

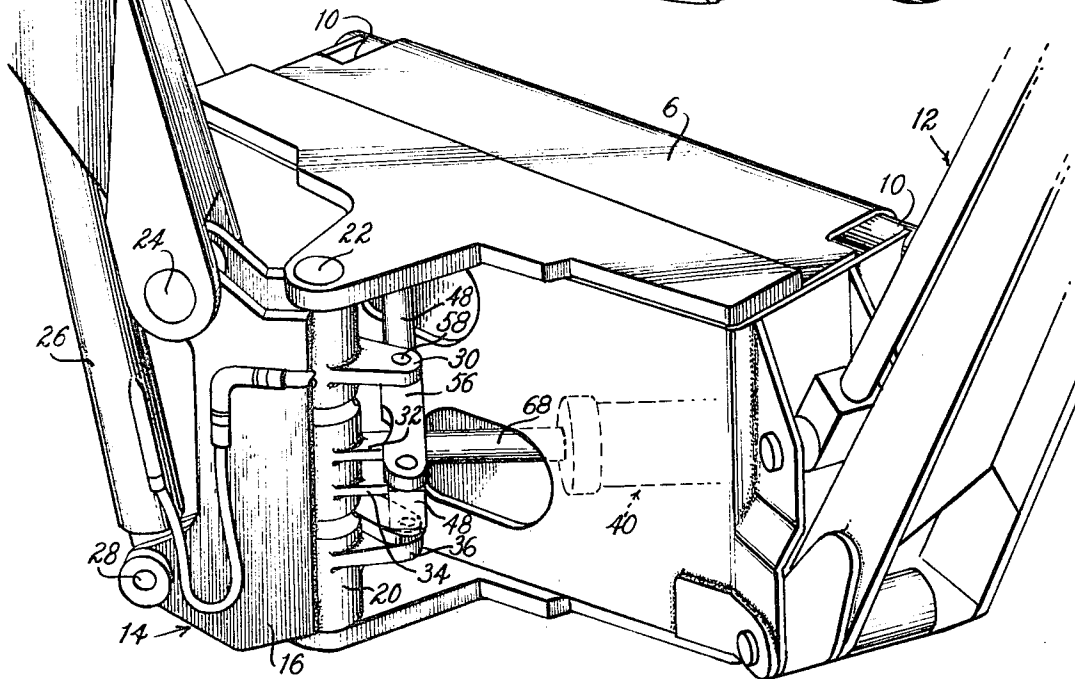
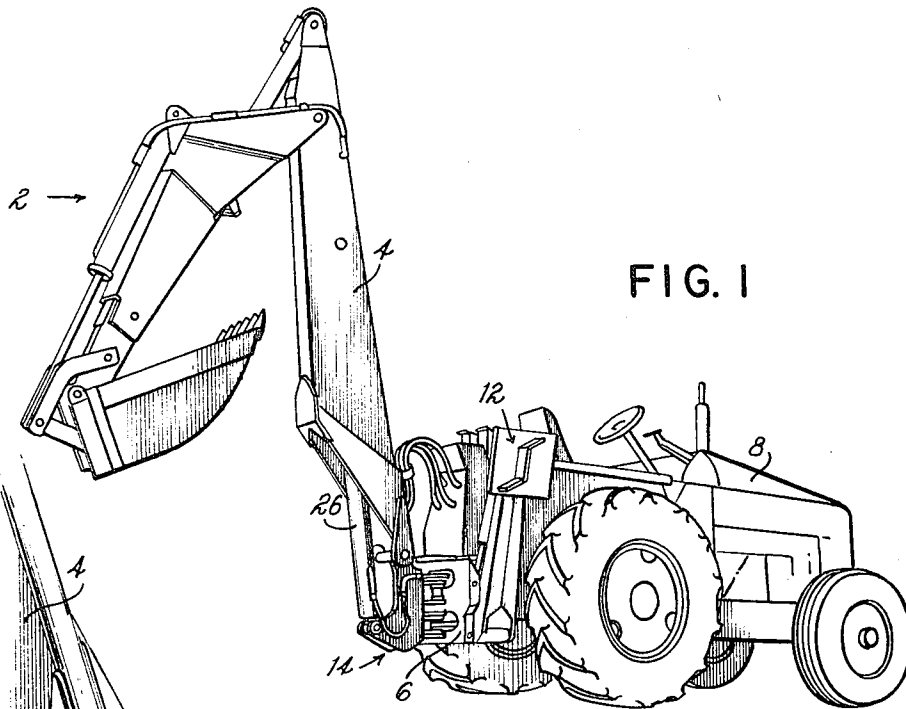
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C. H. ARNOLD
BOOM SWING SYSTEM

3,395,812

Filed March 21, 1966

6 Sheets-Sheet 1



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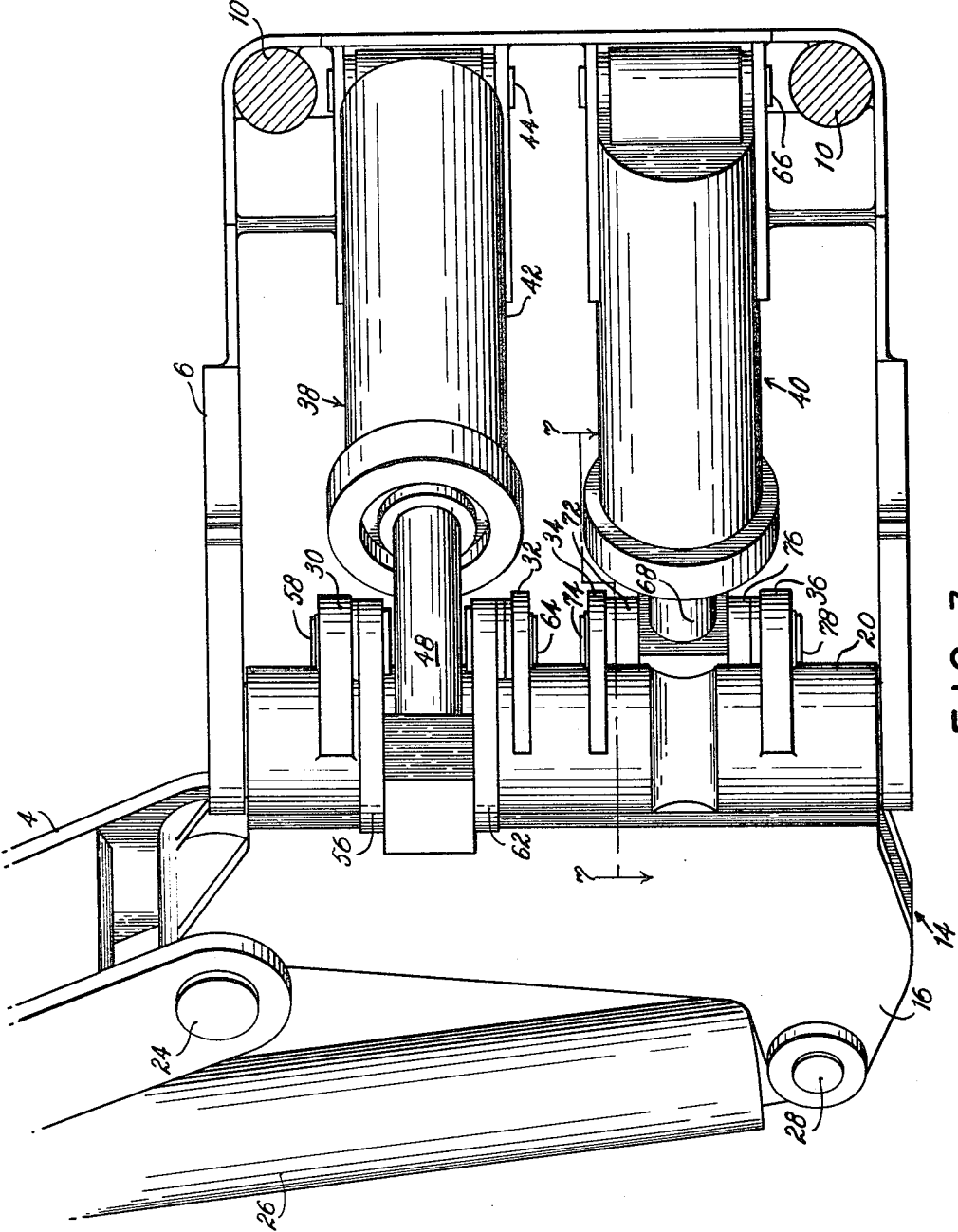


FIG. 3

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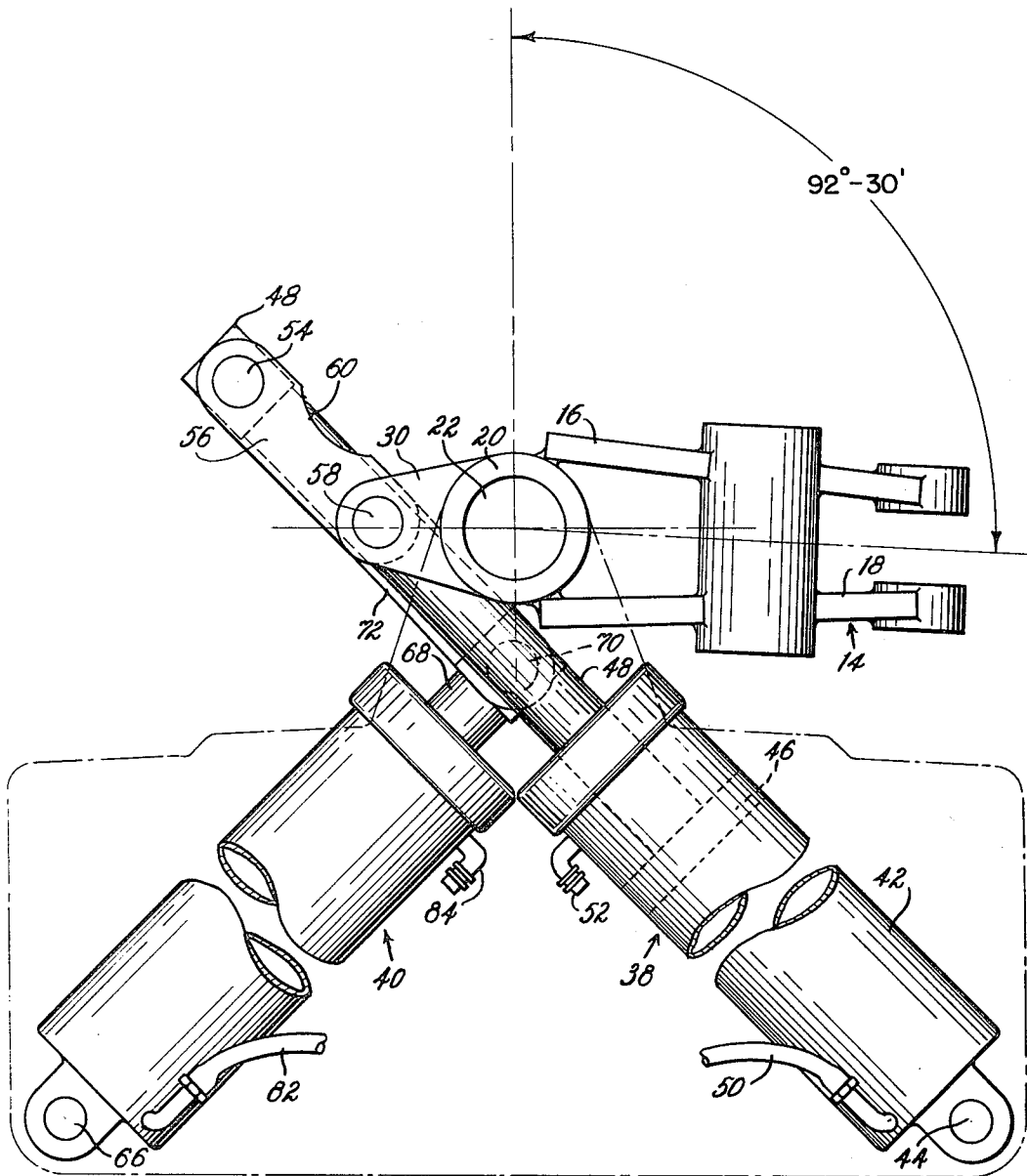


FIG. 4

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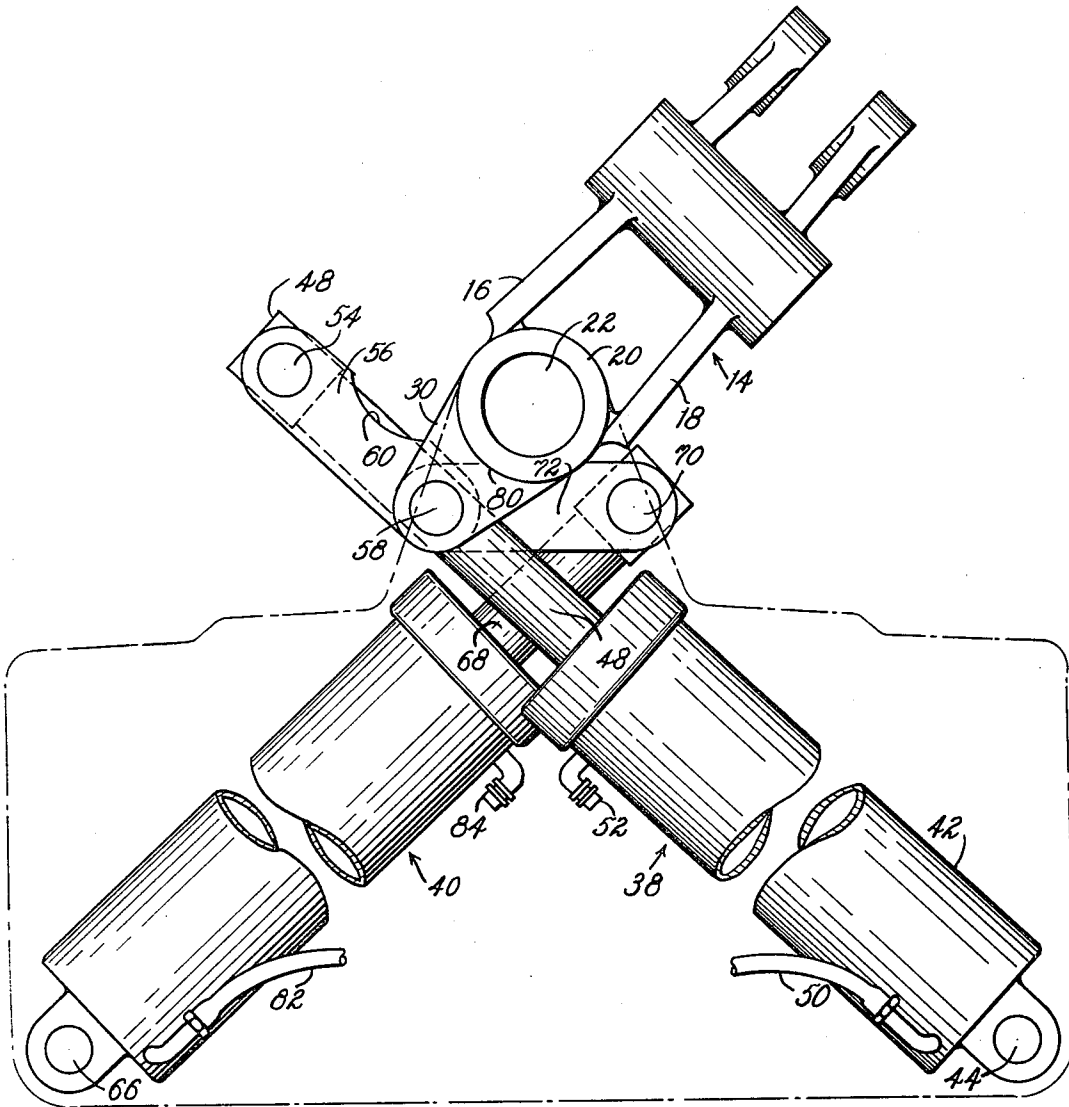


FIG. 5

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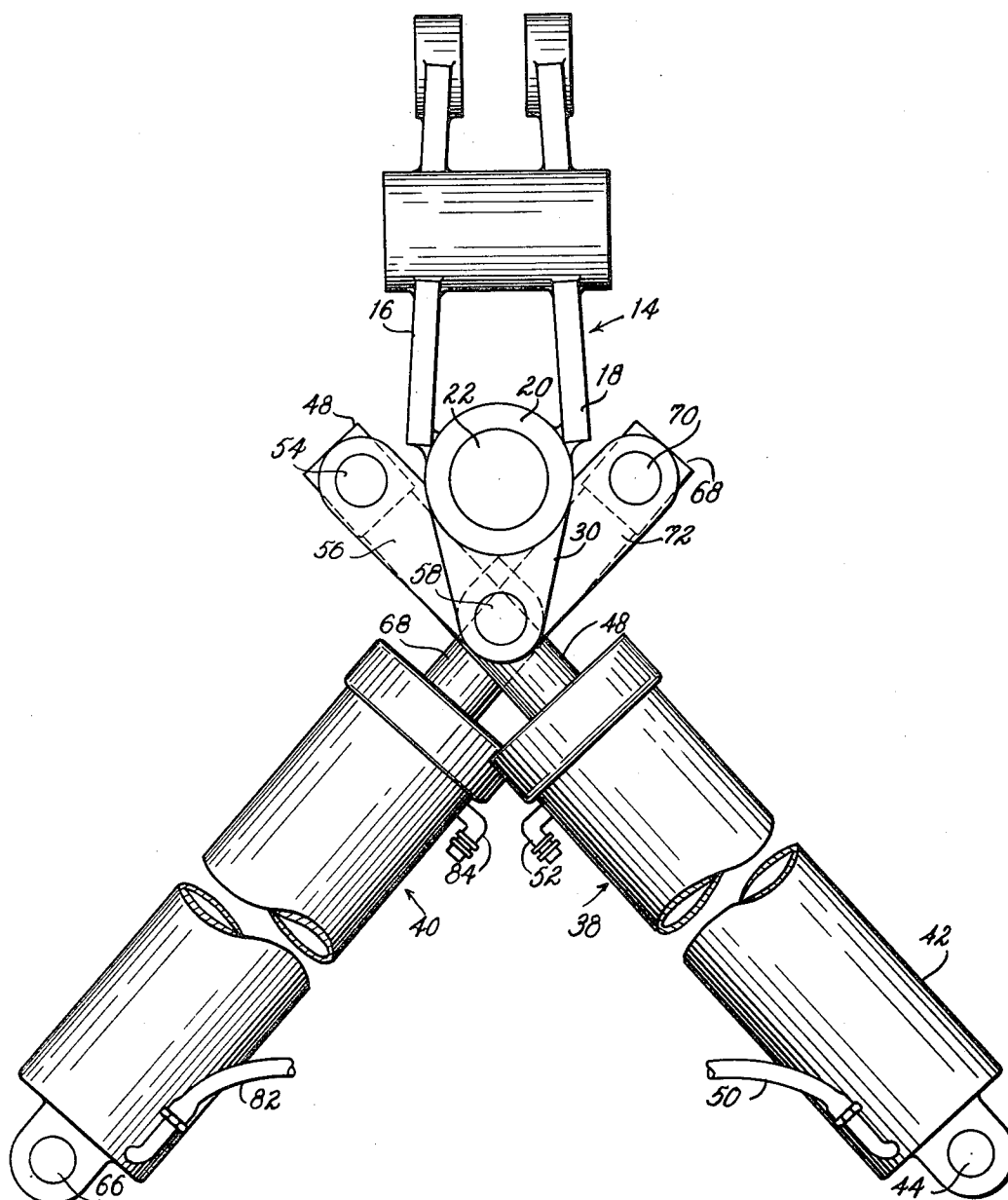


FIG. 6

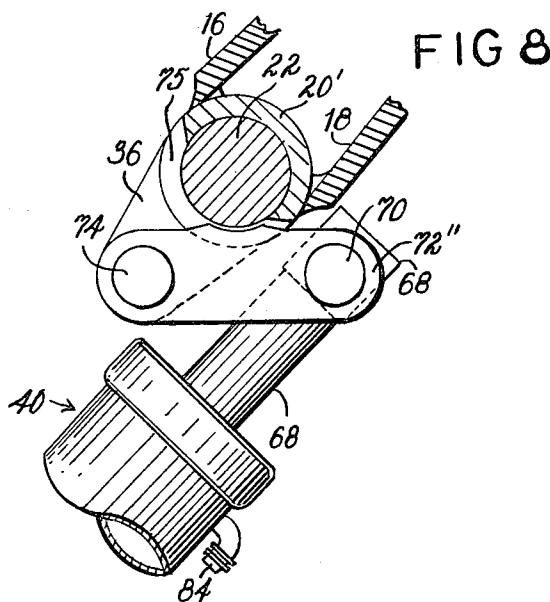
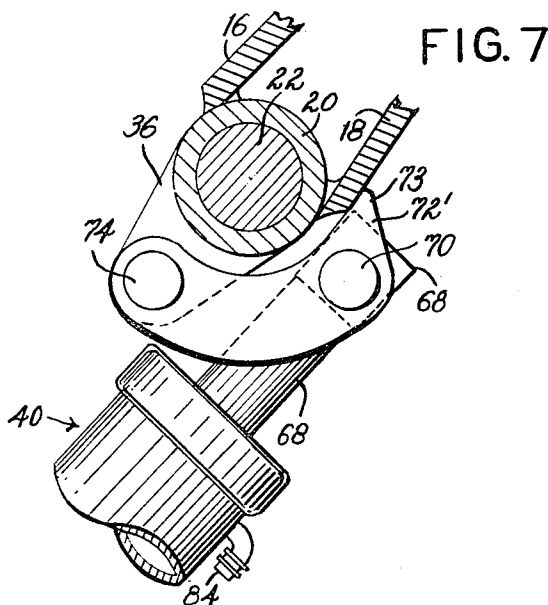
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BOOM SWING SYSTEM

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ABSTRACT OF THE DISCLOSURE

A swing system for swinging a boom from side to side employing two hydraulic jacks which extend during their working stroke, each connected between the stationary boom support and the boom through a link which bears during part only of its working stroke on an abutment carried on the support.

The present invention relates to apparatus for operating a boom and more particularly to apparatus for swinging from side to side a boom such as is employed with backhoes.

Swing mechanism for swinging the boom from side to side is a usual part of backhoes and other earth moving equipment as shown for example in Holopainen Patent No. 2,973,874 of Mar. 7, 1961. The present invention has to do particularly with such swing systems employing two hydraulic jacks, or cylinders, one for swinging the boom in each direction, and wherein the operating mechanism is connected to the boom swing frame through swing links in a manner tending to optimize the rate of swing, as in said Holopainen patent. The mechanism of that patent has proved highly useful and effective.

The swing mechanism of the present invention provides a swing mechanism construction which retains all of the advantages of the mechanism of that patent and of a two-cylinder system while permitting all of the swing mechanism to be contained in a smaller space, with the consequent advantages, e.g., that the backhoe can be positioned further forward, giving better transport balance of the backhoe, and other benefits. With the swing mechanism of the invention the cylinder performs its working stroke upon admission of pressure fluid to its head space, and thus is extended rather than retracted during its working stroke. Thus it is also possible to employ smaller swing cylinders, or stronger cylinders of the same size, because the cross sectional area of the piston rod is not subtracted from the internal cross sectional area of the cylinder in computing the effective working area exposed to the hydraulic pressure fluid which operates the cylinder. When the rod diameter to cylinder bore ratio is not a factor, as in the invention, the piston rod can be made as large as is practical for column strength without unduly increasing the size of the cylinder, or, reducing its effective working force for a given size. Further, in the construction of the invention, only one fluid-tight packing per cylinder is required, at the piston, instead of two, at rod and piston. These advantages are not available with the swing mechanisms of the prior art wherein a part or all of the working movements of the cylinders are performed by retraction of the cylinder under the influence of pressure fluid admitted to its rod end, i.e., its end opposite its head end.

The invention provides apparatus for operating a boom, such as a backhoe boom, comprising a frame member, which may be a base member adapted to be attached to a vehicle and to carry the boom, a swing frame pivoted on the frame member for swinging movement about a substantially vertical axis, an abutment member supported on the frame member adjacent the vertical axis and which

may be a part of the swing frame, the usual boom mounted on the swing frame for pivotal movement about a substantially horizontal axis and means for so moving the boom, a pair of hydraulic jacks extensible during their working stroke and each having one end pivotally connected to the frame member and its other end pivotally connected to one end of a swing link which at its other end is pivotally connected to the swing frame to swing said swing frame in one direction upon extension of the jack, one jack swinging the boom in one direction and the other in the other direction, each link engaging a portion thereof with said abutment member during a portion only of the arc through which it can swing the swing frame, together with port for admitting pressure fluid to the head space of each jack to cause it to extend and perform a working stroke to swing the swing frame.

Illustrative embodiments of the invention as applied to a backhoe are shown for purposes of disclosure of the invention in the accompanying drawings, wherein

FIG. 1 is a perspective view of a complete vehicle and backhoe unit, including an illustrative swing system;

FIG. 2 is a perspective view to an enlarged scale showing the swing mechanism and associated parts;

FIG. 3 is a vertical longitudinal sectional view, showing the swing mechanism largely in elevation;

FIG. 4 is a plan view, partly broken away, showing the boom swung into one of its extreme sidewise positions;

FIG. 5 is similar to FIG. 4 but shows the boom in a position at 45° to the longitudinal axis of the vehicle;

FIG. 6 is similar to FIGS. 4 and 5 but shows the boom extending directly to the rear of the vehicle;

FIG. 7 is a horizontal sectional view taken on line 7—7 of FIG. 3 and partly broken away, showing a modification in which a part of the swing frame other than the swing tube provides the abutment member; and,

FIG. 8 is a horizontal sectional view similar to FIG. 7, showing a further modification in which the swing pin provides the abutment member.

Referring now to the particular embodiments selected for purposes of illustration and first to the embodiment shown in FIGS. 1—6 of the drawings, a backhoe 2 of usual construction and including a boom 4 is mounted on a frame member 6 which is attached to the rear of a tractor 8, for example, by engagement of pins 10 on the frame member 6 with notched bars extending rearwardly from the tractor (not shown). The usual stabilizers 12 are mounted on the frame member 6, on each side thereof.

The boom 4 is mounted on the frame member 6 by means of a swing frame indicated generally at 14 and comprising a pair of plates 16, 18 and a swing tube 20 welded thereto, as shown. The swing tube 20 is pivotally mounted on the frame member 6 for movement about a vertical axis by means of a swing pin 22. In this embodiment the swing tube 20 forms the abutment member for engagement by the swing links, as will be hereinafter described. The boom 4 is pivoted on the swing frame 14 for movement about a horizontal axis provided by a pin 24 and is adapted to be raised and lowered about said axis by a hydraulic jack 26 having its upper end connected to the boom and its lower end pivoted on the swing frame 14 on pin 28.

Extending from the swing tube 20 is a series of ears 30, 32, 34 and 36, each having adjacent its outer end a vertical bore, the bores being in this embodiment disposed along a common axis parallel to the axis of the swing pin 22.

Mounted on the frame member 6 is a pair of single-acting swing jacks 38, 40. The jacks 38, 40 are similar in construction but oppositely disposed and one is adapted to swing the swing frame 14 in one direction and the other to swing it in the opposite direction. The jack 38

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includes a cylinder 42 pivoted at its head end on the frame member 6 at 44. The cylinder 42 contains the usual piston 46 and piston rod 48 extending from the other end of the cylinder. A suitable connection 50 is provided for admission of the hydraulic pressure fluid into the cylinder head space. Hydraulic fluid need not be supplied to the opposite end of the cylinder 42 but instead this end in the present embodiment is connected to atmosphere through a breather 52. Jacks 38, 40 are mounted so that jack 38 is at a higher elevation than jack 40, as appears in FIG. 3, so that they do not interfere.

Connected to the outer end of piston rod 48 by pin 54 is a swing link 56 having its other end pivotally connected to the ear 30 by pin 58. The intermediate portion of link 56 is cut away as shown at 60 to form an internal cylindrical surface to engage with an outer surface of the swing tube 20 during certain parts of the swing. A similar swing link 62 is pivotally connected to the outer end of the piston rod 48 by the pin 54 and has its other end pivotally connected to the ear 32 by the pin 64, FIG. 3. In this construction, a surface on the swing tube forms the abutment member which is engaged by the swing links. This is a convenient arrangement but is not essential as the abutment may be provided by other parts of the swing frame, including the swing pin, as will hereinafter appear, or may be separately provided and mounted on the frame member 6.

The jack 40 and the swing links which connect it to the swing tube 20 are similar in construction to the jack 38 and its links, described above. They are oppositely disposed to the jack 38 and its swing links, jack 40 being pivoted to the frame member 6 at 66, as shown. Its piston rod 68 is pivotally connected by a pin 70 to a swing link 72 which has its other end pivotally connected to the ear 34 by pin 74. A lower swing link 76, identical with the swing link 72, pivotally connects the outer end of piston rod 68 with the ear 36 by means of pin 78. Links 72 and 76 are cut away at 80, in the same manner as the link 56 is cut away at 60, to provide a cylindrical surface for engagement with a part of the swing tube 20. Jack 40 is provided with a pressure fluid inlet connection 82 leading into its head space and its other end is connected to atmosphere through a breather 84. The jack 40 is provided with a piston (not shown) connected to its piston rod 68. In this embodiment, the common axis on which the swing links are pivoted on the swing frame 14 is located on the other side of the axis of swing pin 22 from the boom.

Referring to FIG. 4, with the swing frame 14 in one of its extreme positions, to the right in this figure, the jack 38 has its piston rod 48 fully extended and has by means of the swing links 56, 62 drawn the ears 30, 32 to the position shown in FIG. 4. As the jack 38 is extended, the jack 40 is retracted mechanically by the movement of its associated swing links. In the position of FIG. 4 the jack 40 is fully retracted, its swing links 72 and 76 having their intermediate portions 80 in engagement with a part of the swing tube 20, as shown. In the particular design shown the swing frame has a total swinging movement of about 185°.

When the swing frame 14 is to be swung from the extreme position of FIG. 4 to the other extreme position, pressure fluid is admitted through inlet 82 to jack 40, causing its piston rod 68 to advance and move the pin 70 upwardly and to the right as seen in FIG. 4. The links 72, 76, the ears 34, 36, the swing tube 20 and the swing frame 14 all rotate as a unit about the axis of the swing pin 22, the links 72, 76 being in engagement with the swing tube 20. As this motion continues, the swing frame 14 and associated parts reach the 45° position of FIG. 5, with the swing links 72, 76 still in engagement with the swing tube 20. As the motion further continues, the swing frame 14 reaches the position shown in FIG. 6. As the swing frame passes through this position, the swing links 72, 76 move out of engagement with the swing tube 20. As swinging movement of the swing frame

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14 continues to the left beyond the position of FIG. 6 the swing links 72, 76 remain out of contact with the swing tube 20. In the 45° position corresponding to but the reverse of the position shown in FIG. 5, the swing links 72, 76 are related to the tube 20 as is the swing link 56 in FIG. 5. The swing links 72, 76 continue to remain out of contact with swing tube 20 as the motion to the left continues into the extreme left position corresponding to the position of FIG. 4, but the reverse thereof.

Swinging movement in the reverse direction is effected similarly, by operation of jack 38.

Due to the fact that the swing links engage the abutment member, in this instance a part of the swing tube 20, during a part of the swing and are disengaged from it during the remainder of the swing as described it will be observed that the moment arm through which the jack operates on the swing frame 14, i.e., the distance between the axis of swing pin 22 and the axis of the working piston rod, tends to remain more nearly uniform throughout the swing than would be the case if the piston rod were simply connected to the swing tube ears directly.

In the embodiment described above the swing links 56, 62, 72 and 76 are equal in length and this length is equal to the hypotenuse of the right triangle whose sides are equal to the distance between the axis of the swing pin 22 and the axis of the bores in the ears 30, 32, 34 and 36. This relationship will be apparent from an examination of FIG. 4. In this figure, if the swing frame 14 were moved slightly upward to be exactly at right angles to the center line of the vehicle, the link 72 would coincide with the hypotenuse of such a triangle, the axes of the pins at each end of the link being at two of the corners and the axis of the swing pin 22 at the third corner.

In the modification of FIG. 7 another part of the swing frame 14 than the swing tube 20 provides the abutment member for engagement by the swing links. In this modification, the swing link 72 is replaced by swing link 72' shaped as shown so that it does not engage the swing tube 20 and provided with an extended portion 73 extending beyond the pin 70, which connects the link to piston rod 68, to a position where it engages a part of the outer surface of the plate 18 which thus provides the abutment member. In this modification, all of the other swing links are shaped the same as swing link 72'. This modification operates in the same manner as the modification of FIGS. 1-6, as described above.

In the modification of FIG. 8, the abutment member is provided by the swing pin 22 and the swing link 72 is replaced by a swing link 72'' shaped as shown, to make engagement with the swing pin 22. To permit such engagement the swing tube 20' is provided with a slot 75, as shown, just below the ear 34 and wide enough in its vertical direction to receive the swing link 72''. All of the other swing links in this modification are of the same shape as swing link 72'' and the swing tube 20' is provided with a slot similar to the slot 75 to accommodate each of the swing links. This modification operates in the same manner as the modification of FIGS. 1-6.

The swing jacks need not be positioned as in the drawings. They may be at any convenient angle, for example, they may lie on the center line of the vehicle or extend at substantially right angles thereto, or be in any intermediate position, thus providing a wide range of freedom for the designer in designing the swing system and the associated frame member.

While illustrative embodiments of the invention have been described in detail for purposes of disclosure of the invention, the invention is not limited thereto but includes all modifications embraced within the scope of the following claims.

I claim:

1. Apparatus for operating a boom comprising a frame member, a swing frame pivoted on said frame member for swinging movement about a substantially vertical axis, an abutment member supported on said frame member

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adjacent said vertical axis, a boom mounted on said swing frame for pivotal movement about a substantially horizontal axis, mechanism for pivoting said boom on said swing frame about said horizontal axis, an hydraulic jack extensible during its working stroke and having one end pivotally connected to said frame member, a link pivotally connected at one end to said swing frame and pivotally connected at its other end to the other end of said jack to swing said swing frame in one direction upon extension of said jack, said link engaging a portion thereof with said abutment member during a portion only of the arc through which it can swing said swing frame, means for admitting pressure fluid to the headspace of said jack to cause it to extend and perform a working stroke, and a second similar hydraulic jack and link similarly engageable with said abutment member and connected to said frame member and to said swing frame to cause swinging movement of said swing frame in the opposite direction, said links being of equal length and pivoted on said swing frame on a common axis and the length of said links being equal to the hypotenuse of the right triangle whose sides are substantially equal to the distance between said vertical axis and said common axis.

2. The apparatus of claim 1 wherein said common axis is on the other side of said vertical axis from said boom.

3. The apparatus of claim 2 wherein said abutment member is a part of said swing frame.

4. Apparatus for swinging about a vertical axis a backhoe or like implement having a boom held on a swing frame with which it swings, said swing frame being arranged for pivotal mounting on a vehicle, in combination with said swing frame,

a pair of single acting hydraulic jacks each extensible, while the other retracts, from a retracted to an extended position during its working stroke, in swinging said frame in one direction or the other,

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each jack being adapted to be pivotally mounted on a portion of said vehicle,

a pair of links each respectively pivotally connected at one end at a pivot point to said frame and at the other end at a connection point to one of said jacks, said pivot points being so located that when one jack is in its retracted position its corresponding link extends at an angle thereto and has a portion spaced from its pivot point engaging a portion of said frame so as to exert leverage thereon during a portion only of the stroke of said jack as the latter extends, while at the same time said other jack is in extended position with its link in disengagement with said frame, and lying parallel to the axis of said jack and with its pivot point located between its connection point and the jack,

said jacks having fluid ports at their heads selectively to admit fluid to one to cause it to extend while permitting fluid to escape from the other so it may retract so as to swing said frame to various positions including positions wherein said last named link engages said frame while said first named link disengages the same.

5. The apparatus of claim 4 wherein the pivot points of the links on said swing frame are on the other side of said vertical axis from said boom.

6. The apparatus of claim 5 wherein said links are of equal length.

References Cited

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HUGO O. SCHULZ, *Primary Examiner.*