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SWING MECHANISM FOR BACKHOE

Filed Oct. 12, 1959

4 Sheets-Sheet 1

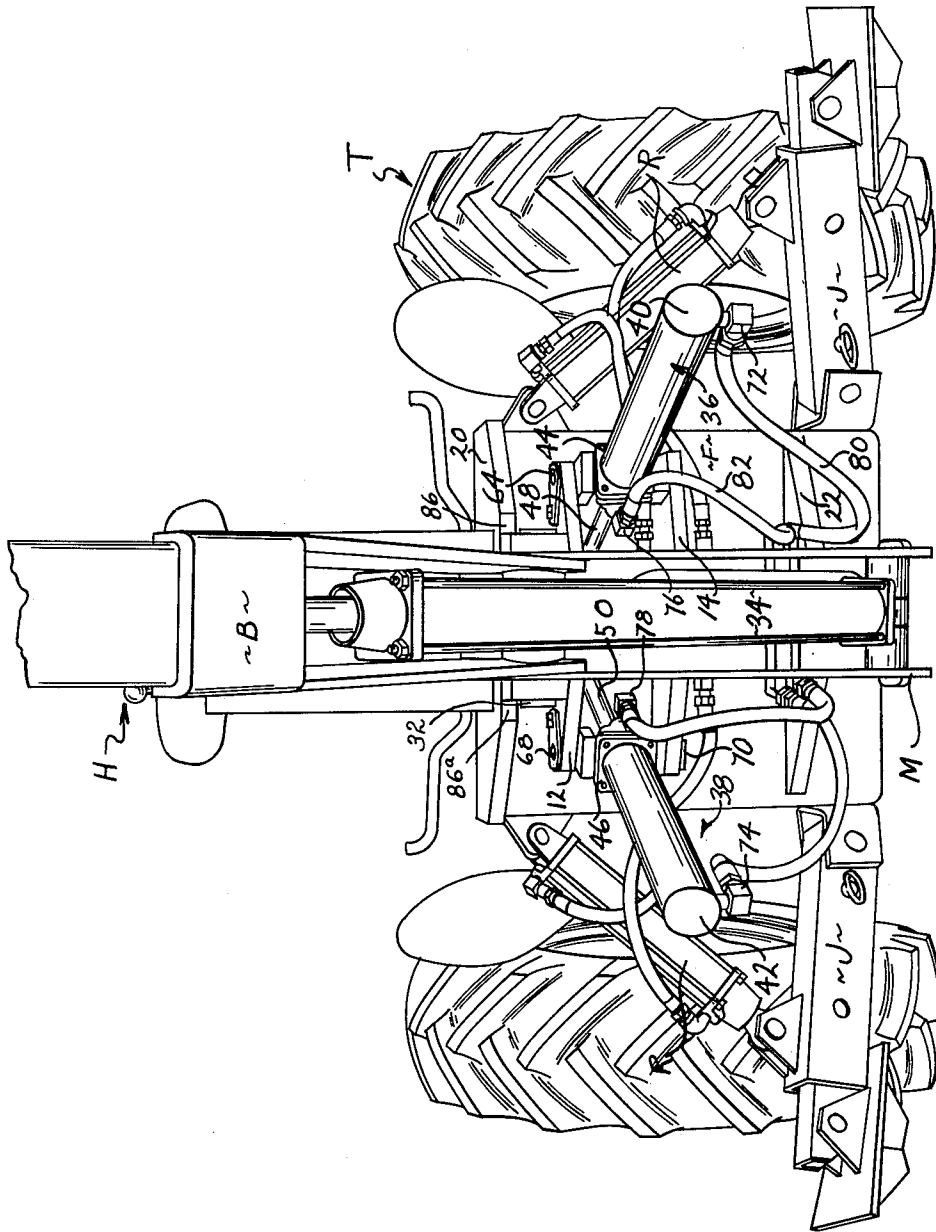


Fig. 1

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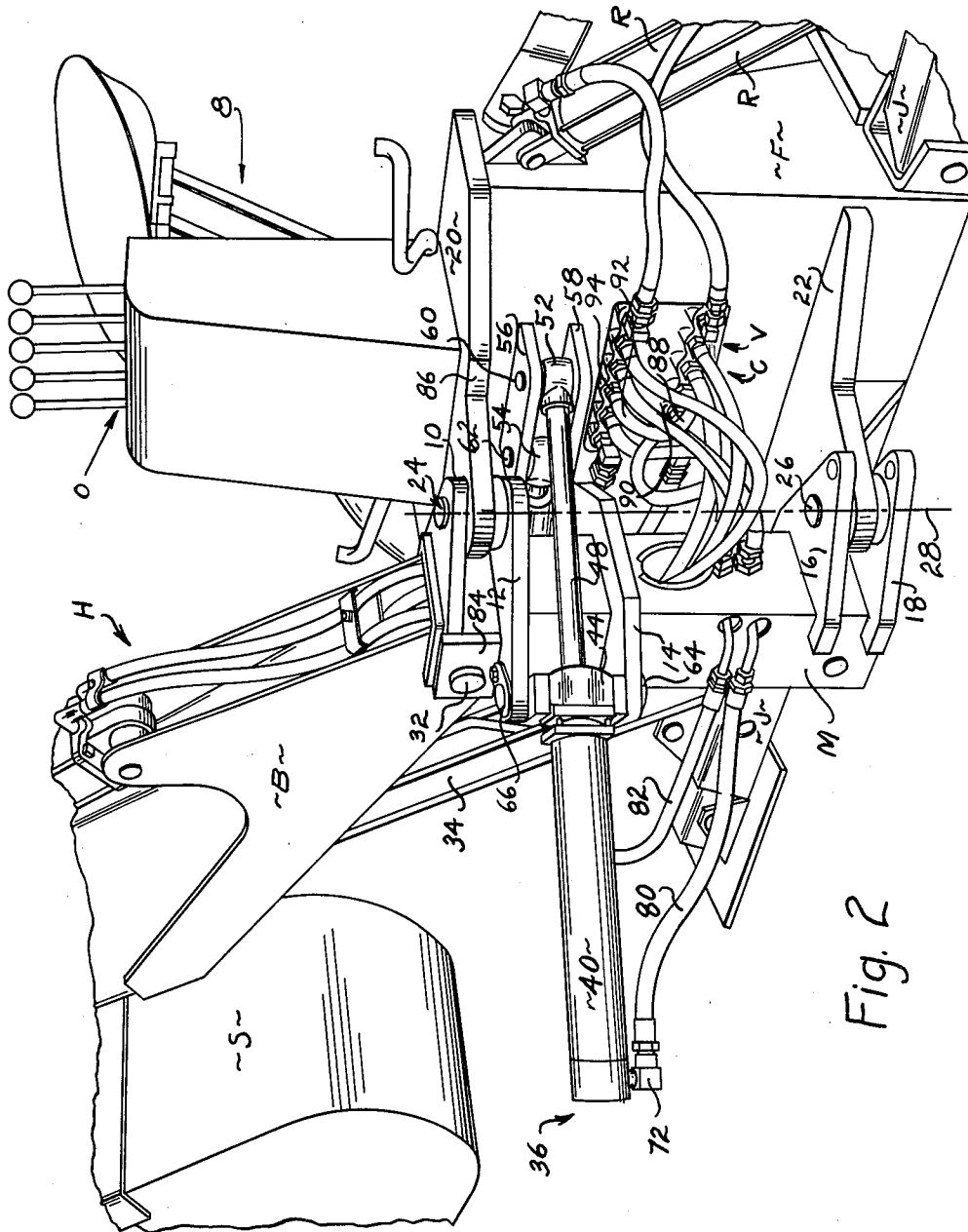


Fig. 2

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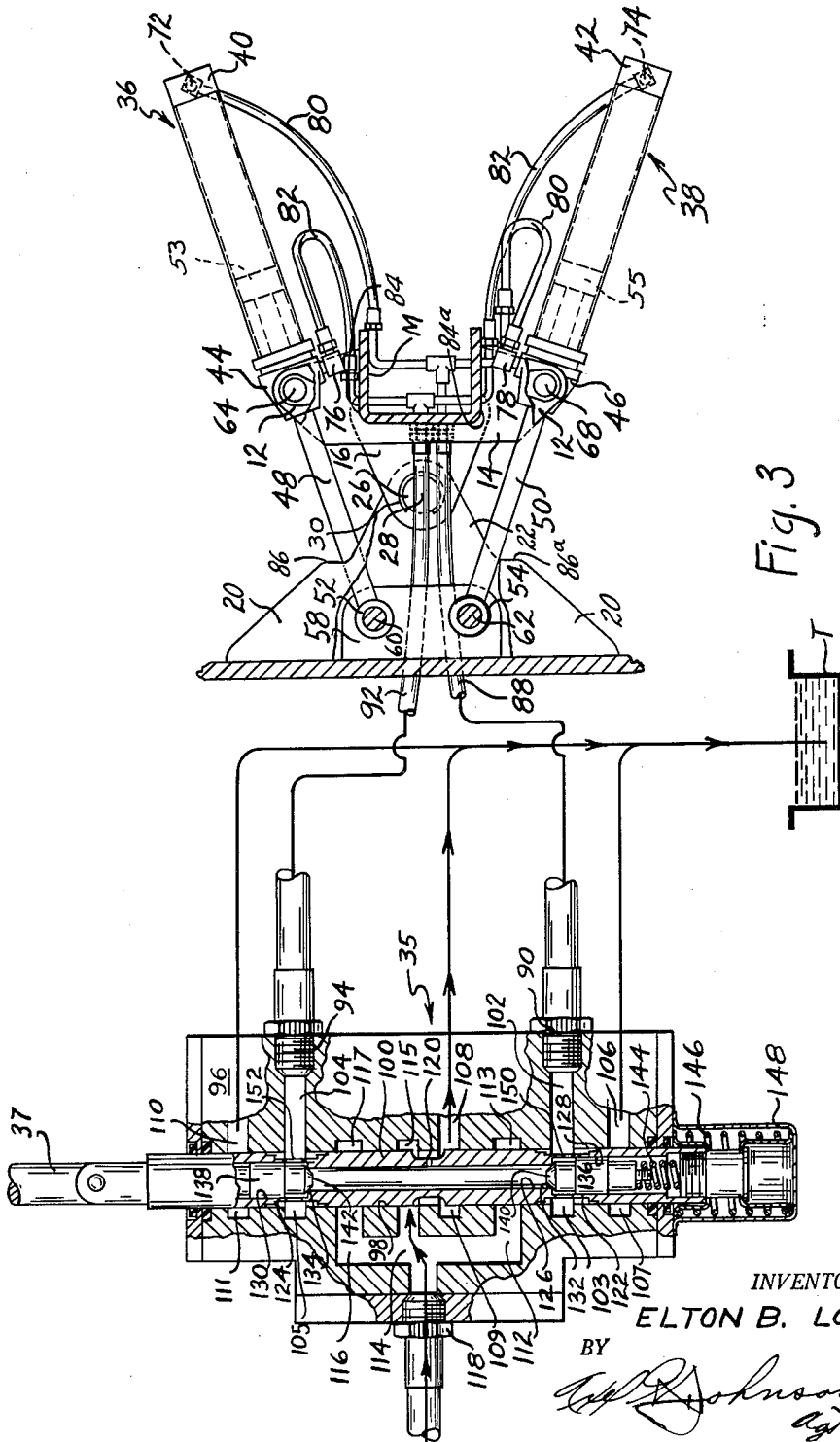


Fig. 3

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Fig. 4

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3,047,171

SWING MECHANISM FOR BACKHOE

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6 Claims. (Cl. 214-138)

This invention relates to a backhoe of the type having a mast which is pivoted on a vertical axis and swung from side to side by means of hydraulic rams, and especially to the hydraulic means for rotating the mast through its arc of travel, and an object of the invention is to generally improve the construction and operation of devices of this class. More specifically, this invention relates to the provision of a means to decelerate the rotation of the mast hydraulically as it approaches the usual stops provided at the extreme limits of swing.

Backhoes are employed to excavate for building foundations, pipe laying, or similar operations. The operation of excavating is a highly competitive one, and therefore, any means whereby the work can be more efficiently performed is desirable. One of the areas of possible improvement in efficiency is that pertaining to shortening the time cycle involved in filling the bucket, raising it out of the excavation, swinging the bucket laterally, depositing the material on a pile or into a truck, and returning to repeat the cycle. With respect to the conventional hydraulic arrangement employed to rotate the mast of a backhoe, the usual practice of an operator, in order to save time, is to swing the mast over hard against the stops on the frame when preparing to dump the load. This practice is detrimental in that the frame, the mast and the hydraulic circuit are subjected to severe shocks. While these shocks may be avoided by carefully manually manipulating the controls, this practice is objectionable in that it is time consuming and therefore slows down the work.

This invention embraces a means whereby the hydraulic system is provided with a hydraulic "buffer" or cushioning arrangement which functions to decelerate the rotation of the mast during its swing to either side of a central position, just prior to the moment that the mast approaches the end of its swing and strikes the stop. This cushioning effect is obtained automatically and makes it unnecessary for the operator to take time-consuming precautions to avoid sudden contact between the mast and the stop.

Accordingly, an object of this invention is to provide a hydraulic means of preventing the shocks resulting when the mast of a backhoe or similar member, operated by rotating rams, strikes stops on the frame at the extreme limit of swing.

A further object is to provide in a hydraulic apparatus already present for swinging the mast structure, means which will cause the apparatus to exert an automatic shock-absorbing effect at the limits of swinging of the mast.

A further object is to provide a novel arrangement of pivots whereby the hydraulic apparatus connected thereto for swinging said mast by expansion, will itself swing past and to the other side of the pivotal connection about which the mast swings, whereupon the hydraulic apparatus will be forcibly contracted by the momentum of the mast, and will tend to check the swinging movement.

Further objects and advantages of the invention will become apparent from a consideration of the following detailed description taken in connection with the accompanying drawings, wherein a satisfactory embodiment of the invention is shown. However, it is to be understood that the invention is not limited to the details disclosed, but includes all such variations and modifications as fall within the spirit of the invention.

When the terms "forward" and "rearward" are used,

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they are to be interpreted as looking forward or aft with respect to the tractor, or toward or away from the support on which the mast is pivotally supported, respectively, from a point rearwardly of the tractor.

FIG. 1 is a fragmentary view of a backhoe looking forwardly toward the tractor on which it is mounted, and showing the mast in a central position.

FIG. 2 is a fragmentary view of a backhoe looking to the left and forwardly toward the tractor, and having the mast rotated to the extreme left side position, and with some parts broken away.

FIG. 3 is a plan view taken approximately in the plane of the axes of the rotating rams, partly in section with parts broken away and in the position shown in FIG. 1, and also showing the hydraulic circuit diagrammatically, with the control valve shown enlarged.

FIG. 4 is a partially diagrammatic view showing the mast swung to the position shown in FIG. 2 and with one of the rams having traversed the mast axis.

FIGS. 5 and 6 show sections through valve unit 35 in the two positions to swing the mast in either direction.

Referring again to FIGS. 1 and 2, the backhoe is indicated generally as H and is mounted rearwardly on a tractor T; the mode of mounting not being of concern in this instance.

The backhoe H, of this invention comprises generally a frame or support F, mounted on a tractor, a mast M pivoted on the frame F, a boom B, and other associated members, carrying a scoop or bucket S. Members not identified do not generally concern this invention.

A pair of stabilizing jacks J are mounted one on each side of frame F, and when lowered to the ground by rams R, support the backhoe in well-known manner against swaying or tipping when the machine is in operation.

Referring again to FIG. 1, mast M is preferably of a rearwardly-open channel shape shown, and is pivoted generally about a vertical axis on frame F. Pivot webs 10, 12, 14, 16 and 18 are welded or otherwise secured to mast M in the positions shown in FIG. 2, and extend forwardly toward frame F.

Frame F is provided with an upper web 20 and a lower web 22. Web 20 is secured rigidly with frame F and extends rearwardly to a point intermediate webs 10 and 12. Web 22 is also secured rigidly with frame F and extends rearwardly to a point intermediate webs 16 and 18. Pivot pins 24 and 26 are of well-known type and have a common vertical axis 28 and provide the bearings on which mast M swings and is supported, the pins being held against displacement as by conventional snap rings such as at 30. Vertical thrust loads imposed on webs 20 and 22 are met by thrust washers not shown or by any suitable means to reduce friction, placed intermediate webs 10 and 20, and webs 16 and 22 respectively, and associated with pins 24 and 26.

Boom B is pivoted at the upper end of mast M on a horizontal pin 32 as shown in FIGS. 1 and 2. Boom B is raised or lowered in a vertical plane about pin 32 by a ram 34 and, in conjunction with other associated members, carries the above mentioned bucket or scoop S, shown in FIG. 2, the whole constituting a boom element swingable about the pivotal connection formed by pivots 24 and 26.

The hydraulic system is shown diagrammatically in FIGS. 3 and 4 and comprises a pump P, a reservoir or tank T, a valve means or assembly V, unit 35 of which concerns this invention, the necessary hose connections or conduits C, and a filter f. Unit 35 is provided with an operating stem 37. Valve unit V is mounted on frame F and is suitably connected to conduits C as will be explained later.

A manual or operator's control center O is provided and is located at a position convenient to the operator. It forms no part of the present invention and will not be further described, unless necessary in order to explain the construction and operation of other components.

This invention is concerned primarily with the means for damping or cushioning the impact, which would otherwise result, when the mast M contacts the limiting means or stops on frame F when the mast is swung to its limit in either lateral direction from a central position. The mast, in this instance, may have a total swing in excess of 180°. The mast rotating means comprises a pair of double-acting rams 36 and 38, one ram being positioned on each side of the mast M as shown in FIGS. 1 and 3. Rams 36 and 38 have axes lying in a generally horizontal plane and are provided with cylinders having head ends 40 and 42, and rod ends 44 and 46. Piston rods 48 and 50 extend forwardly from rams 36 and 38, the rods being provided with pivot portions 52 and 54 at one end, and pistons 53 and 55 at the other end of the rods within the ram cylinders. Pivot plates 56 and 58 are welded or otherwise rigidly secured to frame F, as shown in FIG. 2 and extend rearwardly from the frame. Pivot portions 52 and 54 are positioned between plates 56 and 58 and are pivoted on pins 60 and 62 at laterally spaced points on said plates.

The axes of rams 36 and 38 diverge rearwardly from pins 60 and 62, one being located on each side of mast M, as shown in FIG. 3. Rod ends 44 and 46 of rams 36 and 38 are positioned intermediate webs 12 and 14. Cylinder rod ends 44 and 46 are provided with trunnion pins 64 and 66, 68 and 70 which provide a pivotal relationship between mast M and rams 36 and 38 so that the rams are pivoted, one at 60 and 64, and the other at 62 and 68 in the manner of links pivotally connected between pivots 60 and 64, and between pivots 62 and 68, respectively, while the expansion and contraction of the rams renders the links expansible and contractable to alter the distance between their respective pivots and thereby cause swinging of the mast M and boom element B about the pivotal connection 24—26. Rams 36 and 38 are provided with head-end hydraulic ports 72 and 74, and rod-end ports 76 and 78, and hydraulic conduits or hoses 80 and 82 connect the rams 36 and 38 in the following manner in order to supply pressure fluid to the rams to expand and contract them as desired.

Conduit 80 connects port 72 with port 78, and conduit 82 connects port 74 with port 76. Thus it will be clear that hydraulic pressure supplied to one of the conduits 80 or 82 will tend to move the piston of one ram toward the head end of its cylinder, and the piston of the other ram toward the rod end of its cylinder, although insofar as axial movement is concerned, in the embodiment shown it is the cylinders that move, the pistons being anchored to pivots 60 and 62, on frame F. Mast M, upon actuation of the rams, will swing either right or left until it reaches one or the other limit stop, or until the operator actuates the control valve 35. The two-way nature of valve 35 permits the mast M to be swung in either direction, as will be explained.

The swinging of mast M is positively limited; for example, when swung toward the observer in FIG. 2, by contact of a portion 84 with a portion 86 on web 20, but it will be appreciated that, in view of the substantial mass of the boom element, an undesirable impact or shock effect is possible. Similar stop means 84a and 86a, FIG. 3, are provided on the opposite side of support or frame F. Consideration of FIG. 4 will show that ram 36, which has been expanding in the process of swinging mast M in a clockwise direction as seen from above, toward the limit of this movement as defined by the stop portions 84a and 86a, has crossed over to the opposite side of the axis of the pivotal connection defined by pins 24 and 26, so that ram 36, during the last few degrees of swinging of mast M is forced to

contract in opposition to the pressure fluid in hose 80, and thus exert a strong resistance to further swinging of mast M. This tends to reduce the shock of the impact when the stop portions 84a and 86a, come into contact.

The hydraulic system comprises the usual flexible hoses or conduits and suitable fittings. In this instance, a conduit 88 connects conduit 80 with a port 90, and a conduit 92 connects conduit 82 with a port 94, of valve unit 35, these ports serving as outlet or inlet ports in accordance with the setting of the valve.

Unit 35 of hydraulic valve assembly V is clearly shown in section and diagrammatically, in FIGS. 3 and 4 respectively, and comprises a body 96 having a cylindrical bore 98 in which a plunger 100 is slidably fitted, and which is shown in neutral position in FIG. 3.

Plunger 100 is shifted as desired through stem 37 by well-known mechanical linkage and a suitable control element or lever which forms no part of the invention and need not be further described.

Ports 90 and 94 extend inwardly toward bore 98 and terminate in recesses 102 and 104 which have annular portions 103 and 105 surrounding bore 98. Recesses 102 and 104 alternatively permit fluid to flow to conduits 88 and 92 respectively, when plunger 100 is shifted to one or the other of two alternative operating positions.

Low pressure recesses 106, 103 and 110 are provided having annular portions 107, 109 and 111 respectively, which recesses surround bore 98 and provide means for returning fluid to the reservoir or tank T when plunger 100 is in either the neutral or an operating position.

High pressure recesses 112, 114, and 116 have annular portions 113, 115 and 117 which surround bore 98 and have a common high pressure port 118 which is connected to a hydraulic pump P, shown diagrammatically in FIG. 4, and which receives fluid from tank T.

Plunger 100 is provided with a central annular reduced portion 120 so as to permit flow of hydraulic fluid from pump P through recesses 114 and 108 and then to tank T, when plunger 100 is in the neutral position, as shown in FIG. 3, thus bypassing the flow without developing any substantial pressure.

Plunger 100 is also provided with annular reduced portions 122 and 124 which are aligned with recesses 102 and 104 respectively when plunger 100 is in the neutral position, as shown in FIG. 3. The function of reduced portions 122 and 124 will be explained later.

Plunger 100 is provided with a central axial bore 126 which is enlarged as at 128 and 130, so as to define poppet valve seats 132 and 134. Poppet valves 136 and 138 are fitted in enlarged bores 128 and 130 respectively and have cone portions 140 and 142 which contact seats 132 and 134. Valves 136 and 138 are held in engagement with seats 132 and 134 by springs 144, only one of which is shown, and which springs maintain the valves 136 and 138 in a closed position below a predetermined pressure in the system. Poppet valves 136 and 138 have means, not shown, to permit fluid that has escaped into the chambers containing springs 144, to be returned to the system. However, this detail does not concern the invention so it will not be further described.

A means 146 is employed to return the plunger 100 from either of the operating positions to the neutral position when the control handle of control center O is released. A cap 148 secures the various parts of means 146 in assembly and prevents the entrance of foreign matter. However, means 146 does not directly concern this invention, so it will not be further described.

Plunger 100 is provided with cross holes 150 and 152 centrally positioned in reduced portions 122 and 124, as shown in FIG. 3. These holes form passageways into the enlarged bores 128 and 130 respectively about poppet valves 136 and 138, and their function will be explained. The function of control unit 35 will be fully described when the functional operation of the invention, in general, is explained.

When the operating stem 37 of valve unit 35 is actuated to shift plunger 100 inwardly in bore 98, the escape of fluid from recess 114 through recess 108 to the tank T is interrupted, as shown in FIG. 5, thus resulting in well-known manner in the immediate development of high pressure in recesses 114, 112, and 116. High pressure fluid then passes from recess 116, around reduced portion 124 into annular portion 105 through recess 104 and conduits 92 and 82, and then into the rod end 44 of ram 36. This causes rotation of mast M in a counterclockwise direction about axis 28. However, conduit 82 is also connected to the head end of ram 38 which also receives fluid under pressure tending to also move mast M in a counterclockwise direction as done by ram 36. Inasmuch as these rams are double acting, fluid will return to unit 35 from rod end of ram 38, and the head end of ram 36 by way of conduit 80 and 88 and through port 90. When the fluid from conduit 88 enters recess 102, it passes to the annular portion 103, past reduced portion 122, and through recess 106 to tank T.

When the operator desires to swing mast M in a clockwise direction to the position shown in FIG. 4, he moves operating stem 37 of valve unit 35 so as to shift plunger 100 outwardly relative to bore 98, thus placing reduced portion 124 opposite recess 110 and annular portion 111 as shown in FIG. 6. Recess 108 is then blocked by plunger 100 and fluid under high pressure will then pass through recess 112, around reduced portion 122 and through recess 102, port 90, and then through conduits 88 and 80, finally passing into the rod end 46 of ram 38 and head end 40 of ram 36. During this cycle of operation, fluid will exhaust from the rod end 44 of ram 36 and the head end 42 of ram 38, and conduits 82 and 92, and flow into port 94 and then into recess 104, annular portion 105, around reduced portion 124 of plunger 100, and then through recess 110 to tank T. However, the above description of the operation holds true only for a part of each of the above cycles of operation. A change takes place when either ram 36 or 38 traverses the axis 28 as previously explained, in the cycle described above, and which change of function produces the shock absorbing effect of this invention.

The operation of the device, insofar as the swinging of the boom element is concerned, is thought to be clear from the foregoing, sufficient to say, the fluid originating in tank T is forced by pump P into valve V and bypassed therein to be returned to tank T at such times as swinging of boom element B is not desired. When swinging is desired, valve V is displaced, closing the bypass to cause virtually instantaneous pressure build-up. The pressure is transmitted to the head end of one ram and to the rod end of the other so that the two rams cooperate in swinging the boom in the proper direction, according to the direction of shifting of valve plunger 100.

Assuming boom element or mast M to have been swinging clockwise, as seen in FIG. 4, fluid will have been flowing through conduit 88 into the head end of ram 36 and also into the rod end of ram 38 through conduit 80, both rams exerting a rotating effect in the same direction. Fluid in the rod end of ram 36 and in the head end of ram 38 will have been exhausting through conduits 82, and 92 into valve V and thence to tank T. It is to be noted that rod 48 of ram 36 has been swinging about pivot 60 from a dotted position on the left of pivotal connection 26, but has now reached a position at the right of the same, and that, as rod 48 crossed to the other side, or right side of pivotal connection 26, the direction of movement of piston 53 changed from a movement away from head 40 to a movement toward head 40. In other words, the space between piston 53 and head 40 became a contracting chamber instead of an expanding chamber. The fluid therein, commonly oil, being incompressible was therefore virtually instantaneously raised by this reverse movement of piston 53 to a pressure far in excess of that supplied by pump P. This pressure rise, of course,

strongly resisted any further inward movement of piston 53, and owing to the new relation of pivots 26, 60 and 66, a couple was set up tending to cause reverse rotation of mast M, and thereby tending to check the swinging prior to engagement of the stops, and without the exercise of any particular skill on the part of the operator.

It is to be noted that the sudden rise of pressure in ram 36 is transmitted backwardly through conduit 80 into the rod end of ram 38 and that the resulting force in rod 50 is such as to tend to continue the swinging of mast M, which would seem to counteract the checking effect of the pressure rise in ram 36. There is, however, a certain natural resistance to flow through conduit 80, which tends to retard the building up of pressure in the rod end of ram 38 so that the checking effect of ram 36 may predominate over the propelling effect of ram 38. The exact interaction of pressures between the two rams is not easily understood, but the net effect is an automatic checking of the swinging of mast M immediately prior to contact between the positive stop portions, as hereinbefore stated. Furthermore, such checking does not prevent swinging of the mast to the extreme limit of motion, since continued flow of pressure fluid to conduit 88 will continue to force fluid into the rod end of ram 38, and since ram 38 is in a favorable position for swinging mast M while ram 36 is in a relatively unfavorable position for retarding mast M, subsequent to the momentary checking action above described ram 38 can continue the swinging movement to the extreme limit permitted by the stop portions 84a and 86a on frame F and mast M, respectively.

As heretofore stated, mast M and boom B with their attached parts constitute a very considerable mass and when swinging rapidly contain a large amount of energy or momentum. Therefore, the pressure surge or "kick" in ram 36 may be very substantial. This pressure will react into conduit 88 and recess 102, FIGS. 3 and 6, being transmitted into the space provided by reduced portion 122 of plunger 100. The pressure is also transmitted through bore 150 into the annular space about poppet valve 136. The pressure surge also reacts backwardly past reduced portion 122 into port 112 against the flow of fluid coming from pump P. As will be apparent, this would tend to force fluid backwardly through pump P and would result in excessive pressure in port 112. Such pressure will have a tendency to shift poppet valve 136 downwardly as seen in the illustrations by reason of the difference in area between bore 128 and seat 132, and spring 144 is flexible enough to allow poppet valve 136 to shift away from seat 132 and allow relief of the pressure to bore 126. The resulting rise in pressure in bore 126 will easily unseat poppet valve 138 by reason of the relatively large area of seat 134 so that the excess pressure fluid will be discharged through seat 134, bore 152, recess 110 and returned to the tank through conduit 92. Such discharge of fluid will dissipate the energy applied to ram 136 by momentum of the mast and boom so that it will not be given back to mast M to cause any kind of a rebounding action. In this manner, the combination disclosed serves the dual function of a propelling means and a checking means or shock absorber, thus utilizing parts for one purpose which are already in the combination for another.

As will be understood, the action when mast M is swung counterclockwise in FIG. 4 is equivalent to that just described, except that ram 38 becomes the shock absorber or checking ram, while ram 36 assumes a position where it can complete the swinging movement in opposition to ram 38.

The foregoing being a complete description of an illustrative embodiment of the invention, what is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a backhoe mounted on a tractor, the combination of a support on the rear of the tractor, a pivotal con-

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nection on the support, a boom element mounted on the pivotal connection for swinging from side to side, rearwardly of the tractor, a pivot on the support, a pivot on the boom element, an expansible hydraulic motor comprising a cylinder unit having a head end, a rod end, and a piston rod projecting from said rod end, means in the region of said rod end connected to one of said pivots, and said piston rod being connected with the other of said pivots, said pivots being positioned so that said hydraulic motor will extend along one side of the above-mentioned pivotal connection, stop means limiting the swinging movement of said boom element so positioned that said hydraulic motor will swing to the opposite side of said pivotal connection prior to the arresting of said boom element by said stop means, a pressure fluid supply for said hydraulic motor including a conduit connected to expand said motor upon flow of fluid from said conduit into said motor, and a relief valve opening out of said conduit to relieve excess pressure built up by contraction of said hydraulic motor caused by swinging of said boom element beyond the point where said hydraulic motor swings to said opposite side of said pivotal connection, whereby said excess pressure acts on said hydraulic motor to tend to prevent contraction thereof and to check the swinging of said boom prior to its being arrested by said stop means.

2. In a backhoe mounted on a tractor the combination of a support on the rear of the tractor, a pivotal connection on the support, a boom element mounted on the pivotal connection for swinging from side to side rearwardly of the tractor, a pair of spaced pivots on the support, one on either side of said pivotal connection, a pair of spaced pivots on the boom element, one on either side of said pivotal connection, a pair of extensible hydraulic motors positioned at opposite sides of said pivotal connection, one being connected to one of said pivots on said support and to one of said pivots on said boom structure on one side of said pivotal connection, and the other being connected to one of said pivots on said support and to one of said pivots on said boom element on the other side of said pivotal connection, stop means limiting the swinging movement of said boom element, so positioned that one of said hydraulic motors will swing across to the opposite side of said pivotal connection in one direction prior to the arresting of said boom element by said stop means, and the other hydraulic motor will swing across said pivotal connection in the other direction prior to the arresting of said boom element by said stop means, a pressure fluid supply for said hydraulic motors including a conduit connected to each motor in position to expand said motor upon flow of fluid from said conduit into said motor, and a relief valve opening out of each conduit to relieve excess pressure built up by contraction of the associated hydraulic motor caused by swinging of said boom element in either direction beyond the points where said hydraulic motors swing to said opposite sides of said pivotal connection, whereby said excess pressure acts on said hydraulic motors to prevent contraction thereof and to check the swinging of said boom in either direction prior to its being arrested by said stop means, and whereby said relief valves, by discharging said excess pressure, dissipate the energy imparted to said pressure fluid by the momentum of said boom element when it is compressing either of said hydraulic motors.

3. In a backhoe mounted on a tractor the combination of a support on the rear of the tractor, a pivotal connection on the support having a substantially vertical axis and including spaced bearings, a boom element supported on said pivotal connection for swinging movement about said vertical axis in a region rearwardly of the tractor, a pivot on said boom element spaced rearwardly and at one side of said pivotal connection, a pivot on said support spaced forwardly and at the same side of said pivotal connection, a fluid motor including a cylinder providing a head end and a rod end, a piston rod projecting

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from said rod end, and connected to one of said pivots and said rod end being connected to the other pivot whereby said cylinder lies substantially entirely outside of the region between said pivots, means for supplying pressure fluid to said cylinder for swinging said boom element, and the spacing of said pivotal connection and said pivots being such that said piston rod, in one position of said boom element will swing between said spaced bearings and across said substantially vertical axis so that continued pressure in said cylinder will tend to check the swinging of said boom element.

4. In a backhoe mounted on a tractor the combination of a support on the rear of the tractor, a pivotal connection on the support having a substantially vertical axis and including spaced bearings, a boom element supported on said pivotal connection for swinging movement about said vertical axis in a region rearwardly of the tractor, a first pivot on said boom element spaced rearwardly and at one side of said pivotal connection, a second pivot on said support, spaced forwardly and at the same side of said pivotal connection, a third pivot on said boom element spaced rearwardly and at the other side of said pivotal connection, a fourth pivot on said support spaced forwardly and at the same side of said pivotal connection as said third pivot, a first fluid motor including a cylinder providing a head end and a rod end, a piston rod projecting from said rod end, said rod end being connected with said first pivot, and said piston rod being connected with said second pivot whereby said cylinder lies substantially entirely outside of the region between said pivots, a second fluid motor including a second cylinder providing a head end and a second rod end, a second piston rod projecting from said second rod end, said second rod end being connected to said third pivot and said second piston rod being connected with said fourth pivot, whereby said second cylinder lies substantially entirely outside of the region between said pivots, means for supplying pressure fluid to said cylinders for swinging said boom element, and the spacing of said pivotal connection and said first, second, third and fourth pivots being such that each of said piston rods, in one position of said boom element, will swing between said spaced bearings and across said substantially vertical axis.

5. In a backhoe the combination of a support, a pivotal connection on the support having a substantially vertical axis, a boom element supported on said pivotal connection for swinging movement about said vertical axis in a region rearwardly of the support, a pivot on said boom element spaced rearwardly and at one side of said pivotal connection, a pivot on said support spaced forwardly and at the same side of said pivotal connection, a fluid motor including a cylinder providing a head end and a rod end, a piston rod projecting from said rod end and connected to one of said pivots, and said rod end being connected to the other pivot whereby said cylinder lies substantially entirely outside of the region between said pivots, means for supplying pressure fluid to said cylinder for swinging said boom element, and the spacing of said pivotal connection and said pivots being such that said piston rod, in one position of said boom element will swing across said substantially vertical axis so that continued pressure in said cylinder will tend to check the swinging of said boom element.

6. In a backhoe the combination of a support, a pivotal connection on the support having a substantially vertical axis, a boom element supported on said pivotal connection for swinging movement about said vertical axis in a region rearwardly of the support, a pivot on said boom element spaced rearwardly and at one side of said pivotal connection, a pivot on said boom element spaced rearwardly and at the other side of said pivotal connection, a pivot on said support spaced forwardly and at the same side of said pivotal connection as the first-mentioned pivot, a pivot on said support spaced forward-

ly and at said other side of said pivotal connection, a fluid motor including a cylinder providing a head end and a rod end, a piston rod projecting from said rod end, and connected to one of said pivots on said one side of said pivotal connection and said rod end being connected to the other pivot on said one side of said pivotal connection, a second cylinder providing a head end and a rod end, a piston rod projecting from said rod end and connected to one of said pivots on said other side of said pivotal connection and said rod end being connected to the other pivot on said other side of said pivotal connection, whereby said cylinders lie substantially entirely outside of the region between said pivots, means for supplying pressure fluid to said cylinders for swinging said boom element, and the spacing of said pivotal connection and said pivots being such that one of said piston

rods, in one position of said boom element will swing across said substantially vertical axis so that continued pressure in one of said cylinders will tend to check the swinging of said boom element by the other cylinder.

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