

Oct. 29, 1968

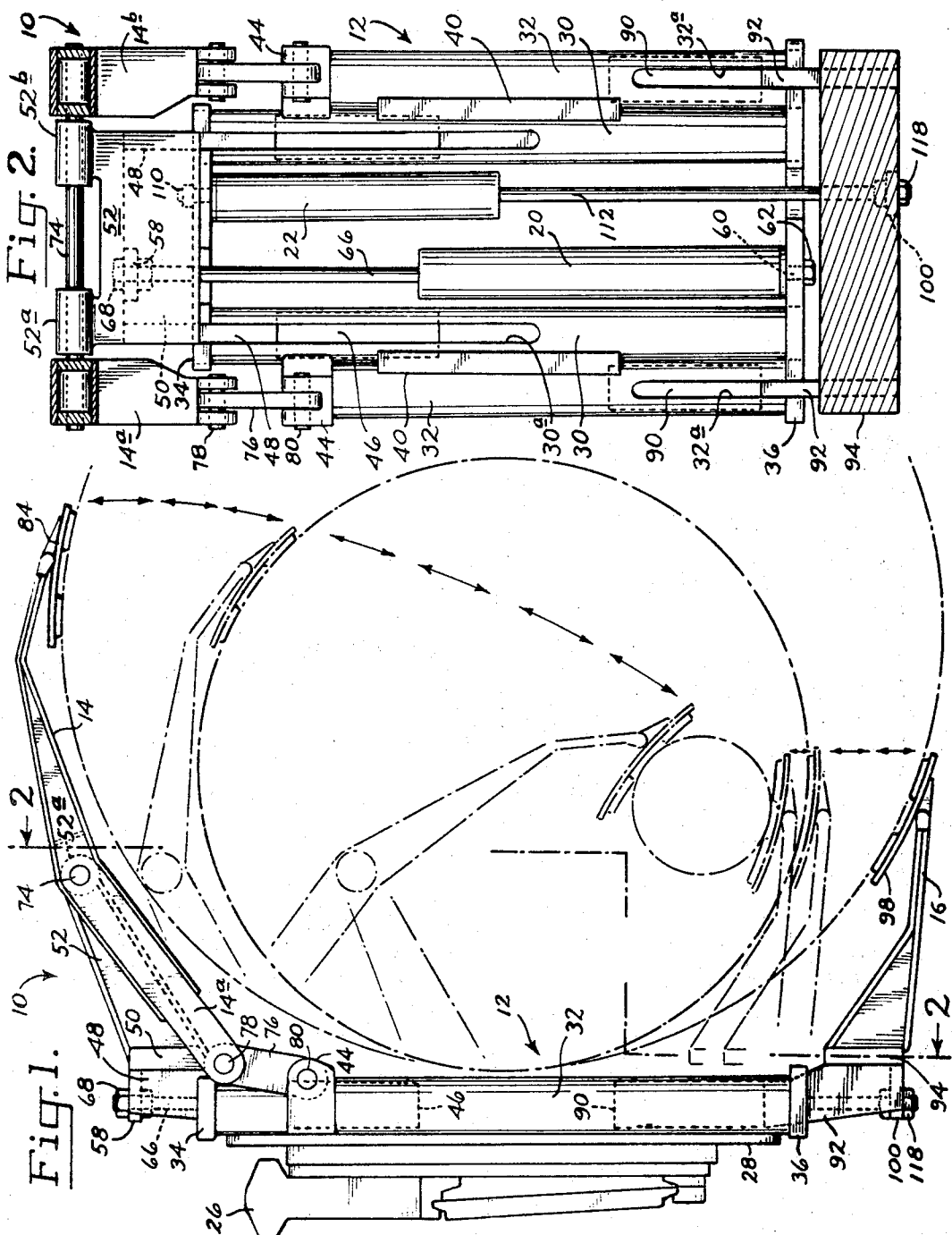
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3,407,951

LOAD CLAMP WITH ARM TRAVEL RETARDING MEANS

Filed June 19, 1967

2 Sheets-Sheet 1



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3,407,951

LOAD CLAMP WITH ARM TRAVEL RETARDING MEANS

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Filed June 19, 1967, Ser. No. 647,121
4 Claims. (Cl. 214-653)

ABSTRACT OF THE DISCLOSURE

Load handling apparatus having a pair of opposed load-clamping arms and a pair of fluid-operated rams connected to the arms, operable to move the arms toward each other. One of the arms has an inner limit position beyond which it cannot move toward the other arm. The ram connected to this one arm includes a passage which allows fluid to exhaust therefrom as the arms are moved toward each other, and a device which partially closes off the passage to retard such exhaust and thereby to retard movement of the one arm prior to its reaching the inner limit position. A check valve is connected within a line through which fluid under pressure is supplied to the other ram, and acts to hydraulically lock this other arm against being backed away from the one arm.

This invention relates to load handling apparatus, and more particularly to load handling apparatus having opposed clamping arms which are moved toward each other, and means for retarding the movement of one of the arms prior to its reaching a predetermined point in its travel.

In the handling of loads, a lift truck having apparatus mounted on its front end including opposed clamping arms and fluid-operated rams for moving the arms toward each other to grip a load therebetween is often used. Differences between the sizes of the rams used to move the individual arms, the configurations of the opposing arms, or the connections of the arms to the rams may be such as to cause one of the arms to be able to exert a greater gripping force against a load than can the opposing arm.

With especially heavy loads, it is generally desirable to grip the load between the arms with the greatest gripping pressure available. However, with apparatus as described above, where one arm can exert a greater force than the other the gripping pressures producible on a load gripped between the arms may be no greater than the pressure exertable by what might be thought of as the weaker of the two arms, i.e., the arm which is able to produce only the lesser gripping force. This is so since the stronger arm can overpower the weaker arm, causing the weaker arm to back away from the stronger arm until the stronger arm can move no further.

A general object of the invention is to provide apparatus having opposed clamping arms which are moved together by rams to grip a load therebetween, characterized in that one arm is able to exert a greater clamping force against the load than the other arm, and novel means in the organization enabling a gripping pressure to be exerted on the load which is the pressure producible by the stronger of the arms in the apparatus.

More specifically, an object of this invention is the provision in the apparatus described of novel locking means which prevents the weaker of a pair of opposed clamping arms from backing away from the other clamping arm when a load is gripped between the two arms, and means assuring that with the weaker arm locked the stronger arm is permitted a limited amount of travel to-

ward the weaker arm, thus to enable the stronger arm to exert full clamping pressure.

Another object of this invention is to provide, in clamping apparatus, novel means for retarding movement of a stronger arm toward a weaker arm prior to the stronger arm reaching its inner limit position in the apparatus. Such retarding means enables the weaker arm to come against the load and press it to the limit of its capability prior to the stronger arm reaching its inner limit position on the apparatus.

More specifically, an object of the invention is the provision of retarding means which takes the form of means retarding the flow of fluid necessary to actuate the ram which moves the stronger of the two arms whereby actuation of such ram is decelerated.

A still more specific object is the provision, in the ram for the stronger arm, of novel means for controlling the exhaust of fluid from one end of the ram after the ram completes part of its stroke in causing its arm to move inwardly against a side of a load. In furtherance of this object, a closure device traveling with the piston acts partially to close off an exhaust passage adjacent said end of the ram, prior to the stronger arm reaching its inner limit position.

These and other objects of the invention will become more fully apparent when the description which follows is read in conjunction with the appended drawings, wherein:

FIG. 1 is a side elevation of load handling apparatus according to the invention, having opposed clamping arms, and showing the opposed arms in dashed outline in various positions which they assume upon being moved toward each other;

FIG. 2 is a view taken along the line 2-2 in FIG. 1, illustrating in the apparatus a pair of rams which are connected to and operate the load clamping arms;

FIG. 3 is an enlarged view of the ram which moves the lower of the opposed pair of arms in FIG. 1, with a section broken away better to illustrate the internal mechanism of the ram; and

FIG. 4 is a schematic diagram illustrating a hydraulic system for actuating the rams connected to the opposed clamping arms.

Referring now to the drawings, and more particularly to FIGS. 1 and 2, at 10 is indicated generally load handling apparatus constructed in accordance with an embodiment of the invention. The apparatus comprises, in broad terms, a mounting frame 12, a pair of opposed, relatively movable clamping arms mounted for movement on the mounting frame, one arm being indicated at 16 and the other arm indicated at 14, and a pair of fluid-operated rams 22, 20, also referred to as fluid-operated means, or fluid motors, connected to the arms and adapted to move the arms toward and away from each other. The apparatus illustrated is suitable for use in handling paper rolls and similar articles.

The apparatus is connected to the elevatable carriage at the forward end of a conventional lift truck (not shown) through a rotator 26. The rotator may be conventional, and includes the usual power operated means for rotating plate 28 in front of the rotator about a substantially horizontal axis which extends along the longitudinal axis of the lift truck. By including the rotator, loads such as paper rolls may be gripped by the clamping arms with rolls either on end or lying on their sides, and such loads after being gripped may be turned on one side or inverted.

Mounting frame 12 is illustrated in FIGS. 1 and 2 in a vertical position. The frame comprises, in addition to plate 28, a first pair of parallel, spaced-apart, elongated tubes 30 and a second pair of elongated tubes 32 mounted laterally outwardly of and paralleling tubes 30. As is best seen

in FIG. 2, tubes 30 have longitudinal slots 30a which extend along the forward sides of the tubes from the tops of the tubes to their approximate midpoints. Tubes 32 also have longitudinal slots 32a extending along their forward sides, which slots extend from the bottom ends of tubes 32 to points short of the midpoints of tubes 32.

A crosspiece 34 in the frame is rigidly secured to the tops of tubes 30. Another crosspiece 36 extends across the bottoms of tubes 30, 32 and is rigidly secured to the bottoms of these tubes. Crosspieces 34, 36 have suitable notches which align with slots 30a, 32a and provide extensions of these slots. A pair of elongated flat bars 40 (see FIG. 2) are positioned parallel to the longitudinal axes of tubes 30, 32. Each of bars 40 joins one of the tubes 30 to one of the tubes 32, by being secured along longitudinal edges to these tubes.

Tubes 32 are shorter than tubes 30 and thus, with their bottoms lying in a common plane, the tops of tubes 30 extend above the tops of tubes 32, as is seen in FIG. 2. A pair of clevises 44 are rigidly mounted on the top ends of tubes 32.

Slidably received within tubes 30 are a pair of elongated cylindrical guide bars 46. A mounting 48 is rigidly secured to the top of each guide bar. Each mounting projects upwardly and forwardly of its associated guide. The slots in tubes 30 accommodate mountings 48, on the guide bars being retracted into the tubes. Mounted on the forward edges of mounting bars 48 for movement with the bars and cylindrical guides is a plate 50 which rigidly interconnects the two mounting bars.

An arm base 52 is secured to the forward side of plate 50 and projects forwardly therefrom. As is best seen in FIG. 2, base 52 is bifurcated adjacent its forward end, and terminates in bearing portions 52a, 52b. Bearing portions 52a, 52b, are aligned in a direction extending transversely of mounting frame 12. An ear 58 is rigidly secured to the backside of mounting plate 50.

As is best seen in FIG. 2, ram 20 extends vertically within frame 12 in the space between tubes 30. Securing the lower end of the ram cylinder is a head bolt 60 which extends through an accommodating bore in crosspiece 36, and a nut 62. Rod 66 of the ram extends through a bore in ear 58 and is secured to the ear by means including a nut 68. Operation of ram 20 causes rod 66 to extend and retract vertically of the frame, to change the effective length of the ram. Such a change in effective length of ram 20 acts to move guide bars 46, mounting plate 50 and arm base 52 as a unit vertically of frame 12.

Referring still to FIGS. 1 and 2, the rear end of arm 14 is bifurcated, to present two laterally spaced-apart arm sections 14a, 14b. These arm sections straddle arm base 52. Pin 74 extending through bearing portions 52a, 52b, pivotally connects arm 14 to arm base 52 at a point between the ends of the arm, and adjacent the forward extremities of arm sections 14a, 14b. Links 76 journaled at 80 on clevises 44 are pivotally connected by pins 78 to the rear extremities of arm sections 14a, 14b, thus serving to anchor the rear of arm 14.

An arcuate gripping pad 84 is hinged to the forward end of arm 14. The gripping pad may be curved over its inner surface, thus to enable it best to grip onto a load such as a paper roll.

With arm 14 pivotally connected to arm base 52, and linked by links 76 to frame 12 as described, upon contraction of ram 20 a given distance, the forward end of the arm and gripping pad 84 will move toward arm 16, a somewhat greater distance. As a consequence, the pressure which can be exerted against a load by arm 14 and gripping pad 84 is somewhat less than would be the case if the arm was connected to the arm base so that its forward end moved inwardly at the same rate as the arm base.

Considering arm 16 and its mounting in the organization, a second pair of guide bars 90 are slidably received in tubes 32. A mounting 92 is rigidly secured to the bottom

of each bar 90 in FIGS. 1 and 2, which projects forwardly and downwardly from such bar. Plate 94 is secured to mountings 92 to interconnect the mountings. Arm 16 is mounted securely on plate 94, and at its forward end terminates in a hinged gripping pad 98 which may be similar to the pad described for arm 14. An ear 100 is rigidly secured to the backside of mounting plate 94.

As is best seen in FIG. 2, ram 22 like ram 20 is positioned within frame 12 between tubes 30. The ram has its cylinder end fastened to crosspiece 34 by a nut 110. Rod 112 of the ram extends through ear 100 and is secured to the ear by means including a nut 118.

Because arm 16 is fixed on plate 94, on contraction of ram 22 a given distance, the forward end of the arm moves the same distance inwardly on frame 12. As a consequence, the pressure which can be exerted against the load by the arm is somewhat greater than the pressure that may be exerted by arm 14 (with the internal diameter of the cylinders of rams 20 and 22 being equal as in the embodiment of the invention herein disclosed). Thus, in the apparatus arm 14 which travels the farthest for a given amount of ram contraction is referred to as the weaker arm, whereas arm 16 is referred to as the stronger arm.

Referring now specifically to FIG. 3, where ram 22 is shown in detail, the ram includes a piston 122 reciprocable within a cylinder 102. Head 124 closes off one end of the cylinder, and head 104 closes off the opposite end. Ram 22 is a double-acting ram and has ports 126, 128 adjacent opposite ends for the supply and exhaust of fluid.

Piston 122 comprises sections 122a, 122b encircling a reduced end portion 112a of the piston rod and held in place on the piston rod by a nut 134 screwed onto an externally threaded portion 112b. The piston is sealed to the interior of cylinder 102 by sealing assembly 130 supported on section 122b between retainers 132. Section 122a includes a skirt portion 136 which is sealed to the interior of the cylinder by seal 140. As can be seen in FIG. 3, the outer diameter of section 122a in the region spaced axially inwardly from seal 140 is considerably less than the inner diameter of the cylinder, providing appreciable clearance in a region 123. Communicating with this region of clearance 123, and extending through skirt 136, is a small port 142.

Extending in an axial direction through piston section 122a is a bore 144. A passage 146 connects the end of this bore with region of clearance 123, about the circumference of piston section 122a. Passage 146 is shown closed off by a ball 148 urged to a closing position by a spring 150. The spring is lodged between a fitting 152 screwed into the left end of bore 148 and a ball retainer 154. A passage 156 in fitting 152 permits the flow of fluid from passage 146 past the ball into the left end of the cylinder, on fluid under pressure being admitted through port 126.

Explaining the operation of ram 22, and assuming that the piston is initially adjacent head 124, on fluid under pressure being introduced through port 128 the piston moves to the left with the exhaust of fluid from port 126. During the initial stroke of the ram the exhaust of fluid is unrestricted. However, as the ram nears the end of its stroke (and arm 16 which is connected to it moves near its inner limit position) seal 140 moves beyond port 126 thus to confine the exhaust of fluid from the left end of the ram to such fluid as may flow through port 142. This severely restricts the exhaust of fluid, and serves sharply to decelerate contraction of the ram near the end of its stroke. On subsequent extension of the ram, fluid may flow relatively rapidly into the left end of the cylinder, through both port 142, and passage 146 which is opened by ball 148 moving to the left in FIG. 3.

Referring now to FIG. 4, which illustrates schematically a hydraulic system used to actuate rams 20, 22, it will be noted that both rams are supplied with pressure fluid from a common source reservoir 160. A pump 162 draws

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fluid from the reservoir, and a control valve 164, also mounted on the vehicle, is adjusted to control the direction of fluid flow through the system.

A pair of hydraulic lines 166, 168 is connected to valve 164. Control valve 164 is adjustable to connect either line 166 or 168 to the discharge side of the pump, with the other of the two lines then being connected to dump into the reservoir.

Hydraulic lines 166, 168 are joined through a rotatable coupling 170 to the remainder of the hydraulic system which is mounted on the carriage of the lift truck vehicle. More specifically, connecting with line 168 beyond coupling 170 are lines 172, 174 which connect with a pair of pilot-operated check valves 176, 178. Connecting with line 166 beyond coupling 170 are lines 180, 182, which join with one set of ends of rams 20, 22. The opposite set of ends of these rams are connected through lines 184, 186 with check valves 176, 178, respectively. The pilot side of check valve 176 connects through pilot line 188 with line 180 and one end of ram 22. The pilot side of check valve 178 connects through pilot line 190 with line 182 and one end of ram 20.

The two check valves are similar in construction and only one will be described in detail. With reference to check valve 178, fluid flow through the valve takes place through passage 192 and bore 194 (which in valve 178 connect lines 174 and 186). A ball 196 is urged by spring 198 against the end of passage 192 to close this passage. The valve includes a pilot chamber 200 snugly receiving a reciprocable piston 202. A rod 204 joined to the piston extends loosely through passage 192 to an end which is not joined to, but abuts ball 196. With such a construction, fluid flow is permitted through the valve from line 174 to line 186, but is prevented in the opposite direction in the absence of fluid under pressure in pilot line 190. With fluid under pressure in line 190, piston 202 is urged inwardly in the valve causing rod 204 to unseat ball 196 whereby fluid flow in the reverse direction through the valve may take place.

Describing now how the apparatus disclosed may be utilized to clamp onto a load, arms 14, 16 are moved apart with extension of rams 20, 22. To extend these rams valve 164 is adjusted to admit fluid under pressure to line 166 and to permit the exhaust of fluid from line 168. As a result, fluid under pressure is delivered to lines 180, 182 and to the left end of ram 22 and the right end of ram 20 in FIG. 4. Fluid under pressure is also admitted to pilot lines 188, 190 whereby the pilot-operated valves are opened to permit exhaust of fluid from the right end of ram 22 through line 184 and the left end of ram 20 to line 186.

To clamp onto a load, the rams are contracted by adjustment of valve 164 to admit pressure fluid to line 168 and to accommodate the exhaust of fluid from line 166. This results in fluid under pressure flowing through line 172 and check valve 176, to line 184 and the right end of ram 22 in FIG. 4. The left end of the ram exhausts through line 180 directly into line 166. In the case of ram 20, fluid flows through line 174 and check valve 178 to line 186 on the left end of the ram, and fluid exhausts from the right end of the ram through line 182 directly to line 166.

Upon contraction of the rams and with the arms moving together, eventually one of the arms comes into contact with a side of a load. On such occurring the arm meets resistance to movement and there is a corresponding increase in the pressure of fluid causing contraction of the ram connected to that arm. Pressure fluid flow is then principally to the ram for the other arm causing such other arm to move up against the opposite side of the load.

With both arms contacting the load, arm 16 which has been referred to herein as the stronger arm, moves against the load as supported by arm 14 on the opposite side to exert the maximum clamping pressure obtainable from

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the particular hydraulic system utilized. Arm 14, or the weaker arm, is prevented from backing away or being overpowered by the shorter arm by check valve 178 which, by controlling exhaust of fluid from the left end of ram 20 in FIG. 4, prevents extension of this ram.

To obtain full clamping pressure it is thus apparent that some movement must be permitted the short, or stronger, arm after contact of the load by the longer arm and the shorter arm being brought up against the load. Without providing for such additional movement, and assuming that ram 22 had fully contracted to move arm 16 to its inner limit position in the apparatus before full clamping pressure had been generated, then it is only the longer arm 14 that could bear against the load finally to clamp it, which, because of the type of mounting for the arm, is limited as to the clamping pressure it can exert. This invention insures that some additional movement is maintained in reserve in the shorter arm by the inclusion of the structure illustrated in FIG. 3 for the ram which powers the shorter arm.

More fully explaining, let it be assumed that a very large-sized load had been placed between the arms and ram 22 has contracted to an extent sufficient to move seal 140 to the left of port 126 in FIG. 3 without the pad of arm 16 coming into contact with the load. When such occurs, and because of the sharp restriction to the exhaust of fluid from the left end of the ram in FIG. 3 which then occurs, further contraction of the ram and inward movement of arm 16 is sharply decelerated. A time interval is thus provided for arm 14 to move in against the load and then move the load toward and against the now rather slowly moving shorter arm 16. With the load moved by arm 14 against arm 16, arm 16 can function as previously described, to clamp the load firmly with further inward movement.

It will be noted that with the construction illustrated the advantages of having a long arm which is moveable over a fairly large distance are realized, which, briefly stated, is the ability to handle effectively a wide range of load sizes while retaining a fairly compact construction in the frame which mounts the two arms.

Check valve 178 and similar check valve 176 described in connection with ram 22 together operate in the organization to prevent release of a load after the same has been clamped, by serving hydraulically to lock the two rams in their particular retracted positions that they have upon a load being clamped between the arms.

While a particular embodiment of the invention has been described, it should be obvious that changes and variations are possible without departing from the invention. It is desired, therefore, to cover all such modifications of the invention as would be apparent to one skilled in the art and that come within the scope of the appended claims.

What is claimed is:

1. Load-handling apparatus comprising a pair of opposed clamping arms relatively movable toward and away from each other and each having a free outer end, fluid-operated means for each arm operatively connected to the arm and operable to move the arm toward the other of the arms to grip a load therebetween, one arm exerting a greater force when moved by its fluid-operated means than the force exerted by the other arm when moved by its fluid-operated means, limit means preventing travel of said one arm toward the other arm beyond a predetermined point, means preventing said other arm from backing away from said one arm under the influence of said one arm, and retarding means operable automatically to decelerate said one arm prior to said one arm reaching said predetermined point.

2. The apparatus of claim 1, wherein said fluid-operated means comprises a fluid-operated motor connected to said one arm, and said retarding means comprises fluid flow control means inhibiting fluid flow necessary to produce motor actuation.

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3. The apparatus of claim 2, wherein said motor is a fluid-operated ram, and wherein said fluid flow control means comprises means inhibiting fluid exhaust from said ram.

4. Load-handling apparatus comprising a frame and a pair of opposed arms, each arm being mounted on said frame for movement toward the other arm to a defined inner limit position for the arm, each of said arms having a load gripping surface adapted to be brought against a load, one fluid-operated ram mounted on said frame and operatively connected to one arm for moving it under power and another fluid-operated ram mounted on said frame and operatively connected to the other arm for moving it under power, the connection between said rams and said arms being such that said one ram undergoes a greater change in effective length than does said other ram to produce an equal amount of movement in the

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gripping surfaces for said arms, means for hydraulically locking said other ram to prevent said other arm to which it is connected from backing away from said one arm, and means operable by controlling fluid flow necessary to actuate said one ram operable to retard actuation of said one ram on said one ram moving said one arm partially to its inner limit position.

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