another object of the invention is to provide an annular auxiliary support for a crane which can be secured thereto in a relatively simple manner.

A further object of the invention is to provide a crane having an auxiliary annular support, a boom having the lower end thereof mounted on a carrier supported by the auxiliary support, a mast pivotally connected to the car-
ier and tensionable means cooperating with the upper end portion of the mast for raising and lowering the boom.

Other objects, advantages and important features of this invention will be apparent from a study of the specification following, taken with the drawing, which together describe and illustrate a preferred embodiment of this invention and what is now considered and believed to be the best mode of practicing the principles thereof. Still other embodiments, modifications, procedures or equi-

DESCRIPTION OF THE PREFERRED EMBODIMENT
FIGURE 1 is a side elevational view of a crane modified in accordance with the principles of this invention, certain parts being broken away for clarity of illustration;
FIGURE 2 is an enlarged horizontal cross sectional view of the crane of FIGURE 1 taken substantially along line 2—2 thereof as viewed in the direction indicated by the arrows;
FIGURE 3 is a side elevational view of the crane of FIGURE 1 illustrating the relationship between the various components when a load is imposed in the boom;
FIGURE 4 is an enlarged horizontal cross sectional view of the crane of FIGURE 1 taken substantially along line 4—4 thereof as viewed in the direction indicated by the arrows; and
FIGURE 5 is an enlarged cross sectional view of the crane of FIGURE 2 taken substantially along line 5—5 thereof as viewed in the direction indicated by the arrows.

Attention is now directed to FIGURE 1 wherein there is shown a load handling assembly comprising a crane 12, a boom 14 and an auxiliary support 16.
The crane 12 comprises a mobile lower works 18 of the type disclosed in application S.N. 629,050 filed Feb. 20, 1967, now Patent No. 3,393,758, to which reference may be had for a more complete description thereof. The lower works 18 comprises a car body 20 having a pair of swinging outriggers 22, 24, extending outwardly on each side thereof in a direction generally transverse to the intended direction of travel. The lower works 18 also comprises a pair of truss assemblies 26 each of which comprises a generally horizontal frame member 28 extending in the direction of intended travel. The wings 22, 24 are supported on the frame member 28 in a direct sliding relationship so that the truss assemblies 26 may be moved inwardly and outwardly with respect to the car body 20 as pointed out in the aforementioned application in FIGURES 2 and 3 and as will be explained more fully hereinafter, the auxiliary support 16 is connected to the lower works 18 adjacent the outer ends of the wings 22, 24.

The truss assembly 26 is illustrated as comprising an endless crawler 30 associated with a driving sprocket 32 and an idling sprocket 34. Any suitable means, such as is disclosed in application S.N. 629,050, now Patent 3,393,758, may be used for driving the sprocket 32. It should be noted that other suitable truss assemblies such as tires or the like, may be used.

The crane 12 also comprises an upper works 36 rotatable mounted on a roller path and ring gear arrangement 38 integral with the car body 20 in a suitable manner. A carrier 40 is connected at one end thereof to the upper works 36 by a pin connection 42. The other end of the carrier 40 comprises rollers 44 in engagement with the auxiliary support 16. A hook arrangement 46 is connected to the outer end of the carrier 40 and underlies a flange 48 of the auxiliary support 16 in much the same manner that conventional hook rollers are associated with a conventional roller path. It will accordingly be apparent that rotation of the upper works 36 effects rotation of the carrier 40 with the outer end thereof being supported by the rollers 44 in conjunction with the auxiliary support 16.

The upper works 36 also carries a conventional counterweight 50 and houses a prime mover, operators station and other suitable controls and equipment normally associated with a load handling assembly.

The boom 14 may be of any suitable type and comprises a boom top 52, a boom boom top 54 and any desired number of boom inserts (not shown) to make the boom 14 of any desired length.

The boom butt 52 is pivotally mounted on the carrier 40 by a suitable pin connection 56. Interconnecting the boom 14 and the carrier 40 are multiple sections 58 which act to prevent elevation of the boom 14 beyond a predetermined angle with respect to the underlying ground surface. A sheave 60 is mounted adjacent the boom top 54 and accommodates a hoist line 62 reeved about a hoist drum 64 housed in the upper works 36. A suitable block 66 is associated with the hoist line 62 in a suitable manner to provide means for attaching the hoist line 62 to a load.

The load handling assembly 10 also comprises a boom hoist assembly 68. The assembly 68 comprises a mast 70 having the lower end thereof pivotally attached to the carrier 40 by a pin connection 72. A pair of suitable bridles 74 interconnect the boom 14 to the mast 70 and the boom top 54 adjacent the upper end thereof. A gantry assembly 76 is provided on the upper works 36 for rotating the mast 70 about the axis of the pin connection 72. The gantry assembly 76 comprises a first link 78 connected to the top of the mast 70 and the second link 82 connected to the counterweight 50 by a pin connection 84. The links 78, 82 are connected together by a pin connection 86 and accordingly describe a triangular structure. Although it would appear that this triangular structure is rigid, a certain amount of deflection therein occurs when the boom 14 is heavily loaded. The importance of this deflection will be pointed out more fully hereinafter.

A boom hoist line 88 is wound about a pair of boom hoist drums 90 within the upper works 36. The intermediate portion of the line 88 are reeved about a pin connection 92 mounted on the upper portion of the mast 70, suitable sheaves 94 on gantry assembly 76, and eye sheaves 96 on the upper portion of the mast 70. It will be apparent that the retraction of the boom hoist line 88 by the hoist drums 90 acts to move the upper end of the mast 70 toward the gantry assembly 76 which results in elevation of the boom 14. As will be apparent to those skilled in the art, a downward pull on the boom hoist line 88 compressively loads the mast 70 which transmits the load to the carrier 40. The load transmitted to the carrier 40 thus assists in maintaining the carrier 40 in engagement with the auxiliary support 16.

The auxiliary support 16 describes an annular circular support for the rollers 44 as may be seen best in FIGURE 2. The auxiliary support 16 is preferably comprised of a plurality of generally similar sections 98 which describe generally circular arcs. The support sections 98 are secured together in any suitable manner and may be disassembled for ease of shipment. Each of the sections 98 comprises the flange 48 which provides an engagement with the rollers 44 of the carrier 40. A generally vertical load bearing web 100 connects the flange 48 to a similar annular flange 102. The flange 102 is supported from the ground surface in any suitable manner, as by the use of wooden blocks or sills 104 as shown in FIGURES 1-3.

As shown in FIGURES 2 and 5, the auxiliary support 16 comprises a frame member 106 on each side of the lower works 18 which extends generally in the direction of travel of the crane 12. The frame member 106 comprises an upper flange 108 connected to a lower flange 110 by a generally vertical web 112 which may be apertured as at 114 to minimize the weight thereof consistent with necessary strength. The vertical web 112 carries an inwardly extending load supporting plate 116 which underlies the wings 22, 24. Suitable connecting means 118, such as nut and bolt assemblies, interconnect the plate 116 with the upper portions of the wings 22, 24. Although it is preferred to connect the frame members 106 to the wings 22, 24 when the truss assemblies 26 are in a retracted position, it will be evident that the wings 22, 24 and the auxiliary support 16 may be so configured such that the frame members 106 may be attached to the wings 22, 24 when the truss assemblies are in the outwardly disposed position.

Disposed on the frame members 106 are jack assemblies 120 which are used to support and level the entire system prior to the positioning of the wooden blocks 104. Suitable measuring equipment (not shown) is used to position the system in a horizontal plane prior to the insertion of the wooden blocks 104. It should be understood that jack assemblies may be positioned about the periphery of the auxiliary support 16 in lieu of the wooden blocks illustrated.

Positioned rearwardly of the counterweight 50 is counterweight means 122 which is illustrated as comprising a container 124 filled with suitable ballast material, such as concrete or the like. The container 124 is normally supported by a pin connection 126 on the upper flange 48 of the auxiliary support 16 as shown in FIGURE 1. A link 128 is pivotally connected to the upper portion of the container 124 by a pin connection 130 with the upper end thereof pivotally connected to the gantry assembly 76 by the pin connection 86. Cooperating between the container 126 and the counterweight means 122 is a guide arrangement 132 comprising an extension 134 of a wall of the container 124. A first abutment 136 is secured to the foremost portion of the extension 134 by a suitable fastener arrangement 138 such as machine screws. It will accordingly be seen that the abut-
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It will be seen that the rotation of the upper works 36 about the axis of the ring gear or roller path assembly 38 results in the rotation of the carrier 40 and the boom 14 about the same axis with the rollers 44 supporting the carrier 40 with the boom 14 being on the flange 45 of the auxiliary support 16. Similarly, it will be seen that the counterweight means 122 rotate with the upper works 36 and is supported from the auxiliary support 16 by the rollers 126 during such rotation.

An important feature of the invention resides in the relationship between the counterweight means 122 and the auxiliary support 16. As shown in FIGURE 1, the counterweight means 122 is supported on the auxiliary support 16 by the rollers 126 when the boom 14 is not handling a load. It will accordingly be apparent that the support necessary for the counterweight means 122 comprises the auxiliary support 16 and not the crane 12. It will thus be seen that the size of the crane 12 need not be increased to accommodate the mast or the counterweight means 122 at least when the counterweight means 122 is carried by the auxiliary support 16. For example, one crane having a 150 ton nominal capacity was modified in accordance with the principles of this invention. The counterweight on this size crane is normally 50 tons, the counterweight means 122 added to the modified crane weighed approximately 25 tons without requiring modification of the upper or lower works thereof.

As shown in FIGURE 3, a substantial load 144 is connected to the block 66 by a suitable connection 146. When the load hoist drums 64 are manipulated to retract the load hoist line 62, the load 144 is lifted thereby tending to rotate the boom 14 and the mast 70 in a clockwise direction. Since the bridles 74 stretch somewhat upon the application of the load 144, the upper portion of the mast 70 undergoes a smaller degree of the movement than does the boom top 54.

Rotation of the mast 70 tends to move the pin connection 86 of the gantry assembly 76 in the direction shown by the arrow in FIGURE 3. Since the boom hoist line 88 stretches somewhat upon rotation of the mast 70, movement of the pin connection 86 is less than the movement of the upper portion of the mast 70. Because of the deflection induced in the gantry assembly 76 and the upper works 12 by the application of the load 144, the upper end portion of the link 125 is raised thereby lifting the counterweight means 122 off of the auxiliary support 16 as shown in FIGURE 3. It will accordingly be seen that the lifting of the counterweight means 122 from the auxiliary support 16 imposes an additional restraining force on the boom hoist equipment 68 to maintain the boom 14 stationary. In other words, the load 144 is partially counterbalanced by the counterweight means 122 acting through the boom hoist assembly 68.

When the counterweight means 122 is raised from that portion of the auxiliary support 16 rearwardly of the upper works 38, the load imparted to the assembly 10 is translated into a compressive force vector acting through the mast 70, the rollers 44 and the auxiliary support 16 in front of the upper works 36 to the ground surface. It will thus be seen that the load imparted to the assembly 10 by the counterweight means 122 is transferred to the auxiliary support 16 when the counterweight means 122 is raised as shown in FIGURE 3 so that the weight thereof is not required to be supported by the crane 12.

In order to move the assembly 10, the jacks 120 are manipulated to emphasize the ground surface so the wooden blocks 104 can be removed. After the blocks 104 are withdrawn from beneath the support sections 98, and the jacks withdrawn, the driving sprockets 32 of the traction assemblies 26 are driven by suitable means (not shown) to propel the assembly 10 to a new location. It should be pointed out that the support sections 98 are carried by the frame members 106 which are affixed to the wings 22, 24 as shown in FIGURES 2 and 5. Since the wings 22, 24 are in turn supported by the frame members 28 of the traction assemblies 26, it will be evident that the loads produced by the counterweight means 122 and the boom 14 are transferred through the support sections 98, the frame members 106, the wings 22, 24 and the frame members 28 to the underlying ground surface. It will thus be seen that the loads produced by the counterweight means 122 and the boom 14 do not pass through the upper works 36 and the ring gear-roller path arrangement 38.

Since the load produced by the counterweight means 122 on the assembly 10 is never carried by the upper works 36 of the crane 12, it will be apparent that the invention may be used on conventional cranes without extensive modification thereof.

While the invention has been described and disclosed in terms of an embodiment which it has assumed in practice, the scope of the invention should not be deemed to be limited by the precise embodiment herein described and illustrated and it is to be understood that such other embodiments are intended to be reserved, especially as they fall within the scope of the subjoined claims.

What is claimed is:

1. A load handling assembly comprising:
   a central station;
   a support having a segment disposed on one side of the central station;
   a boom carried by the assembly on the other side of the central station for handling a load at the free end thereof;
   means for hoisting a load from the free end of the boom;
   a counterweight supportedly engaging the support; and
   means interconnecting the counterweight and the boom for raising the counterweight off of the support when the boom is loaded by hoisting a load.

2. The load handling assembly of claim 1 wherein:
   the support comprises another segment on the other side of the central station for providing support for the boom, the segments being directly supported on the underlying surface; and
   the boom comprises:
   a carrier connected to the central station and supported by the other segment;
   the boom being pivotally connected to the carrier.

3. The load handling assembly of claim 2 wherein the interconnecting means comprises:
   a mast pivotally connected to the carrier;
   bridle means connecting the mast and the boom;
   cable means for pivoting the mast about its pivotal axis; and
   means for connecting the counterweight means to the cable means.

4. The load handling assembly of claim 3 wherein the connecting means comprises:
   a gantry assembly mounted on the central station; and
   a link connecting the counterweight means to the gantry assembly;
   the cable means comprising:
   sheave means and elongate tensionable means interconnecting the gantry assembly and the mast.

5. A load hoisting assembly comprising:
   a lower works;
   an upper works rotatably mounted on the lower works; a support having at least a first portion horizontally positioned on one side of the upper and lower works and a second portion horizontally positioned on the other side thereof, the portions being directly supported on the underlying surface;
   the counterweight means directly supported by the first portion for movement thereon as the upper works rotates with respect to the lower works;
means cooperating between the counterweight means and the upper works to enable the counterweight means to rotate with the upper works;

a carrier connected at one end to the upper works and supported at the other end by the support for movement thereon;

boom means connected to the carrier;

means for hoisting a load from the free end of the boom means; and

means interconnecting the counterweight means and the boom means for raising the counterweight means off the support when the boom means is loaded.

6. The load hoisting assembly of claim 5 wherein the support describes an annular generally circular path;

the counterweight means comprises rollers on the path; and

the carrier comprises rollers on the path.

7. The load handling assembly of claim 5 wherein the interconnecting means comprises

a mast pivotally connected to the carrier;

bride means connecting the mast and the boom adjacent the upper end thereof;

a gantry assembly mounted on the upper works;

cable means interconnecting the gantry assembly and the mast for pivoting the mast about its pivotal axis; and

a link connecting the counterweight means to the gantry assembly.

8. A load hoisting assembly comprising:

a lower works;

an upper works rotatably mounted on the lower works;

a carrier connected at one end of the upper works;

a support, providing at least a semicircular path on one side of the upper and lower works, for mounting the other end of the carrier for movement along the path and maintaining the carrier in a predetermined angular position with respect to the underlying surface;

a boom pivotally mounted on the carrier for handling a load at the free end thereof; and

means for raising and lowering the boom comprising a mast pivotally mounted on the carrier adjacent the other end thereof;

means interconnecting the upper portions of the mast and the boom; and

means for pivoting the mast about the pivot axis thereof.

9. The load hoisting assembly of claim 8 wherein:

the means for pivoting the mast comprises

gantry assembly on the upper works; and

cable means interconnecting the gantry assembly and the mast for imposing a force on the mast normal to the pivot axis thereof;

the mast extending upwardly beyond the top of the gantry assembly so that the angle between the upper portion of the mast and the upper portion of the boom is greater than the angle between the upper portion of the mast and the top of the gantry assembly.

10. The load hoisting assembly of claim 9 wherein:

the support describes a circular path around the upper and lower works; and further comprising

counterweight means normally carried by the support on the opposite side of the lower works than the boom; and

means interconnecting the counterweight means and the mast for raising the counterweight means from the support when the boom is loaded.

11. A load handling assembly comprising:

a car body having wings thereon extending generally transversely to the direction of travel; and

traction assemblies comprising

frame members extending generally in the direction of travel, the frame members sup-
porting an intermediate portion of the wings of the car body;

traction means carried by the frame members for moving the load handling assembly on an underlying surface;

an upper works rotatably mounted on the car body;

boom means carried by the upper works for handling a load;

means for hoisting a load from the upper end of the boom; and

an auxiliary support comprising

a generally horizontal annular member disposed about the lower works;

frame means connecting portions of the annular member together, the frame means extending generally parallel to the frame members of the traction assemblies; and

means connecting the end portions of the wings to the frame means.

12. The load handling assembly of claim 11 wherein:

the boom means comprises

carrier connected to the upper works for rotation therewith and having a portion thereof in engagement with the annular member for movement thereon; and

a boom pivotally connected to the carrier;

the load handling assembly further comprising:
counterweight means normally carried by the support on the opposite side of the lower works for rotation therewith; and

means interconnecting the counterweight means and the boom for raising the counterweight means from the support when the boom is loaded.

13. The load handling assembly of claim 12 further comprising:

means for transmitting the load of the counterweight means to the auxiliary support on the boom side thereof when the counterweight means is lifted off of the auxiliary support.

14. The load handling assembly of claim 13 wherein:

the transmitting means and the interconnecting means comprise

a mast pivotally connected to the carrier;

means connecting the upper end portion of the mast to the upper portion of the boom; and

means connecting the mast and the counterweight.

15. The load handling assembly of claim 2 further comprising:

means for transmitting at least a portion of the load of the counterweight means to the auxiliary support on the boom side thereof when the counterweight means is lifted off of the auxiliary support.

16. The load handling assembly of claim 5 wherein the interconnecting means includes means for raising the counterweight means from the support when the boom is loaded by hoisting a load.

17. A load handling assembly comprising a lower works; an upper works rotatably mounted on the lower works and having pivot means thereon; a carrier, connected at one end thereof to the pivot means, having a hinge connection at the other end thereof; a boom pivotally connected to the carrier, bride means connecting the mast and the boom top, and retractable means operatively lower works connected to the mast for pivoting the mast, the operative connection between the retractable means and the mast being high enough on the mast with respect to the retractable means to impose a compressive load thereon during raising of the boom to maintain the carrier in engagement with the holding means.
18. The load handling assembly of claim 17 wherein the mast is positioned adjacent the other end of the carrier.

19. The load handling assembly of claim 17 wherein the mast extends substantially above the upper works and the retractable means extends from the upper works upwardly to the operative connection.

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<th>Patent Number</th>
<th>Date</th>
<th>Inventor</th>
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<tr>
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Primary Examiner—Robert J. Spar

ABSTRACT
There is disclosed a load handling assembly having a lower works and an upper works rotatably mounted thereon. An auxiliary generally circular support is disposed about the lower works and is supported from the ground in the normal load handling situation. A boom is carried by the circular support which acts to increase the angle between the boom raising lines. A counterweight is carried by the circular support and means are provided which interconnect the counterweight and the boom so that the counterweight is raised from the support when the boom is loaded.
REEXAMINATION CERTIFICATE
ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS
INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the
patent, but has been deleted and is no longer a part of the

patent; matter printed in italics indicates additions made
to the patent.

AS A RESULT OF REEXAMINATION, IT HAS
BEEN DETERMINED THAT:

Claims 1–19 are now disclaimed.