

[54] **HYDRAULIC ACTUATORS FOR ORIENTING IMPLEMENTS ON CRANES**

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Related U.S. Application Data

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[51] Int. Cl. **B66c 1/22**

[58] Field of Search..... 294/69, 70, 71, 82 R, 294/83 R, 88; 24/230.5 R, 230.5 AD, 230.5 SS, 230.5 SA, 230.5 PA; 37/117.5, 183, 186; 92/121, 125; 214/147 G, 657

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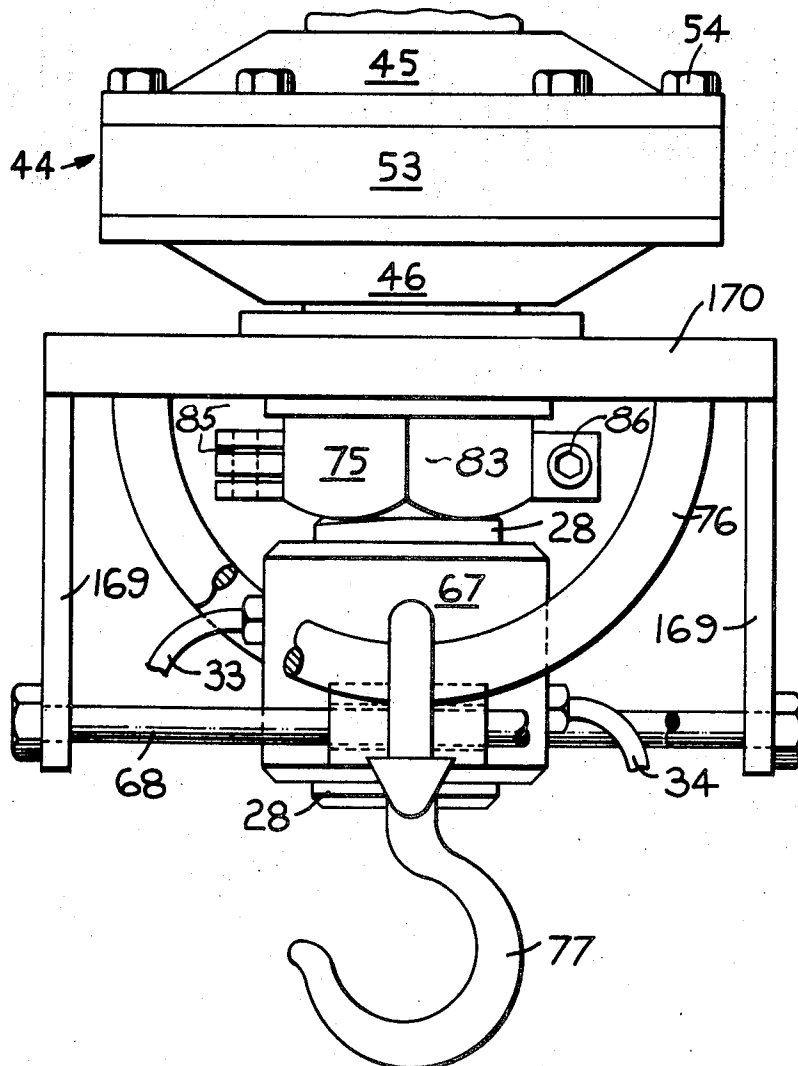
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[57]

ABSTRACT

A pressure plate which is adjustably supported on the end of the dipper stick has a depending non-rotatable shaft around which a circular hydraulic actuator is rotatably mounted, there being provision for removably supporting an implement for rotation around the shaft, together with means for detachably connecting the implement to the actuator so that the latter operates the implement in swiveling movement, hydraulic conduits for the actuator and implement being disposed within the non-rotatable shaft.

8 Claims, 7 Drawing Figures



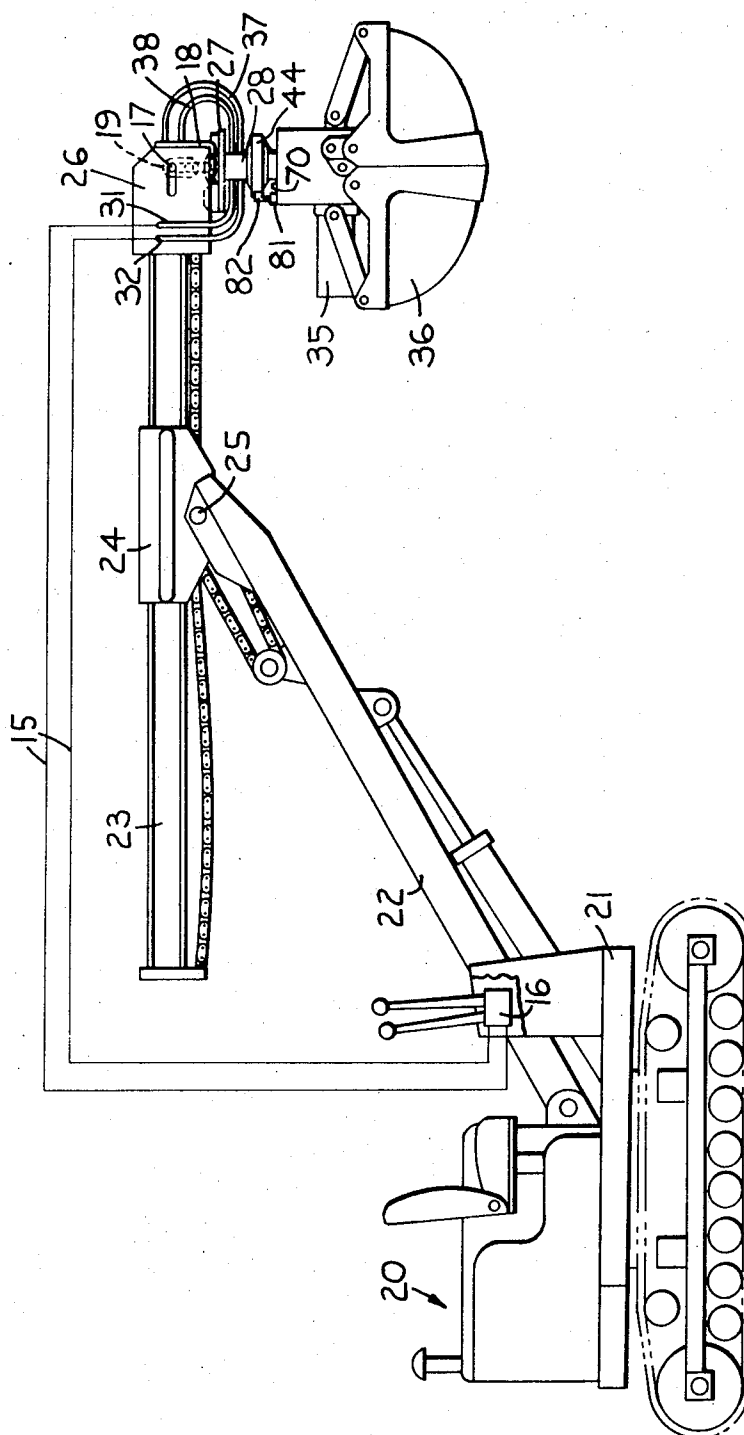


Fig. 1-

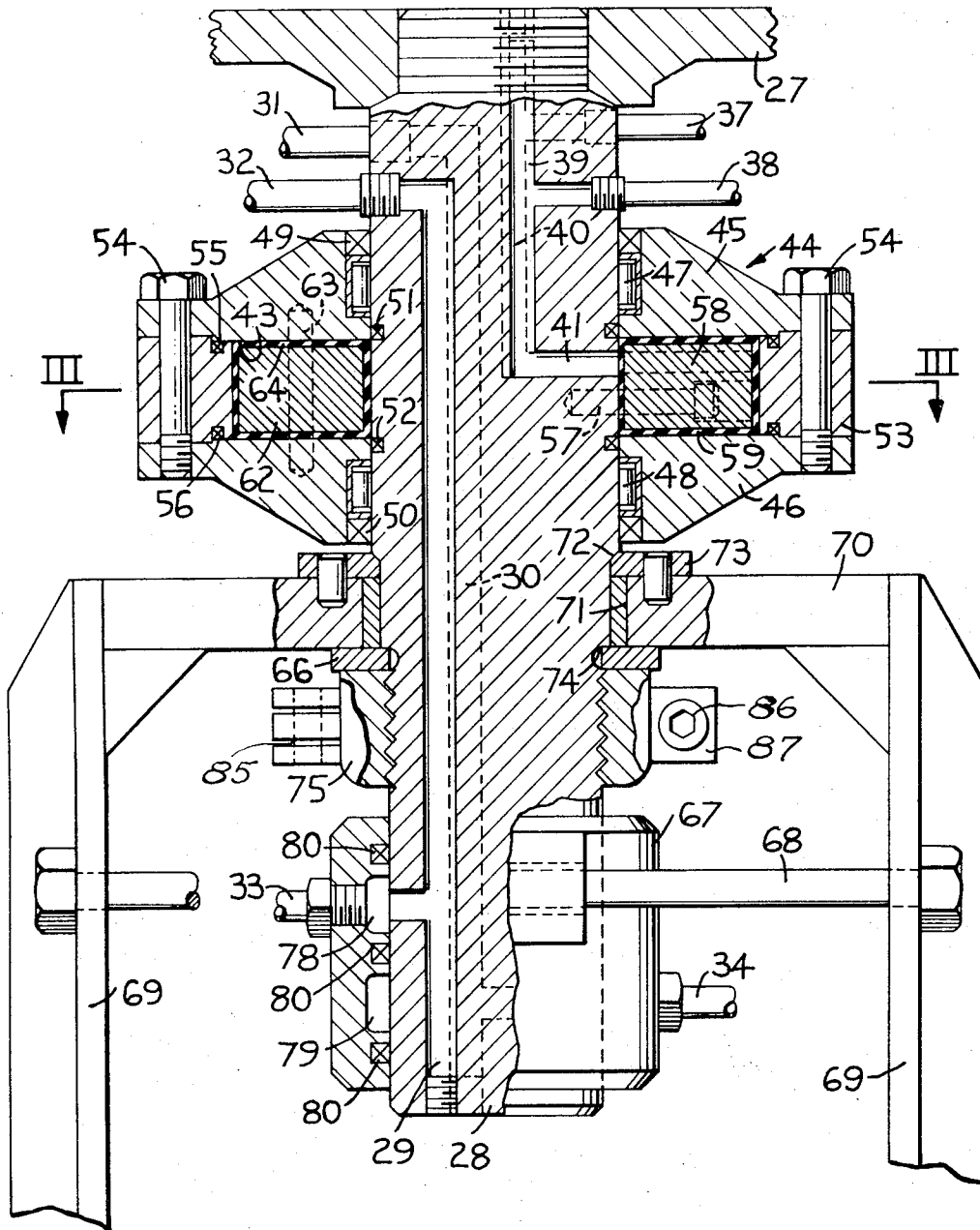


FIG. 2.

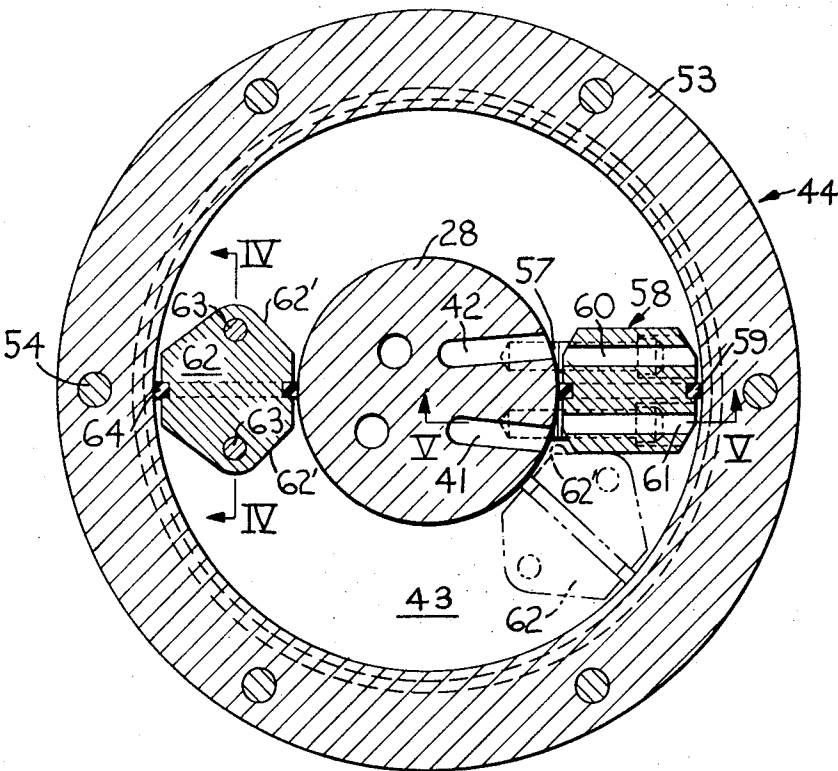


Fig. 3.

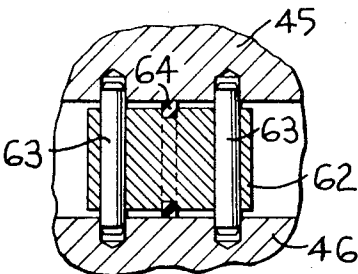


Fig. 4.

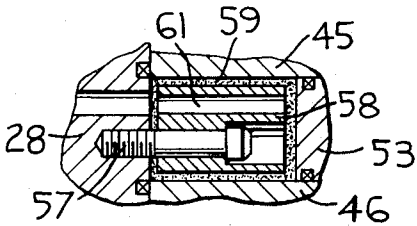
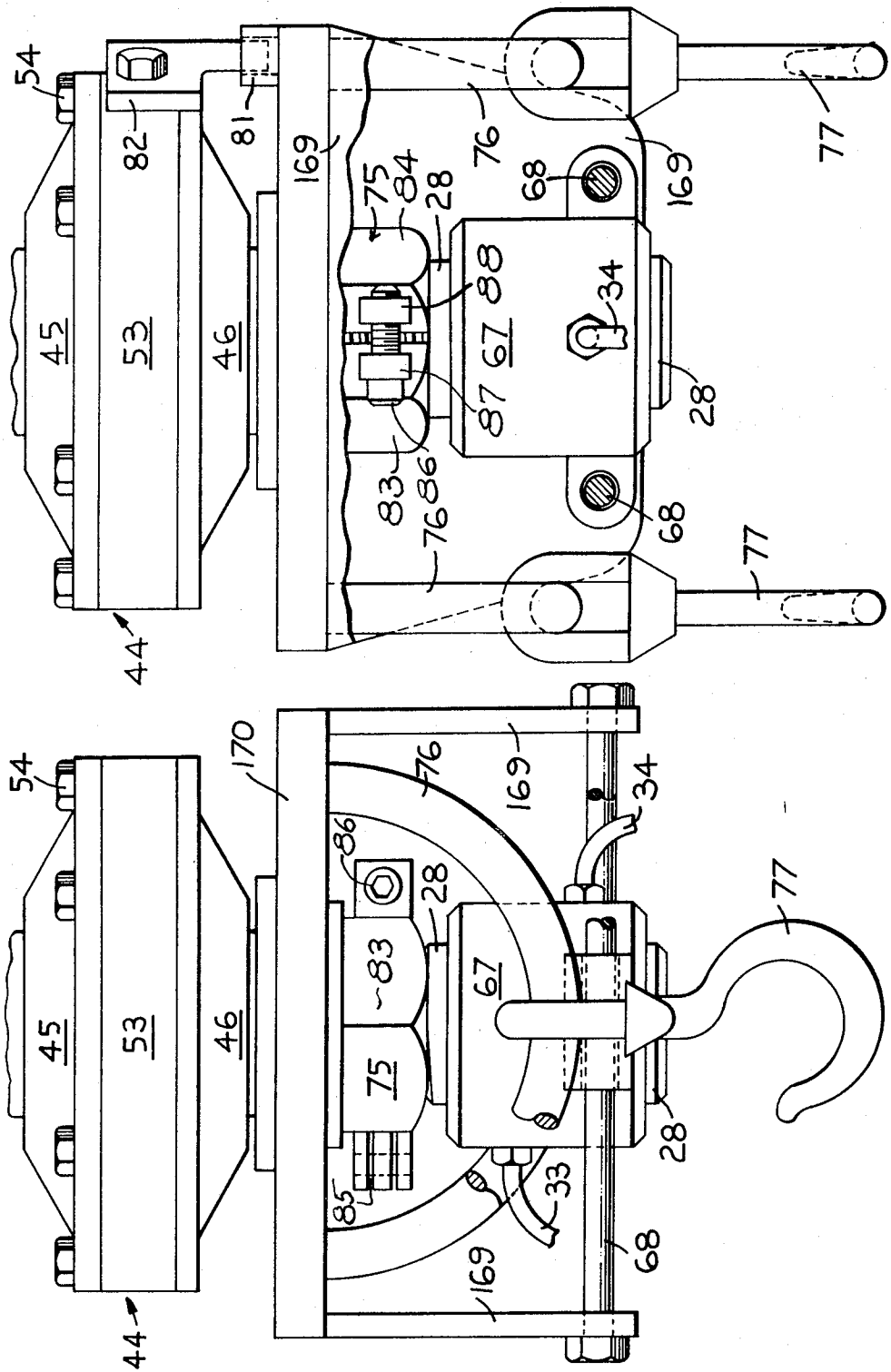


Fig. 5.

Fig. 7-

Fig. 6-



HYDRAULIC ACTUATORS FOR ORIENTING IMPLEMENTS ON CRANES

This is a division of application Ser. No. 879,686, filed Nov. 25, 1969, now Pat. No. 3,633,607.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The improved hydraulic actuator is particularly useful in cranes of the type having a dipper stick, the hydraulic actuator being capable of causing rotatable movement for various implements supported from the dipper stick such as clamshell buckets, twin hooks, trencher attachments, slope mowers, and various other attachments which may be suspended from twin hooks.

2. Description of the Prior Art

Heretofore most clamshell buckets have been of the "free fall" type. That is, the buckets are so supported that they are allowed to fall onto the work and the bowls are closed by pulling upwardly on cables. Thus the bucket relies on its own weight to dig into the ground. Where the ground is very hard it is difficult to dig with this type of bucket because it tends to skim over the surface. An improvement was disclosed in my prior U.S. Pat. Nos. 3,143,228 and 3,143,229 where there is a crane having a dipper stick from which an hydraulically operated clamshell bucket is adjustably suspended, there being cooperable male and female pressure plates with controlled means for causing either a tight or loose connection between the pressure plates. In my prior patents, however, there was no means for causing controlled swiveling movement of the bucket for better orienting the position thereof.

While means has heretofore been proposed for causing swiveling movement of a grapple hook or other hooks suspended from cables, such as in Carlson U.S. Pat. No. 2,736,600 and Lawton U.S. Pat. No. 3,210,114, and while Gafner U.S. Pat. No. 2,914,203 discloses a grapple hook on a pulp wood loader which can be hydraulically rotated, none of these patents discloses arrangements wherein the rotated means surrounds a swivel shaft which depends from a pressure plate where the latter is adjustably connected to a dipper stick in such a manner that digging pressures may be imposed upon the pressure plate, the construction, at the same time, providing for swiveling of the bucket or other implement on the swivel shaft. Furthermore, where there are hydraulically driven implements such as in Gafner, there are always loose cables leading to the implement which could become twisted during operation, and in Gafner the suspension and working load is through the actuator which would be unsatisfactory in a digging implement such as a clamshell bucket.

SUMMARY OF THE INVENTION

The present invention is for use in a crane or the like having a boom with a dipper stick adjustably connected thereto, in which there is a male pressure plate positioned for adjustable coaction with a female pressure plate on the bottom of the dip stick, the male plate being flexibly suspended from the female member in a manner which permits either a tight or loose connection between the male and female pressure plates while permitting the male pressure plate to assume various angles with respect to the dipper stick. As a feature of the present invention, depending rigidly from the male pressure plate is a non-rotatable shaft around which a circular hydraulic actuator is rotatably mounted, there

being provision for removably supporting an implement such as a bucket or twin hook assembly for rotation around the shaft, together with means for detachably connecting the implement to the hydraulic actuator so that operation of the actuator causes swiveling movement of a selected implement under control of the operator in the cab, hydraulic conduits for the actuator and implement being within the non-rotatable shaft to eliminate tangling problems.

A general object of the invention is to provide, in a device of the class described having a pressure plate, a swivel shaft for supporting an implement depending rigidly from said pressure plate, an hydraulic actuator surrounding the swivel shaft for rotation therearound and having means for effecting a detachable connection with an implement, with the latter detachably mounted on the swivel shaft.

A further object of the invention is to provide a device as above described in which hydraulic conduits for the hydraulic actuator and for the implement are embodied in the swivel shaft.

A further object is to provide for use in connection with a crane, means whereby interchangeable attachments such as clamshell buckets or hook assemblies may be swiveled to any selected position for best accomplishing the work.

A further object of the invention is to provide in a device of the class described, novel supporting means whereby a suspended implement may be swung to a selected angle and also swiveled to a selected position, the construction being rigidly supported from a pressure plate which permits a down pressure to be exerted in operations such as digging.

With the above and other objects in view the invention consists of the improved hydraulic actuators for orienting implements on cranes, and all of its parts and combinations, as set forth in the claims, and all equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, in which the same reference numerals designate the same parts in all of the views:

FIG. 1 is a side elevational view of a crane equipped with a dipper stick, including the hydraulic actuator;

FIG. 2 is a fragmentary view, principally in vertical section, showing a portion of a pressure plate with its depending swivel shaft, and showing the actuator and implement frame supported on the swivel shaft;

FIG. 3 is a transverse sectional view through the hydraulic actuator, taken approximately on the line 3—3 of FIG. 2;

FIG. 4 is a fragmentary sectional view taken approximately on the line 4—4 of FIG. 3;

FIG. 5 is a fragmentary sectional view taken approximately on the line 5—5 of FIG. 3;

FIG. 6 is a side elevational view showing how a twin hook assembly may be interchanged for the bucket of FIG. 1; and

FIG. 7 is a front elevational view of the structure of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to the drawings, the numeral 20 designates the tractor portion of a crane which has a turntable 21 supporting a pivoted boom 22.

A dipper stick 23 is adjustably slideable in a saddle 24 pivoted as at 25 on the boom. At the outer end of the dipper stick is an attachment 26, the lower end of which forms a female pressure member and has spaced side portions between which portions of a male pressure plate 27 fit, the L-shaped lower edges 18 of which side portions are adapted to coact with the top of the plate 27 to exert pressure thereon during digging. The male pressure plate 27 is angularly adjustably supported from the attachment 26 with either a tight or loose connection through a flexible connection 19 with a pin 17, as shown in FIG. 1. The L-shaped lower edges 18 of the female pressure plate may be made to engage the pressure plate end-on, in the right-angularly-suspended position of FIG. 1, or in a desired angular position therebetween in which there is corner engagement by the corners of the L-shaped edges 18. This pressure plate connection forms the subject matter of co-pending application Ser. No. 55,910. A similar support for a pressure plate from the dipper stick is disclosed in my prior U.S. Pat. No. 3,143,229, dated Aug. 4, 1964. This patent discloses an arrangement whereby a clamshell bucket may be hydraulically drawn into and out of engagement with the lower end of the dipper stick, and whereby digging pressure may be exerted on the pressure plate from which the bucket is suspended, and the same basic arrangement is employed in the structure of FIG. 1 of the present case.

THE SWIVEL SHAFT

Supported rigidly from the male pressure plate 27 is a swivel shaft 28, the lower portion of which is of enlarged diameter as shown in FIG. 2. Within the enlarged portion of the swivel shaft are hydraulic conduits 29 and 30. Flexible cables 31 and 32, which may connect with hydraulic conduits in the dipper stick, are connected with the upper ends of the conduits 29 and 30. Flexible cables 33 and 34 may connect the lower ends of the ducts 29 and 30 with an hydraulic operator in an implement, such as with the hydraulic cylinder 35 of the clamshell bucket 36 of FIG. 1. Other flexible conduits 37 and 38 extending from hydraulic conduits in the dipper stick connect with the upper ends of ducts 39 and 40 in the upper portion of the swivel shaft 28. These ducts extend downwardly in the swivel shaft for a short distance and then laterally as at 41 and 42 (see also FIG. 3) where they communicate with a circular chamber 43 in an hydraulic actuator 44 which surrounds the swivel shaft. The hydraulic conduits in the dipper stick are connected by hydraulic cables, with any suitable source of hydraulic fluid under pressure, and there may be a control valve 16 at the operator's station.

THE HYDRAULIC ACTUATOR

The hydraulic actuator 44 comprises upper and lower rings 45 and 46, respectively, which rotate around the swivel shaft 28 on roller bearing sets 47 and 48, there being suitable sealing rings 49 and 50, as well as O-rings 51 and 52. The upper and lower rings 45 and 46 are spaced apart by a spacer ring 53, and the parts are detachably held in assembled position by bolts 54 in the manner illustrated in FIG. 2, there being O-rings 55 and 56 between the spacer ring 53 and the upper and lower rings.

Bolted to the swivel shaft 28 by bolts 57 and positioned within the chamber 43 of the actuator, as shown

in FIG. 3, is a vane 58, there being a sealing member 59 surrounding the vane and making sealing contact with the inner sides of the upper and lower rings 45 and 46, and also with the spacer ring 53 and with the swivel shaft 28, as shown in FIGS. 2, 3 and 5. The vane is provided with a fluid passageway 60 on one side of the seal 59 and with a similar passageway 61 on the other side. The vane 58 is a stationary vane with the hydraulic actuator casing adapted to rotate around it.

Another vane 62 is pinned to the actuator as at 63 for rotation therewith. A sealing member 64 which surrounds this vane seals against the upper and lower rings 45 and 46 and against the spacer ring 53 of the swivel shaft 28 as illustrated.

Projecting from the spacer ring is a torque member (see FIG. 7) having a depending portion 82 which is adapted to make detachable connection with a socket 81 or the like on the deck 70 of an implement such as the bucket of FIG. 1 whereby, when the actuator is caused to rotate around the swivel shaft, it will cause swiveling movement of the suspended implement, such as the bucket 36 around the swivel shaft 28.

The lower portion of the swivel shaft 28 extends slideably through a sleeve 67 which is supported by rods 68 connecting with the sides 69 of the implement deck 70 so that the sleeve is rotatable around the shaft 28 with the implement. The deck has an opening 71 equipped with a bushing through which the shaft 28 extends. The shaft preferably has an enlargement 72 which is adapted to seat on a washer 73 above the deck. At the underside of the deck the shaft 28 is of slightly reduced diameter to provide an annular shoulder 74. The deck for the implement is removably held in assembled position by a nut 75, which is preferably a quick attachment nut, the nut acting against the washer 66 between it and the deck. The nut comprises two complementary half sections 83 and 84 (see FIGS. 6 and 7) having interfitting, laterally-projecting ears for receiving a pivot pin 85 whereby the half sections are hingedly connected for laterally swinging movement toward and away from each other. When the sections 83 and 84 are in the closed position of FIGS. 6 and 7 they are held in closed position by a threaded bolt 86 coacting with projecting ears 87 and 88 on the half sections, as shown in FIG. 7, to bring the threads into engagement with the threads on the shaft portion as shown in FIG. 2. By using a quick attachment nut of the type disclosed, the nut can be readily released by removal of the bolt 86, and removed laterally by movement in a plane parallel to the deck 70 to then permit gravity removal of the deck 70 and implement supported thereby, such as the bucket 36 together with the sleeve 67. During such removal the connection member 82 between the deck socket 81 and actuator is automatically disengaged.

THE DOUBLE HOOK ATTACHMENT

FIGS. 6 and 7 show how a double hook attachment may be substituted for the bucket 36. Here the deck 170 of the double hook attachment has depending sides 169 to which the sleeve 67 is anchored by the bolts 68. Suspended from opposite sides of the lower portion of the deck are half rings 76 from which hooks 77 are slideably suspended. These hooks may be used to support any desired implement and, in the case the implement is hydraulically operated, the flexible conduits 33 and 34 from the sleeve 67 may be detachably con-

nected to the hydraulic operator of the implement. Thus the double hook assembly provides a means for swivelingly supporting an implement and there is also means for supplying hydraulic fluid thereto without any danger of the hydraulic conduits tangling during swivel-
 ing. It is to be noted from FIG. 2 that in the sleeve 67 are circular fluid conduits 78 and 79 which register with the outlet branches of the conduits 29 and 30 in all positions of swiveling movement, and communicate with the nipples which connect with the flexible conduits 33 and 34. Sealing rings 80 within the sleeve 67 surround the lower portion of the swivel shaft 28.

In use, with the implement suspended at any selected angle from the dipper stick, which may be at the right angle shown in FIG. 1, which may be head-on with the dipper stick, or which may be at any angle therebetween, if it is desired to cause swiveling of the implement, it is merely necessary for the operator in the cab 20 to operate the control valve 16, connected with the hydraulic lines 15 leading to the dipper stick 23, whereby hydraulic fluid under pressure may be caused to flow out of the duct 40-42 into the chamber 43 in the actuator (see FIG. 3). This hydraulic fluid under pressure will act on the vane 62 to cause rotation of the actuator casing in a counterclockwise direction until the vane 62 reaches the broken line limit of its movement in this direction. To cause rotation in the opposite direction the operator reverses the hydraulic flow so that it flows out of the duct 39-41 on the opposite side of the stationary vane 58 to act on the vane 62 and cause rotation of said vane and its attached actuator casing in a clockwise direction. When the movable vane 62 is in the broken line position of FIG. 3, then, when hydraulic fluid under pressure enters from the duct 41 to start rotation in a clockwise direction, some of the hydraulic fluid will by-pass through the duct 61 in the stationary vane 58 to get over to a location where it can act on the other side of the vane 62 so that there is a quick start in rotating movement. The duct 60 in the stationary vane 58 performs a similar function when starting counterclockwise rotation. It is to be noted that the corners of the stationary vane 58 are beveled to allow entering hydraulic fluid to act more effectively on the movable vane. It is also to be noted that the movable vane 62 is so shaped as to present flat abutment portions 62' for abutment with the fixed vane 58 at the limits of movement, as shown by the broken line position in FIG. 3. Rotating motion is possible for nearly 360°, the width of the stationary vane 58 being deducted. When the actuator casing rotates in this manner, then through the detachable connection 81-82 swiveling movement of the deck 70 or 170 of the implement is brought about, this swiveling movement being around the swivel shaft 28.

This swiveling movement gives extra control to the implement, such as the clamshell bucket, so that its position can be accurately and positively oriented and controlled. It is also apparent that with the novel arrangement, wherein the actuator rotates around a swivel shaft having hydraulic conduits therein, the actuator may be supplied with hydraulic fluid and caused to swivel without causing tangling of loose-hanging conduits. In addition, the hydraulic conduits in the swivel shaft provide for supply of hydraulic fluid when required for any supported hydraulic implements, such as the hydraulically-operated clamshell bucket 36 of FIG. 1.

When the novel double hook assembly of FIGS. 6 and 7 is substituted as the implement for the bucket 36, a means is provided for supporting a variety of implements from the double hooks with assurance that the implement will not swing. This is always a problem where devices are suspended from cable type cranes. With the present invention no tag line is needed to control the suspended implement. In addition, the quick connection between the double hook assembly and the swivel shaft makes it possible to quickly provide a powered swiveling motion for the twin hook assembly under the control of an operator in the cab. The improved arrangement makes it possible for the load to be swiveled to a desired degree and then held rigid, through take-up of the male pressure plate against the end of the dipper stick, as fully disclosed in my prior U.S. Pat. No. 3,143,229 heretofore referred to and as illustrated in FIG. 1.

It is to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

What I claim is:

1. In combination, a non-rotatable swivel shaft; an actuator having a casing mounted for rotation around said swivel shaft; a hook assembly having a deck with a central opening through which the swivel shaft extends; retainer means on the swivel shaft below the deck supporting the deck for swiveling movement around the swivel shaft; a drive connection between said actuator and said deck; operating means for the actuator; laterally-spaced arcuate guide rods depending from the deck on opposite sides of the retainer means, each guide rod having widely-spaced ends with one end secured to the deck on one side of the axis of the swivel shaft and with its other end secured to the deck on the other side of the axis of the swivel shaft; and a hook slideably suspended from each guide rod.

2. A combination as set forth in claim 1 in which each arcuate guide rod is a half ring.

3. A combination as set forth in claim 2 in which the retainer means for supporting the deck is a nut threaded on the swivel shaft and comprising laterally-separable sections whereby the nut may be removed by lateral withdrawal.

4. A combination as set forth in claim 3 in which the arcuate guide rods are of such extent with respect to the size of the retainer nut that the latter may be withdrawn laterally through an arcuate guide rod.

5. A combination as set forth in claim 1 in which the retainer means on the swivel shaft is readily removable by lateral withdrawal to permit removal of the hook assembly from the swivel shaft, and in which the drive connection between the actuator and deck comprises male and female elements which are disengageable in response to said removal of the hook assembly from the swivel shaft.

6. A combination as set forth in claim 1 in which the deck has oppositely-disposed depending sides positioned at right angles to the arcuate guide rods, and in which there is a sleeve supported by and between said depending sides in a position to receive a lower portion of the swivel shaft.

7. A combination as set forth in claim 6 in which there are hydraulic conduits extending longitudinally of the swivel shaft and having outlet branches which communicate with the periphery of the swivel shaft within

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the sleeve, said sleeve having circular fluid conduits in registration with said branches in any position of rotatable movement of the deck and sleeve, and there being flexible conduits leading from said circular conduits of the sleeve whereby hydraulic fluid may be fed to an implement supported on the hooks.

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8. A combination as set forth in claim 7 in which the actuator is hydraulically operated and in which there are hydraulic connections between the actuator and the hydraulic conduits in the swivel shaft.

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