

March 23, 1971

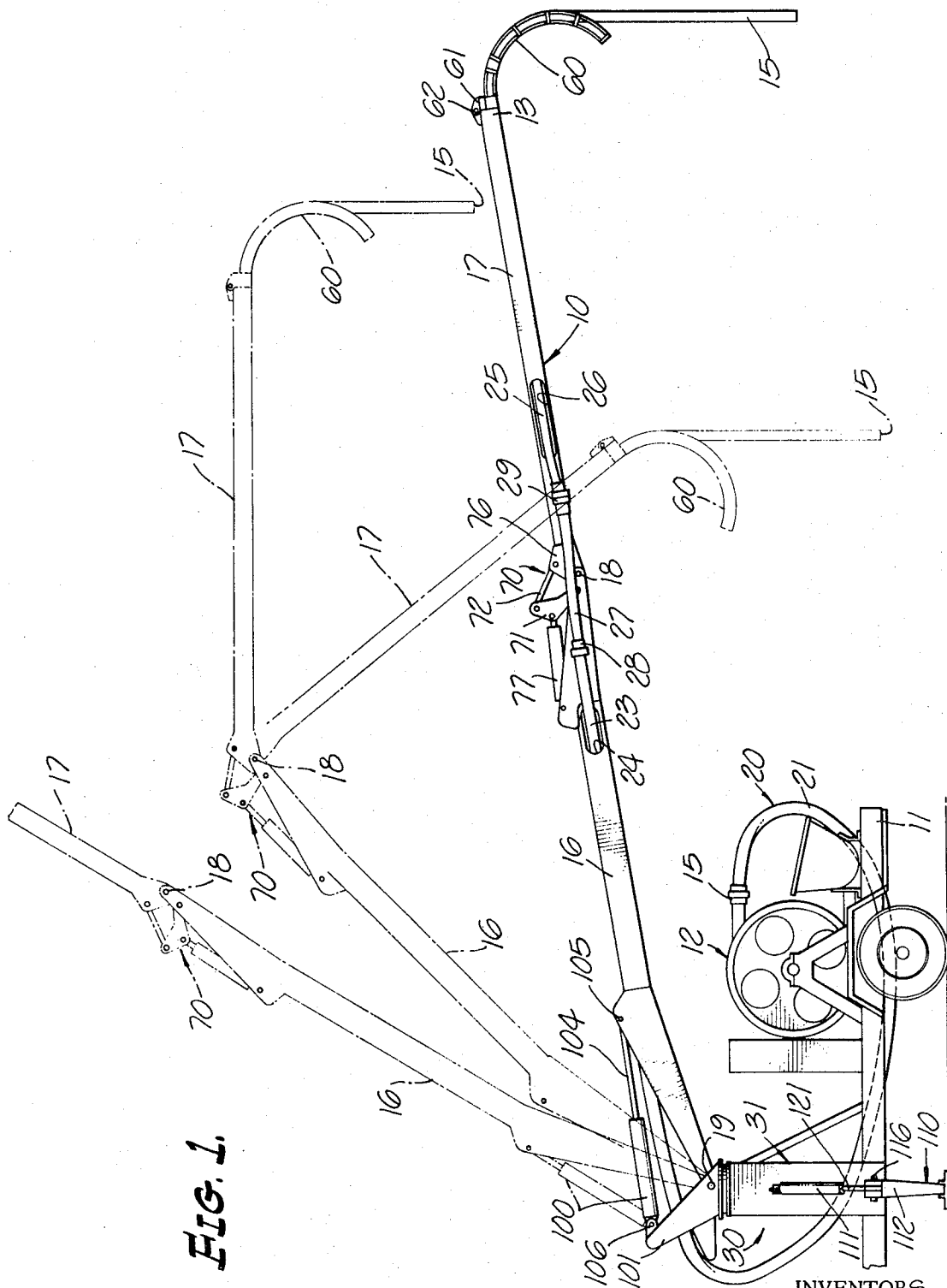
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3,572,380

CONCRETE PUMP BOOM

Filed Oct. 8, 1968

3 Sheets-Sheet 1



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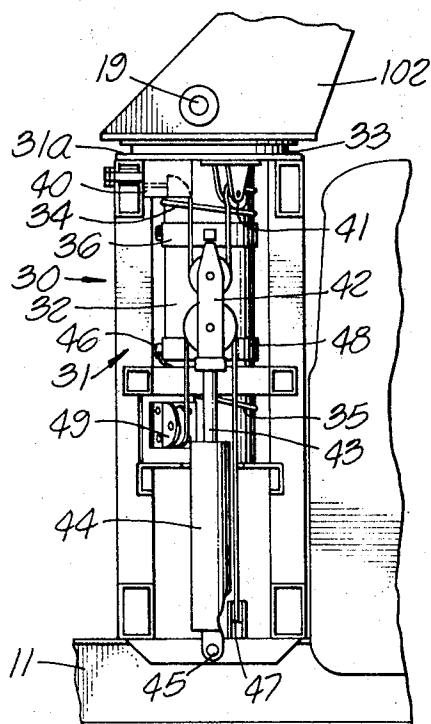
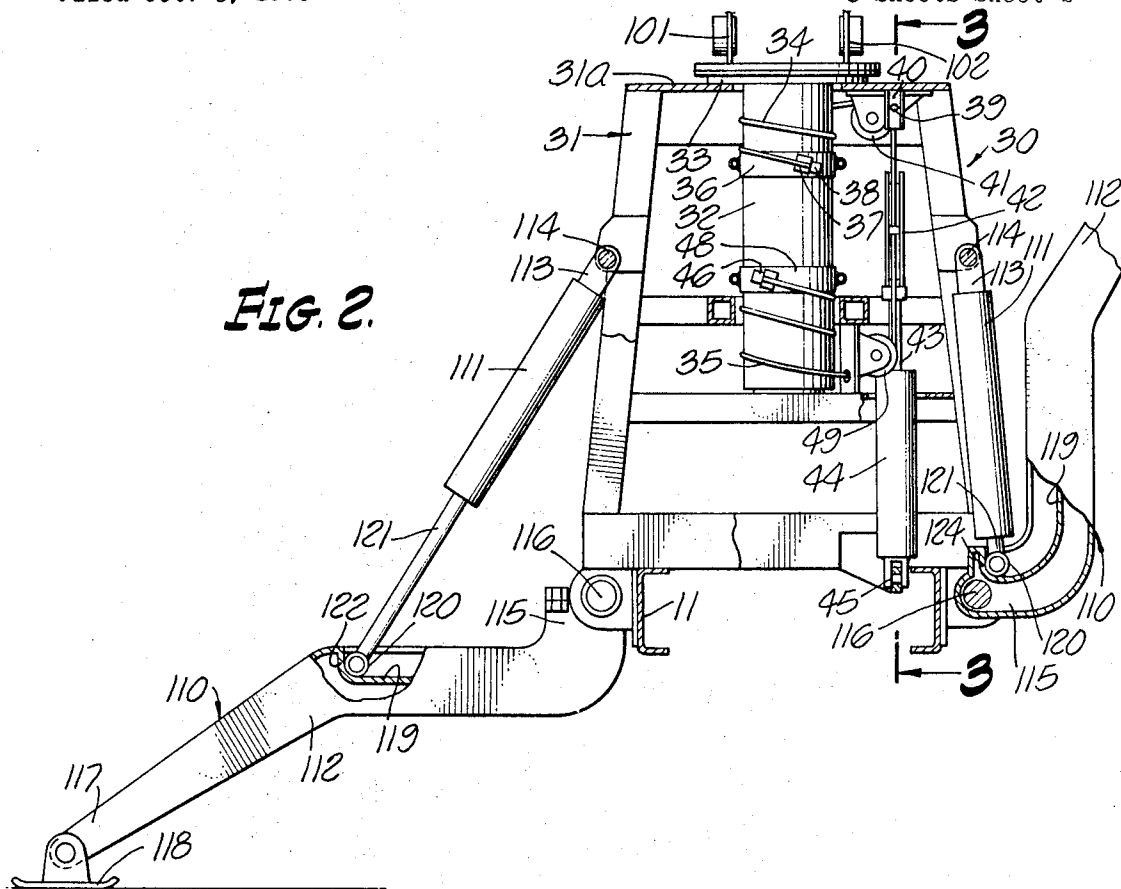
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

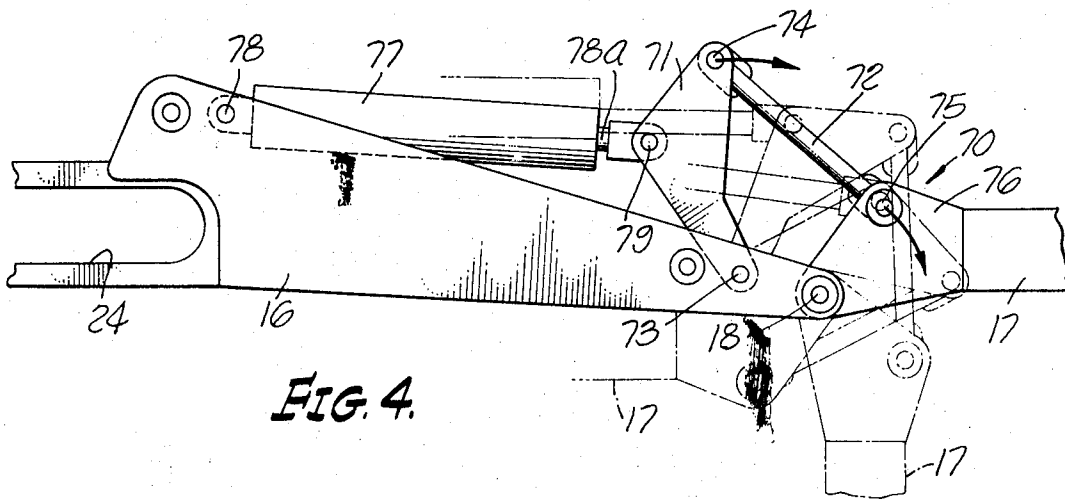


FIG. 4.

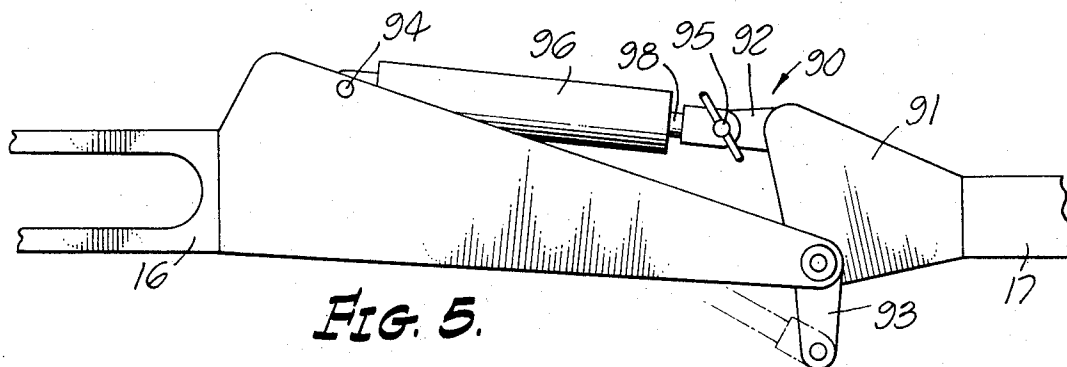


FIG. 5.

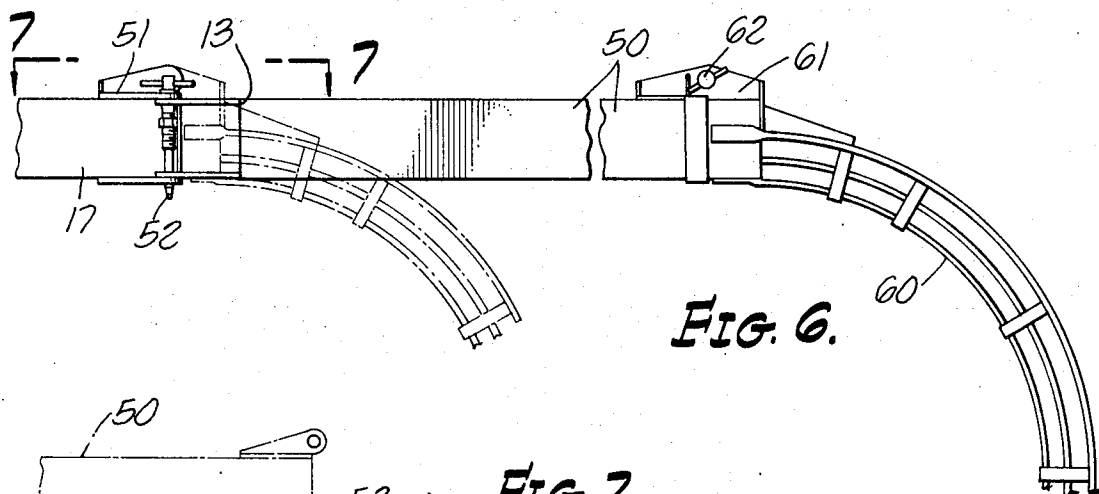


FIG. 6.

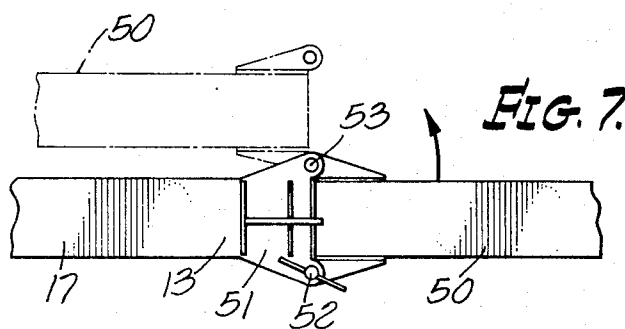


FIG. 7.

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3,572,380

CONCRETE PUMP BOOM

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16 Claims

ABSTRACT OF THE DISCLOSURE

An articulated and hydraulically operated boom includes pivotally connected boom segments to support a conduit which communicates concrete pumped from a concrete pump to any selected location above and below ground level within a predetermined radius. One of the boom segments is pivotally and rotatably secured to a portable chassis which includes a plurality of outriggers to provide stability during the pumping operation.

This invention relates to a boom of the type employing in part a flexible conduit which communicates concrete from a concrete pump and the invention is particularly directed to improvements in the articulation of the boom.

Manual placement of mixed concrete on a construction job has always been a major problem but recent wide spread use and development of concrete pumps has helped reduce this problem. However, placement of the pumped concrete by the use of a discharge hose alone is still very time consuming and expensive since it usually requires several men and, in most instances, special rigging for each phase of the job.

Booms to support and locate the discharge hose have been used before, but up to now the use of such booms has not been entirely satisfactory. Furthermore, each time a boom was moved into a position for use, a lengthy set up was usually required to insure stability of the boom during the pumping operation. Also, the range of coverage by a boom from one position was sometimes so limited that it either precluded the use of the boom or required that the boom be moved several times which caused additional time consuming set ups. Further problems resulted because of the manner in which the conduit was supported by the boom, particularly at the joints, and because of inadequate and flexibility of the boom.

Briefly, the present boom includes boom segments which are pivotally linked together, with one of the segments pivotally and rotatably secured to a portable chassis. A conduit communicates concrete from a concrete pump on the chassis to the point of placement. This conduit is supported by the boom segments and a substantial portion of the conduit is mounted within the segments. A turning apparatus mounted on the chassis turns the boom segments and retractable outriggers level and stabilize the portable chassis during the pumping operation.

Accordingly it is a principal object of this invention to provide a novel form of articulated boom wherein the movement of the boom is hydraulically controlled for precise movement.

Another object of this invention is to provide a novel form of boom which adequately supports and protects the conduit hose without impairing the movement of the boom.

Still another object of this invention is to provide a novel form of drive arrangement for turning the boom on a portable chassis employing a hydraulic cylinder assembly.

A further object of this invention is to provide a novel form of hydraulically operated, retractable outriggers

which operate independently to level and stabilize the portable chassis during the pumping operation.

Still another object of this invention is to provide a novel form of linkage system connecting the boom segments to allow the boom to place concrete both above and below ground level.

Other and more detailed objects and advantages of this invention will appear from the following description and the accompanying drawings, wherein:

FIG. 1 is a side view of the boom with phantom lines illustrating the articulated movement of the boom.

FIG. 2 is an end view partially in section showing the apparatus which turns the boom segments on the portable chassis and the outrigger assemblies which stabilize the portable carrier during the pumping operation.

FIG. 3 is a side view taken substantially on the line 3—3 of FIG. 2.

FIG. 4 is a side view of the linkage system at the joint which pivotally connects the boom segments, with phantom lines illustrating the operation of the linkage system.

FIG. 5 is a side view similar to FIG. 4 but illustrating a modified form of the linkage system.

FIG. 6 is a side view showing the discharge end of the boom and the connection of an additional boom segment to the boom.

FIG. 7 is a top view illustrating the connection of the additional boom segment of FIG. 6 taken substantially on line 7—7 of FIG. 6.

Referring now in detail to the drawings and particularly to the embodiment illustrated in FIG. 1, the concrete placement boom is generally designated 10 and includes a portable mobile chassis 11 to transport the boom. A concrete pump 12 is mounted on the portable chassis 11 and pumps conventional or light weight concrete either horizontally or vertically. A conduit assembly, generally designated 20, communicates the concrete from the pump 12 to the discharge end 15 of the conduit assembly 20. A coupling 14 connects the conduit assembly 20 to the pump 12. Hollow boom segments 16 and 17 support, position and protect the conduit assembly 20 during operation of the boom 10. The boom segments 16 and 17 are pivotally connected at a joint 18 and boom segment 16 is pivotally and rotatably connected at one end 19 to a turning apparatus, generally designated 30, which is mounted to the chassis 11. Pivotaly connected to the chassis 11 are outrigger assemblies, generally designated 110. The outrigger assemblies 110 stabilize and level the chassis during boom operation.

The conduit assembly 20 may be of various diameters and materials depending on the desired flow of concrete and load on the boom. The conduit assembly 20 generally includes a first flexible section 21, preferably rubber, between the pump and the end 19 of the boom segment 16. A coupling, not shown, positioned inside boom segment 16 connects the first flexible section 21 to a second section 23, which preferably is of rigid construction for long wear and is sometimes referred to as "slick-line" pipe. The rigid second section 23 extends within the hollow boom segment 16 from any convenient point therealong to a longitudinal slot 24 located on the side of boom segment 16 relatively near the joint 18. A fourth flexible section 25 of the conduit assembly 20, preferably rubber, extends from a longitudinal slot 26 on the side of the hollow boom segment 17 to the discharge end 15. The flexible fourth section 25 is located within the boom segment 17 between the slot 26 and the end 13 of the boom segment 17. A third flexible section 27 of the conduit assembly 20 is located laterally of the joint 18 and outside boom segments 16 and 17 and is connected at one end by a coupling 28 to the rigid second section 23 and at the other end by a coupling 29 to the flexible fourth section 25 to provide com-

munication between sections 23 and 25. Therefore, being relatively short, the third section 27 of the conduit assembly 20, which is subjected to a great deal of bending and wear, can be replaced easily and inexpensively when worn without replacing the entire conduit assembly 20. Also short section 27 may be disconnected or removed when folding the boom for transportation after the pumping operation has been completed. Since the other flexible sections of conduit are not part of the boom structure, they may be replaced individually when worn. Moreover, section 27 can be constructed of a more flexible material than the other sections of the conduit assembly 20 to minimize interference with the movement of the boom segments 16 and 17 and free of joint 18, concrete flow through the conduit assembly 20 is less likely to be restricted in this area during articulation of the boom 10.

As shown in FIGS. 6 and 7, a third hollow boom segment 50, is connected to end 13 of boom segment 17 and can be manually swung from its normal position extending along the side of boom segment 17 into a position in front of and in straight alignment with boom segment 17 to increase the overall length of the boom 10. When the added boom segment 50 is used, the flexible fourth section 25 of the conduit assembly 20 is increased and the additional portion is positioned within and extends the length of boom segment 50. A latch 51 located at end 13 connects boom segment 50 to boom segment 17. A pin 52 located on one side of the latch 51 can be removed to allow boom segment 50 to pivot at 53 until it is adjacent to boom segment 17 as shown by the phantom lines in FIG. 7. This adjacent or so called "folded" position is the position of boom segment 50 when it is not being used and when the boom 10 is being transported.

A saddle or cradle 60, shown in FIG. 6, is connected to boom segment 17, or to boom segment 50 when it is used, and guides and supports the discharge end 15 of the conduit assembly 20 during placement of the concrete. A lug 61 having a cantilevered pin 62 engages a hole in the particular boom segment when the saddle 60 is raised 90° from the operating position. After the pin 62 engages the hole the saddle 60 is lowered into the operating position where it is retained either by a guide flange (not shown), which engages the end segment of the boom, or locating pins (not shown) which prevent disengagement of the pin 62 from the hole on the adjacent boom segment. To remove the saddle 60, it is rotated 90° up from the operating position and the pin 62 is removed.

A linkage assembly shown in FIG. 4 and generally designated 70, is located near pivot 18 and allows boom segment 17 to be pivoted from a folded position under boom segment 16 a full 180° in a vertical plane about boom segment 16. Linkage system 70 includes a triangular shaped bell crank 71 and a link rod 72. One corner of the bell crank 71 is pivotally connected at 73 to the boom segment 16. Another corner of the bell crank 71 is pivotally connected at 74 to one end of the link rod 72 and the other end of the link rod 72 is pivotally connected at 75 to the foot 76 of the boom segment 17. Movement of the bell crank is accomplished by the use of a double acting hydraulic cylinder assembly 77 which is pivotally connected at one end 78 to the boom segment 16. The piston rod 78a of the hydraulic cylinder assembly 77 extends axially from the cylinder assembly and is pivotally connected at 79 to the bell crank 71. The boom segment 17 is raised from the folded position by retracting the piston rod 78a which pivots the bell crank 71 at an axis 73 causing the link rod 72 to pull at 75 on the foot 76 and pivot boom segment 17 at the joint 18. By advancing the piston rod 78a, the boom segment 17 is lowered in a similar fashion.

FIG. 5 illustrates a modified linkage assembly, generally designated 90, which also provides for a 180° pivot of boom segment 17 about boom segment 16 with the use of less components than the linkage system 70, but it requires a two step operation. As before, the movement

of the linkage system is accomplished through use of a double acting hydraulic cylinder assembly 96 pivotally connected at one end 97 to the boom segment 16. A foot 91 of the boom segment 17 includes a pair of rigid flange arms 92 and 93. Each flange arm 92 and 93 is adapted to be pivotally connected by a removable pin 95 to the piston rod 97 extending axially from the cylinder assembly 96. The boom segment 17 is raised from the folded position by first attaching piston rod 97 to the flange arm 93 and then retracting piston rod 97 until boom segment 17 has swung a full 90° at which position the three working pivot points are in line and inertia carries boom segment 17 past center. The piston rod 97 is then extended to move boom segment 17 another 90° to its extended position parallel with boom segment 16. The end 13 of boom segment 17 is rested on the ground and the piston rod 97 is then manually disconnected from flange 93 and connected to flange 92. Once the piston rod 97 has been connected to flange 92 the cylinder assembly 96 may be used to move boom segment 17 through 90°. The steps are merely reversed when it is desired to lower the boom segment 17 into its storage position beneath segment 16.

Another hydraulic cylinder assembly 100 pivots the boom segments 16 and 17, and also boom segment 50 when it is used, in a vertical plane 90° about end 19 of the boom segment 16. End 19 is mounted on a horizontal axis between a pair of vertical flange members 101 and 102 which are connected to the turning apparatus 30. Pivotally connected at 106 between the upper ends of flange members 101 and 102 is the end of the cylindrical sleeve of the hydraulic cylinder assembly 100. The piston rod 104 extending axially from the cylinder assembly 100 is pivotally connected at 105 to the boom segment 16. Retraction of the piston rod 104 will raise the boom segment 16 90° from a horizontal position to a vertical position. Extension of the piston rod 104 lowers the boom segments.

Horizontal movement and positioning of the boom segments and conduit assembly 20 is provided by the turning apparatus 30, shown in FIGS. 2 and 3, which is hydraulically operated for smooth and precise movement. The chassis 11 includes an upwardly extending frame 31 which is rigidly mounted on the chassis 11 and has a horizontal platform 31a. The turning apparatus 30 includes a vertical drum 32 which is rotatably mounted on the frame, generally designated 31, and has a turntable 33 on its upper end. The turntable 33 includes the flange members 101 and 102 and rests on bearings, not shown, positioned between the bottom of the turntable 33 and the platform 31a. The bearings support the turntable 33 and allow it to rotate on the platform 31a. Similar bearings, also not shown, are positioned between the bottom of the drum 32 and the frame 31 to allow for rotation of the drum. The turning apparatus 30 also includes a pair of cables 34 and 35. A collar 36 mounted circumferentially on the drum 32 has a slotted member 37 which receives one end 38 of the cable 34 to secure that end of the cable to the drum. The other end 39 of the cable 34 is secured at 40 to the platform 31a. A portion of the cable 34 extending from end 38 is wrapped clockwise and circumferentially about the drum 32. The unwrapped remaining portion of the cable 34 extends from the drum 32 into a single sheave 41 mounted on the bottom of the platform 31a. The single sheave 41 guides the unwrapped cable 34 downwardly onto the upper one of a double sheave or pulley 42 which in turn guides the cable 34 back up to the secured end 39 of the cable. The double sheave or pulley 42 is connected to the end of a piston rod 43 of a hydraulic cylinder assembly 44. The end 45 of the hydraulic cylinder assembly 44 is connected to the frame 31.

A collar 48 similar to collar 36 and mounted circumferentially around the drum 32 secures one end 46 of the cable 35 to the drum 32. The other end 47 of the cable 35 is secured to the frame 31. A portion of the cable 35 beginning at end 46 is wrapped counter-clock-

wise about the drum 32. Single sheave 49 mounted on the frame 31 and similar to sheave 41, guides the unwrapped portion of the cable 35 from the drum 32 upwardly onto the lower sheave or pulley of the double sheave or pulley 42 which in turn guides the cable back down to the secured end 47.

Rotation of the drum 32 and the turntable 33 in either direction is accomplished by moving the piston rod 43 vertically toward the secured end of the unwrapped portion of one cable and away from the secured end of the unwrapped portion of the other cable. This causes the double sheave 42 to pull on one of the cables to unwrap a portion of that cable from the drum 32 while allowing an additional portion of the other cable to wrap around the drum. The length of cable unwrapped is approximately twice the length which the double sheave moves. This pulling and unwrapping of a cable causes the drum to turn. The collars 36 and 48 are circumferentially adjustable to select the desired arc of turning of the boom. The length of the stroke of piston rod 43, taken with the diameter of drum 32, determines the degree of turning that can be accomplished which preferably should approach 360°.

Outrigger assemblies 110 stabilize the chassis 11 when the boom segments are elevated. The outrigger assemblies 110 are hydraulically raised and lowered. FIG. 2 illustrates outrigger assemblies in both the operating lowered position and the nonoperating raised position at the left and right, respectively, of the figure. In the nonoperating position the outrigger assembly 110 is essentially adjacent to the frame 31 and is usually held in place during transportation by a chain, not shown, which is wrapped around the outrigger assembly and frame 31. Normally, two outrigger assemblies 110 are positioned on either side of the chassis 11, however, more outrigger assemblies can be employed if desired. Each outrigger assembly 110 includes a hydraulic cylinder assembly 111 and an outrigger arm 112. The end 113 of the cylinder assembly 111 is pivotally connected at 114 to the frame and one end 115 of the outrigger arm 112 is pivotally connected at 116 to the chassis 11 below the frame 31. The other end 117 of the outrigger arm 112 is equipped with a foot pad 118 which contacts the ground surface and pivots at 119 on the arm 112 to adjust to the contour of the ground.

Within a portion of the outrigger arm 112 is a cam track 119. A cam follower 120, connected to the piston rod 121 of the hydraulic cylinder 111, is slidably mounted on the cam track 119. The cam follower 120 moves between a pair of stops 124 and 122 located at each end of the cam track 119. Stop 124 is located relatively near the pivot end 115 of the outrigger arm 112 and stop 122 is located relatively distant from the pivot end 115. When the outrigger arm 112 is being lowered, the cam follower 120 moves from stop 124 on cam track 119 towards and finally against stop 124. A 90° turn in the cam track at 123 prevents the cam follower 120 from moving back towards stop 122 when the outrigger arm 112 is being raised. Thus, the outrigger arm 112 is raised and pivoted through substantially 90° in a single stroke by merely retracting the piston rod 121. The length of the stroke of the piston rod required to raise the arm 112 adjacent to the frame 31 is reduced to a minimum because of the short moment arm between stop 124 and the pivot 116. Extending the piston rod 121 lowers the outrigger arm 112 and the long moment arm between stop 122 and the pivot 116 provides a large force at the foot pad 118 to insure adequate stability.

The operation of the concrete pump boom is as follows:

To mobile chassis 11 transports the concrete pump boom into position. The outrigger safety chains are then released and a remote control switch actuates the hydraulic cylinders 111 to extend the piston rod 121 and lower the outrigger arm 112 until the chassis and frame 31 have been adequately stabilized. If the ground is not firm, additional blocking may be placed under the outrigger foot pads 118 to increase stability.

The boom segment 16 is then elevated by causing the hydraulic cylinder assembly 100 to retract piston rod 104. Boom segment 16 is raised until there is sufficient clearance over the concrete pump 12 to permit boom segment 17, located underneath and adjacent to boom segment 16, to be unfolded by pivoting it vertically about boom segment 16 at joint 18. In the preferred embodiment this is accomplished by actuating the hydraulic cylinder assembly 77 and retracting the axially extending piston rod 78a. When the modified linkage system 90 is employed, the piston rod 97 is first retracted to move boom segment 17 90°. Inertia moves the boom segment past center. The piston rod 97 is then retracted to move the boom segment the remaining 90°. Piston rod 97 may be disconnected from flange 93, connected to flange 92 and retracted, to swing a loaded boom segment 17 through 90°.

If it is desirable to increase the overall length of the boom, boom segment 50 is manually swung from along side boom segment 17 into a working position in front of and in straight alignment with boom 17 and latched into position by the pin 52.

The flexible portion 25 of the conduit assembly 20 is then threaded through boom section 17, and also boom section 50 if it is being used, until it extends out the longitudinal slot 26. The flexible portion 27 is then connected at one end to the rigid portion 23 and at the other end to the flexible portion 25. The saddle or cradle 60 is then attached to the end of the boom.

After the conduit has been properly positioned both boom segments 16 and 17 can be raised or lowered simultaneously to attain the height desired for placement of the concrete. To locate the discharge end 15 of the conduit assembly 20 in the proper horizontal position, hydraulic cylinder assembly 44 is actuated to retract or extend the piston rod 43 depending on which direction the boom segments are to be turned. The pumping operation is now ready to begin.

The control panel used to actuate the various hydraulic cylinder assemblies includes electric switches which are spring loaded and must be held on for continuous action. Therefore, as a safety measure a simple release of pressure on the switch will stop all action. The control panel may be located at the carrier or remotely at the point of placement or at any vantage point.

The concrete pump boom articulates to provide unmatched placement versatility and eliminates the time consuming awkwardness normally inherent in present booms. By being able to pivot the upper segment 17 of the boom in a downward direction the concrete can actually be discharged at points over walls or below ground level. The boom is compact and may be easily transported. Concrete may be placed by the boom at any angle from horizontal to nearly vertical. The placement of the concrete is precisely controlled by the boom and the boom can be operated at the chassis or remotely. Operation of the concrete pump boom is fully hydraulic and check valves throughout the hydraulic system freezes the boom segments and outrigger assemblies in position if the hydraulic power should fail for any reason.

Having fully described our invention in connection with a specific embodiment of concrete placing boom apparatus it is to be understood that I am not to be limited to the details herein set forth, but rather our invention is of the full scope of the appended claims.

I claim:

1. An articulated boom to place concrete pumped from a concrete pump, comprising: a portable chassis; first and second hollow boom segments; said first hollow boom segment having one end pivotally secured to said chassis; said second hollow boom segment pivotally connected to the other end of said first hollow boom segment; means to pivot said first and second hollow boom segments independently in a vertical plane; means on said chassis to turn said first and second hollow boom segments; conduit means to communicate concrete having one end for dis-

charge and having the other end connected to the concrete pump; and said conduit means having a substantial portion located axially within and completely supported by said first and second hollow boom segments without said conduit means structurally reinforcing said boom segments whereby said conduit means is moved and said discharge end is positioned entirely by pivoting and turning said first and second hollow boom segments.

2. An articulated boom to place concrete pumped from a concrete pump, comprising: a portable chassis, first and second hollow boom segments, said first hollow boom segment having one end pivotally secured to the said chassis, said second hollow boom segment pivotally connected to the other end of said first hollow boom segment, means to pivot said first and second hollow boom segments independently in a vertical plane, means on said chassis to turn said first and second hollow boom segments, conduit means to communicate concrete having one end for discharge and having the other end connected to the concrete pump; said conduit means having first, second, third and fourth sections; said first section having one end connected to the pump and being located between said pump and said first hollow boom section; said second section having one end connected to the other end of said first section and being located axially within said first hollow boom segment; said third section having one end connected to the other end of said second section and being located entirely outside said first and second hollow boom segments and adjacent to the pivotal connection of said first and second hollow boom segments; said fourth section having one end connected to the other end of said third section and the other end being the discharge end of said conduit means; and said fourth section being located axially within said second hollow boom segment and extending out the other end of said second hollow boom segment.

3. The combination as set forth in claim 2, wherein said first, third and fourth sections are flexible and said second section is rigid.

4. The combination as set forth in claim 2, wherein couplings connect said first section to said second section and said second section to said third section and said third section to said fourth section.

5. The combination as set forth in claim 2, wherein said third section is flexible for accommodating the pivoting between said first and second boom segments and can be disconnected from said second and fourth conduit sections.

6. The combination as set forth in claim 2, wherein a saddle connected to the other end of said second hollow boom segment supports and guides said fourth section extending out from said second hollow boom segment.

7. The combination as set forth in claim 2, wherein a third hollow boom segment in non-adjacent parallel straight alignment to said second hollow boom segment is connected at one end to the other end of said second hollow boom segment; and

said fourth section extending out from said second hollow boom segment is located axially within said third hollow boom segment and extends out the other end of said third hollow boom segment.

8. The combination as set forth in claim 7, wherein a saddle is connected to the other end of said third hollow boom segment to guide and support said fourth section extending out from said third hollow boom segment.

9. An articulated boom to place concrete pumped from a concrete pump, comprising:

a portable chassis carrying pivotally connected boom segments;
outrigger arms pivotally connected at one end to said chassis;
each said outrigger arm having a cam track;
each said cam track extending between a first stop radially close to the pivotally connected end of said outrigger arm and a second stop radially distant from

the pivotally connected end of said outrigger arm; a cam follower slidably mounted on each said cam track;

means to move each said cam follower on said cam track either towards and against said first stop to raise said outrigger arm about said pivotally connected end or towards and against said second stop to lower said outrigger arm to support said chassis during movement of said boom segments.

10. The combination as set forth in claim 9, wherein said means to move said cam follower includes a hydraulic cylinder assembly pivotally connected at one end to said chassis and connected at the other end to said cam follower.

11. The combination as set forth in claim 9, wherein the other end of said outrigger arm has adjustable means to contact the ground surface when said outrigger arm is lowered.

12. The combination as set forth in claim 9, wherein each said cam track has means to prevent said cam followers from moving back towards said second stop when said cam follower is moved against said first stop.

13. The combination as set forth in claim 9, wherein said outrigger arm pivots 90° between the lowered position and the raised position.

14. The combination as set forth in claim 9, wherein said cam track is contained within said outrigger arm.

15. The combination as set forth in claim 12, wherein said preventing means is a 90° turn in said cam track near said first stop.

16. A mobile boom apparatus placing concrete pumped from a concrete pump comprising:

a movable chassis having a plurality of outrigger arms each pivotally connected at one end to said chassis; adjustable means at the other end of each said outrigger arm to contact the ground surface; means to pivot each said outrigger arm at the pivotally connected end;

said pivot means including a cam track on each said outrigger arm, a cam follower slidably mounted on each said cam track and hydraulically operated means to slidably move each said cam follower on said cam tracks;

said cam track having a first stop radially close to the pivotally connected end of each said outrigger arm and a second stop radially distant from the pivotally connected end of each said outrigger arm whereby moving said cam follower against said first stop raises said outrigger and moving said cam follower against said second stop lowers said outrigger;

said chassis including a frame rigidly mounted to said chassis;

a vertical drum rotatably mounted on said frame; first and second cables each having a first end secured to said drum and each having a portion beginning at the end secured to the drum wrapped circumferentially about said drum;

said first and second cables wrapped in opposite directions;

said first cable having a second end secured to said frame;

said second cable having a second end secured to said chassis;

hydraulically operated means engaging the unwrapped portion of each said cable whereby moving said engaging means towards the second end of one said cable and away from the second end of the other said cable pulls on and unwraps one cable to turn said drum while allowing the other cable to wrap an additional portion on said drum;

first and second hollow boom segments;

said first hollow boom segment having one end pivotally secured to the upper end of said vertical drum;

hydraulically operated means to pivot said first hollow

boom segment in a vertical plane about said pivotally secured end;
 said second hollow boom segment having one end pivotally connected to the other end of said first hollow boom segments;
 5 hydraulically operated means to pivot said second hollow boom segment about said pivotally connected end in a vertical plane independent of said first hollow boom segment;
 10 conduit means to communicate concrete from the concrete pump;
 said conduit means having a substantial portion located axially within and supported by said first and second hollow boom segments; and
 said conduit means is positioned by pivoting and rotating said first and second hollow boom segments whereby the pumped concrete is discharged anywhere within a predetermined radius above or below ground level.

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U.S. Cl. X.R.

137—615