OUTRIGGERS FOR POWER SHOVELS, CRANES, OR THE LIKE

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

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The present invention relates generally as indicated to outriggers for power shovels, cranes, or the like, and more particularly to automatic power-operated outriggers that embody certain improvements over the curved beam outriggers disclosed in the A. O. Felkner U.S. Patent Re. 24,482, reissued June 3, 1958 (original U.S. Pat. No. 2,740,538, dated April 3, 1956).

Hitherto, prior to the development aforesaid by A. O. Felkner and thereafter, it has been the prevalent practice to provide power shovels, cranes and like equipment with outriggers that are in the form of horizontally slidable beams contained in boxes mounted on the frames of such equipment and adapted to be pulled manually out of such boxes and to have blocks inserted under their outer ends, some outrigger beams being provided with jack screw actuated floats at their outer ends to eliminate the need of such "blocking up." It is also known to provide power-operated outrigger beams moved out as by hydraulic cylinders and provided with screw jack floats that are power operated as by means of rotary hydraulic motors.

A disadvantage of such known outriggers is the relatively great length of time which it takes to extend the outrigger beams and to either actuate the floats thereof or to block up the outer ends of the outrigger beams.

Accordingly, it is a primary object of this invention to provide an automatic power operated outrigger which is provided with curved beams that have pivotally mounted floats and which, in their retracted, inoperative position, are fully contained within the outrigger box for providing adequate road clearance and which, when extended to working position, simultaneously move outwardly and downwardly to ground-engaging position.

It is another object of this invention to provide a curved beam outrigger in which the beam box or housing has combination beam guide and locking shoes that, in addition to guiding the extension and retraction movement of the beams, serve to lock the beams at any partly or fully extended position with need of employing the conventional locking pins or without reliance on the hydraulic actuating system for locking.

It is another object of this invention to provide a curved beam outrigger as aforesaid, which doubles as a jacking means for quickly lifting the carrier from the ground for fire or wheel changes or for lifting the wheels from soft spots in the ground whereby planks or the like may be inserted under the wheels.

It is another object of this invention to provide a curved beam outrigger which enables leveling of the carrier on sloping ground thereby eliminating uphill swelling of the boom, thus reducing swing clutch wear and tear and relieving long booms of hazardous side loadings.

It is yet another object of this invention to provide a curved beam outrigger in which the curved beams have vertically and toploading floats and whose beams on opposite sides may be extended to different positions when working in crowded quarters, that is, on one side of the carrier which is close to the wall of a building or other obstruction the float is adjusted to a lowered position and is adapted to engage a block next to the wall whereby the beam need be moved out only a relatively short distance.

It is another object of this invention to provide an outrigger of the character indicated which may be operated from the driver's cab and/or from the crane cab, and preferably, the hydraulic power is derived from the same source that supplies the carrier power steering mechanism.

It is yet another object of this invention to provide an outrigger of the character indicated, which embodies novel double-acting telescopic hydraulic cylinders to achieve full power extension and retraction of the curved beams thereof.

It is yet another object of this invention to provide an outrigger of the character indicated which has double-acting telescopic cylinders as aforesaid and which has novel hose reels to keep taut the flexible hoses that are connected to the extensible cylinder parts without employment of any sealed swivel joints between the hydraulic supply lines and the respective flexible hoses.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features herein-after fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a side elevation view of a motor crane which has two sets of curved beam outriggers according to this invention installed transversely respectively at the rear and between the front and rear axles of the carrier frame, the curved beams thereof being shown in fully retracted positions with the floats folded up to constitute the closures for the open-ended outrigger boxes, each box containing a pair of curved beams disposed in side-by-side relation for extension transversely from the opposite sides of the carrier frame.

FIG. 2 is a rear elevation view of one of the outriggers (the rear one in FIG. 1), such view being partly in cross-section, to show in detail the operating and supporting mechanism for one of the two curved beams therein.

FIG. 3 is a top plan view as viewed from the top of FIG. 2.

FIGS. 4, 5 and 6 are cross-section views taken substantially along the lines 4--4, and 5--5 of FIG. 2 and line 6--6 of FIG. 4, respectively.

FIG. 7 is an enlarged central longitudinal cross-section view of a preferred form of double-acting telescopic hydraulic cylinder for actuating the outrigger beam secured to one end thereof.

FIG. 8 is a rear elevation view showing the instant outriggers adjusted for working in crowded quarters; and FIG. 9 is a rear elevation view similar to FIG. 8 except showing the instant outriggers as used in leveling the crane, shovels, or like machine on sloping or irregular ground.

Referring now more particularly to the drawings and first, to FIG. 1, there is shown therein a motor crane comprising a frame 2 provided with front and rear axles 3 and 4 upon which front and rear wheels 5 and 6 are mounted. Adjacent the front end of the frame 1 there is mounted the driver's cab 7 and on an intermediate portion of the frame 1, usually above or forward of the rear axles 4, is a turntable 8 on which the crane assembly is mounted for turning about a vertical axis. Said crane assembly, includes a boom 9 and a crane cab 10 in which the crane operator manipulates the controls (not shown) and cables 11 for swinging the boom 9 about the turntable axis and for raising and lowering the boom 9 about the boom pivot 12.

The carrier frame 2 also has mounted transversely therebeneath, between the front and rear axles 3 and 4...
and to the rear of the rear axles 4, the respective outrigger assemblies 14 and 15. As known in the art, outriggers are provided on equipment of this nature so that heavy loads handled by the boom 9 on either side of the crane 1 may be safely handled without danger of tipping. Outriggers also relieve the springs, axles, and tires of added load to which they would be subjected to otherwise.

In the ensuing description and drawings reference is made particularly to the outrigger assembly 15 which is mounted at the rear end of the carrier frame 2 and it is to be understood that the other outrigger assembly 14 which is mounted between the front and rear axles 3 and 4 is of the same general construction as assembly 15 so as not to require separate illustration and description.

It should also be noted that all controls are preferably provided so that the outriggers 14 and 15 may be manipulated as through the rear window of the driver's cab 7 or from within the crane cab 10, and although any source of fluid pressure may be employed, I prefer to utilize the same fluid pressure system that is employed for the power steering mechanism, since that pressure system is not used at the same time that the outriggers 14 and 15 are manipulated.

As described in FIGS. 2 to 6, the outrigger box or housing 16 is of generally rectangular cross-section providing two compartments 17 and 18 to accommodate the respective curved beams 19 therein in side-by-side relation. One end of each beam 19 has a float 21 pivotally mounted thereon by means of the pin 23, the float 21 being automatically swung up by reaction to retraction of the beams 19 to constitute closures for the open-ended housing 16 (see FIG. 1 and left side of FIG. 2). The housing 16 has the lugs 24 and 25 by which it is detachably attached to the carrier frame 2.

As shown in the drawings, each beam 19 is of longitudinally curved form of say, about 16° radius and is of hollow rectangular cross-section. Each float 21 is provided with two sets of vertically spaced holes so that it may be vertically positioned on pin 23 with respect to beam 19 to best suit the ground conditions at the site where the outriggers are to be used.

The housing 16 is provided with two sets of friction shoes 26 and 27 therewithin, one set for each beam 19. The shoes 26 are mounted to engage the bottom sides of the respective beams 19 and shoes 27 are mounted to engage the top sides of the respective beams 19, such zones of engagement being spaced apart lengthwise of the beams 19. These shoes 26 and 27 by reason of their spacing and angular relation serve not only as beam guides, but, also as wedge locks to immovably support the beams 19 in any extended position without any reliance whatever on the hydraulic system or without requiring the use of the conventional locking pins 28 that are adapted to be inserted through the holes 29 formed in the beams 19 with their ends engaging the ends of the housing 16. This, upward ground reaction at the float pivot 23 will be ineffective to cause inward collapsing movement of the beams 19. It is through these guides and locking shoes 26 and 27 also that a force multiplication of about 2:1 for example is obtained, that is, for each two feet of horizontal extension of the beams 19, the floats 21 move down about one foot.

Each beam 19 is extended from and retracted into the housing 16 by means of a telescopic double-acting hydraulic cylinder assembly 30 which is pinned at 31 to housing 16 and at 32 to beam 19 so as to extend generally horizontally and lengthwise of the respective compartment 17 or 18.

The construction of such double-acting telescopic hydraulic assembly 30 is shown in detail in FIG. 7. As shown, the main cylinder 34 is provided with ports 35 and 36 at its ends adapted alternately to be communicated with a fluid pressure supply line (not shown) and with a fluid reservoir (not shown) via a conventional four-way valve located in the crane cab 10 or in the driver's cab 7, or in both places, as previously mentioned.

Reciprocable in said main cylinder 34 is an annular piston 37 which, as shown, has a tubular piston rod constituting a secondary cylinder 38 for the piston 39, the latter having limited travel to the end of the main cylinder 34. The piston rod 40 is slightly sealed in the end cap 41 which is mounted at the outer end of the aforesaid secondary cylinder 38, said end cap being provided with a port 42 to which a flexible hose 43 is adapted to be connected and which flexible hose 43 and the flexible hose 45 and the aforesaid four-way valve, be alternately communicated with a fluid pressure source and with a fluid reservoir depending upon whether the cylinder assembly 30 is being retracted or extended respectively. The other flexible hose 46 also leads to the four-way valve to serve as a pressure line or return line as the case may be.

Accordingly, when an outrigger beam 19 is to be moved out and down to carry supporting position, the four-way valve will be actuated so that fluid under pressure in hose 46 enters the port 35 of the main cylinder 34 by way of line 47 and fluid is displaced from secondary chambers 48 and 49 to the fluid reservoir by way of port 42, and hoses 43 and 45 and of the port 36, line 50 and hose 45, respectively. Such fluid under pressure will actuate the annular or hollow piston 37, until it engages the end cap 51, whereupon the beam 19 will be further extended and the other end of the pole 34, having connection to the drum 57 of the hose reel 58 is one end of a flexible hose 62 or the like, which has its other end connected to the drum 57 of the hose reel 58 which radially clears the tubular reel supporting shaft 59, the end of the portion 56 being connected to the inner portion of a double elbow fitting 60. The hose 43 is connected at one end to the outer portion of the elbow 60 and is wrapped helically about the drum 57 with its other end connected to an elbow 61 or like fitting or outlet at the port 42 of the secondary cylinder end cap 41. Also connected to the drum 57 of the hose reel 58 is one end of a flexible steel tape 62 or the like, which has its other
end connected within a tension unit 63 which may comprise, for example, a conventional sash balance. Thus, when the telescopic cylinder assembly 30 is extended, the hose reel 58 will be turned in a counterclockwise direction, as viewed in FIG. 2, and the tape 62 will be wound around the drum 57 under the tension imposed by the tension unit 63. This keeps the section of the hose 43 between the reel 58 and the secondary cylinder 38 taut. Now, when the cylinder assembly 30 is retracted, the tension unit 63 acting on the tape 62 will turn the reel 58 in a clockwise direction thereby winding hose 43 on the drum 57 and taking up slack in the portion of the hose 43 between the secondary cylinder 38 and the reel 58. When the hose reel 58 is rotated in a counterclockwise direction, the portion 56 of the hose inside the reel will be wound up to a smaller helix but still clear of the center shaft 59. On the other hand, when the hose reel 58 rotates in a clockwise direction, the portion of the hose 43 on the exterior will be helically coiled thereabout while the portion 56 of the hose inside the reel will expand in diameter but yet not tight against the inside of the drum 57. With such hose reel 58 it is therefore not necessary to provide any rotary, scaled swivel joints, or any lid or ring for the like, since one end of the portion 56 is secured to the inside portion of the elbow 60 and the other end of the hose is secured to a T or like fitting 64 fixedly mounted in the outrigger housing 16.

In any case, by reason of the provision of the double-acting telescopic hydraulic cylinder assembly 30, it is possible to exert large forces endwise or lengthwise, of the curved beam 19 to move the float 21 thereof into and out of ground-engaging position.

The versatility of the present invention is illustrated, for example, in FIGS. 8 and 9. In FIG. 8 is shown the operating position of the outriggers 14 and 15 in connection with crowded quaters as, for example, a building wall W located close to one side of the carrier frame 2. In that case the floats 21 on that side of the carrier are adjusted to their upper position as shown so that a block B or the like, may be inserted under each float between the crane 1 and the wall W. In FIG. 9 is shown the operating position of the outriggers 14 and 15 on sloping ground and again, the floats 21 at the right are each adjusted to the upper position and each outrigger beam 19 is actuated to the extent necessary to level the crane 1 or other equipment. For purposes of leveling, the crane 1 is provided with a bubble level (not shown) and by thus leveling the equipment there is a substantial saving in swing clutch wear and tear since uphill swinging of the boom 9 is eliminated, such leveling also relieving long booms 9 of hazardous side loadings. Another feature of this invention is that one or both sides of the carrier may be lifted from the ground to provide for quick jacking up of the wheels for tire changes, or for lifting the wheels out of soft spots in the ground. Because there are two longitudinally spaced beams 19 on each side the crane 1 may also be leveled fore and aft.

As previously mentioned, the series of holes 29 in each outrigger beam 19 are intended for reception of a locking pin 28 which has its ends projecting beyond the sides of the beam 19 to engage the adjacent end of the housing 16. However, by reason of the novel wedge locks 26 and 27 the outrigger beams 19 are rendered self-locking in any extended position and, therefore, the locking pins 28 are not necessary at all except as reassurance to workmen who, by reason of union regulations or fear complexes are not inclined to work near equipment that they believe to be locked only by the hydraulic system. However, it has been demonstrated that the aspheric lines herein may be completely severed and the pins 28 pulled out without any danger of collapsing of the outrigger beams 19 from their extended ground-engaging positions.

By way of illustrative example, it has been found that the present outriggers 14 and 15 can be set up very quickly. Actually the four outrigger beams 19 herein shown can be fully extended to working position within a matter of a little over one minute, namely, seventy-six seconds. Of course, each outrigger beam 19 may be controlled independently to adjust to varying ground conditions as, for example, some floats 21 may be adjusted to their lower positions to engage on downwardly sloping ground or to engage in hollows or ditches in the ground, and floats 21 may be adjusted to their upper positions to engage upwardly sloping ground or on bumps or rises in the ground. For highway travel the outrigger beams 19 are fully retracted and the floats 21 automatically fold back flush against the ends of the boxes 16 for maximum road clearance, as best shown in FIG. 1. However, for frequent on-the-ground moves the beams 19 need only be retracted until the floats 21 have about eight inches of ground clearance, and such retraction takes only a matter of twenty seconds, whereupon the machine may be moved to the next position wherein in another twenty seconds actuating means 21 to start productive work again. Thus, the total time is just forty seconds plus the travel time for each move-up of the machine.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position wherein an end thereof is engaged with the ground; the combination therewith of support means on said carrier engaging the top and bottom sides of said beam at points that are located to resist upward swinging of said beam by upward reaction of the ground against such one end and to provide frictional locking of said beam in extended position without aid of said actuating means.

2. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position wherein an end thereof is engaged with the ground; the combination therewith of support means on said carrier engaging the top and bottom sides of said beam at points that are located to resist upward swinging of said beam by upward reaction of the ground against such one end and to provide frictional locking of said beam in extended position without aid of said actuating means.

3. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position wherein an end thereof is engaged with the ground; the combination therewith of support means on said carrier engaging the top and bottom sides of said beam at points that are located to resist upward swinging of said beam by upward reaction of the ground against such one end and to provide frictional locking of said beam in extended position without aid of said actuating means.

4. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means
simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position whereat an end thereof is engaged with the ground; the combination therewith of fluid pressure means on said carrier engaging the top and bottom sides of said beam at points that are located to resist upward swinging of said beam by upward reaction of the ground against such one end and to provide normal reaction forces therewith which when multiplied by the coefficient of friction of said support means and said beam exceeds the force component of such upward reaction acting longitudinally of said beam whereby locking said beam in extended position without aid of said actuating means.

5. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position whereat an end thereof is engaged with the ground; the combination therewith of friction shoes on said carrier engaging the top and bottom sides of said beam at points that are located to provide a horizontal to vertical ratio in the extension movement of said beam of about 2:1 which, in relation to the coefficient of friction of said shoes on said beam, is effective to lock said beam in extended position against the upward reaction of the ground against such one end without aid of said actuating means.

6. In an outrigger of the type which is characterized by the provision of a beam and actuating means therefor which are adapted to be mounted on a carrier for longitudinal movement of said beam by said actuating means simultaneously outwardly and downwardly from a retracted position clearing the ground to an extended position whereat an end thereof is engaged with the ground; the combination therewith of support means on said carrier engaging the top and bottom sides of said beam at points that are located to resist upward swinging of said beam by upward reaction of the ground against such one end and to provide frictional locking of said beam in extended position without aid of said actuating means, said actuating means comprising a double-acting cylinder assembly including a main cylinder, a secondary cylinder formed as a piston to reciprocate in said main cylinder, and a piston reciprocable in said secondary cylinder and having a piston rod extending through the latter said cylinder and piston rod being connected to said carrier and beam; fluid pressure supply and return lines connected with said main cylinder at its ends to act on said secondary cylinder and piston to move them in one direction and to act on said secondary cylinder to move it in the opposite direction, and a flexible fluid pressure supply and return line connected with an end of said secondary cylinder to act on said piston also to move it in such opposite direction.

7. The outrigger of claim 6 wherein said actuating means further includes a hose reel rotatably mounted on said carrier from which said flexible line is unwound and rewound responsive to movement of said secondary cylinder in opposite directions.

8. The outrigger of claim 7 wherein said flexible line includes a helically coiled portion ahead of the portion thereof wound around said reel adapted to be connected alternately with a source of fluid pressure and with a fluid reservoir, said helically coiled portion being free to increase and decrease in diameter responsive to rotation of said reel in opposite directions.

9. The outrigger of claim 7 wherein spring means are provided to act on said reel to maintain tension on said flexible line.

10. An outrigger comprising a hollow housing open at one end and adapted to be mounted in transverse, generally horizontal position on a carrier; a longitudinally curved beam in said housing having a ground-engaging float at an end thereof; guide means in said housing respectively engaging the top and bottom curved sides of said beam at longitudinally spaced points serving to guide said beam for longitudinal movement through such open end from a retracted position in said housing to an extended position whereat said float is moved out and down simultaneously to ground-engaging position spaced to one side of the carrier; and a double acting hydraulic cylinder assembly extending generally lengthwise of said beam and having its ends connected to said housing and to said beam respectively and operating to move said beam to extended position and back to retracted position; said guide means being so constructed and disposed relative to said beam as to frictionally lock said beam in extended position against upward ground reaction on said float even when said cylinder assembly is wholly disabled.

11. The outrigger of claim 10 wherein said float is formed to be mounted in a lower position and an upper position with respect to said beam respectively and engage in a hollow or ditch in the ground on that side of the carrier or on ground that slopes downwardly away from that side of the carrier and to engage a bump or rise in the ground on that side of the carrier or on ground that slopes upwardly away from that side of the carrier.

12. The outrigger of claim 10 wherein said guide means comprises a pair of beam engaging shoes disposed at an angle such that the normal force components of the upward reaction of the ground at said shoes exceeds the force component longitudinally of said beam multiplied by the coefficient of friction of said shoes on said beam.

13. An outrigger assembly comprising a hollow housing open at both ends and adapted to be mounted in transverse, generally horizontal position on a carrier; a pair of longitudinally curved beams disposed in side by side relation in said housing and each having a ground engaging float at one end thereof; guide means in said housing respectively engaging the top and bottom curved sides of each beam at longitudinally spaced points serving to guide said beams for longitudinal movement through the respective open ends from retracted positions in said housing to extended positions whereat said floats are moved out and down to ground-engaging positions on opposite sides of the carrier; and power means operative to independently move said beams as aforesaid; said guide means being so constructed and disposed relative to said beams as to frictionally lock them in extended positions against upward ground reaction on said floats even when said power means are wholly disabled.

14. The outrigger assembly of claim 13 wherein said guide means comprise shoes fixed in said housing to provide a mechanical advantage of the horizontal force components over the vertical force components at said floats.

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