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Didtel et al.

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[54] **CLAMP MECHANISM WITH TRAILING ARM CONTROL**

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[52] **U.S. Cl.** **214/653,** 214/730

[51] **Int. Cl.** **B66f 9/14**

[58] **Field of Search** 214/653, 730

[56] **References Cited**

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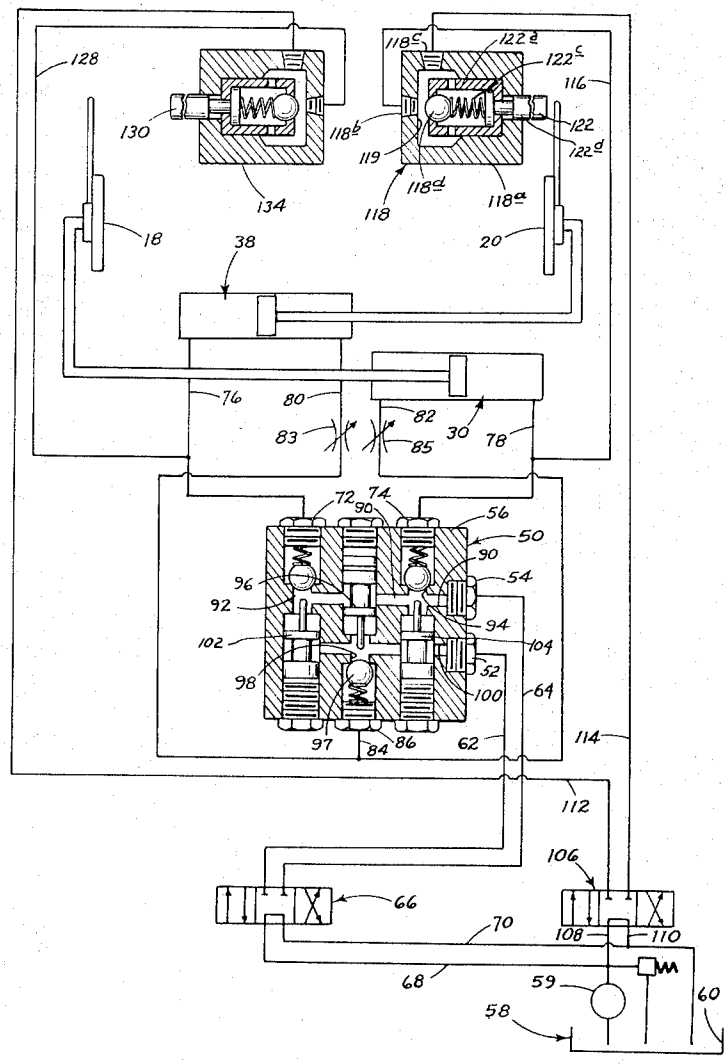
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Assistant Examiner—George F. Abraham
Attorney—Kolish, Hartwell & Dickinson

[57] **ABSTRACT**

Clamp mechanism including a pair of opposed clamp members movably mounted on a frame. The clamp members are movable toward and away from each other to effect clamping and release of a load, and are movable in the same direction on the frame, to one or the other side, for the purpose of side shifting a load. A fluid-pressure operated ram is connected to each clamp member to move it under power. Hydraulic circuit means connects a source of fluid under pressure with the rams, this circuit means on side shifting connecting the rams in series with one dumping into the other. The hydraulic circuit means includes a pair of valves, one associated with each clamping member. One valve is actuated by the clamp member which is trailing on side shifting in one direction to stop the supply of pressure fluid to the rams prior to the ram for the trailing clamp member reaching the end of its stroke. A valve associated with the other clamp member performs a similar function with the other clamp member moving as a trailing member on side shifting.

4 Claims, 4 Drawing Figures



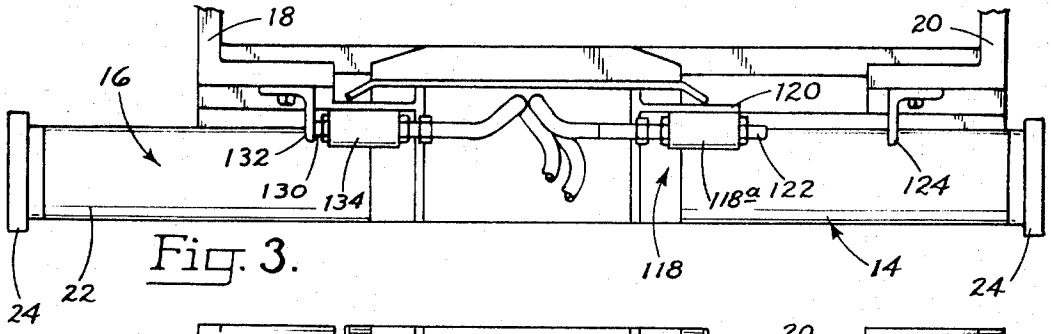


Fig. 3.

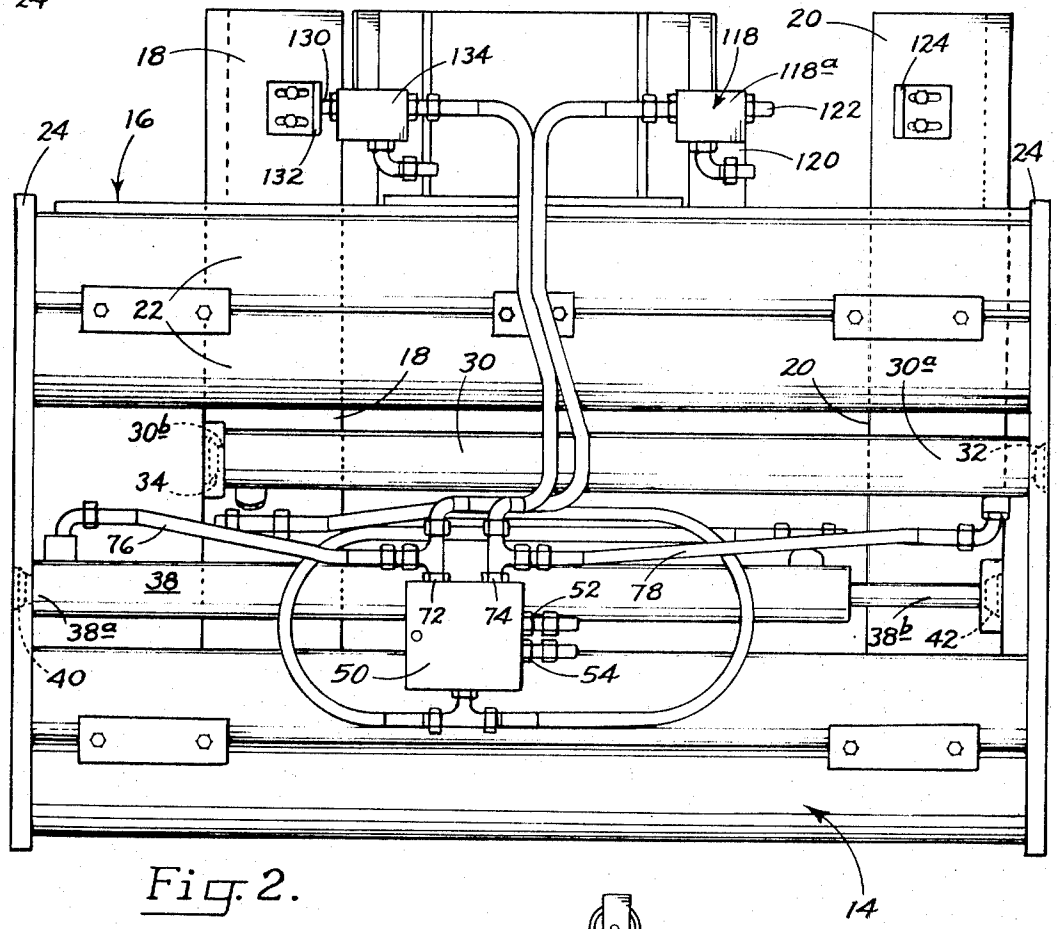


Fig. 2.

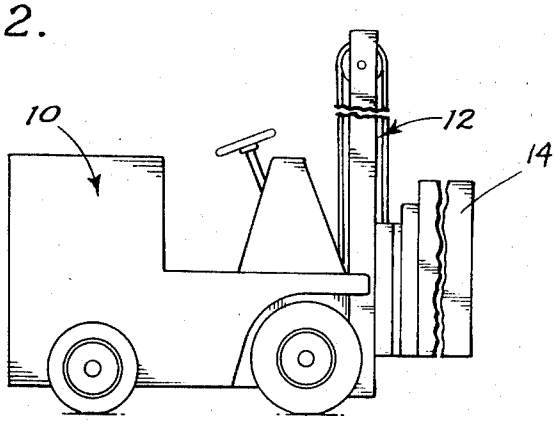


Fig. 1.

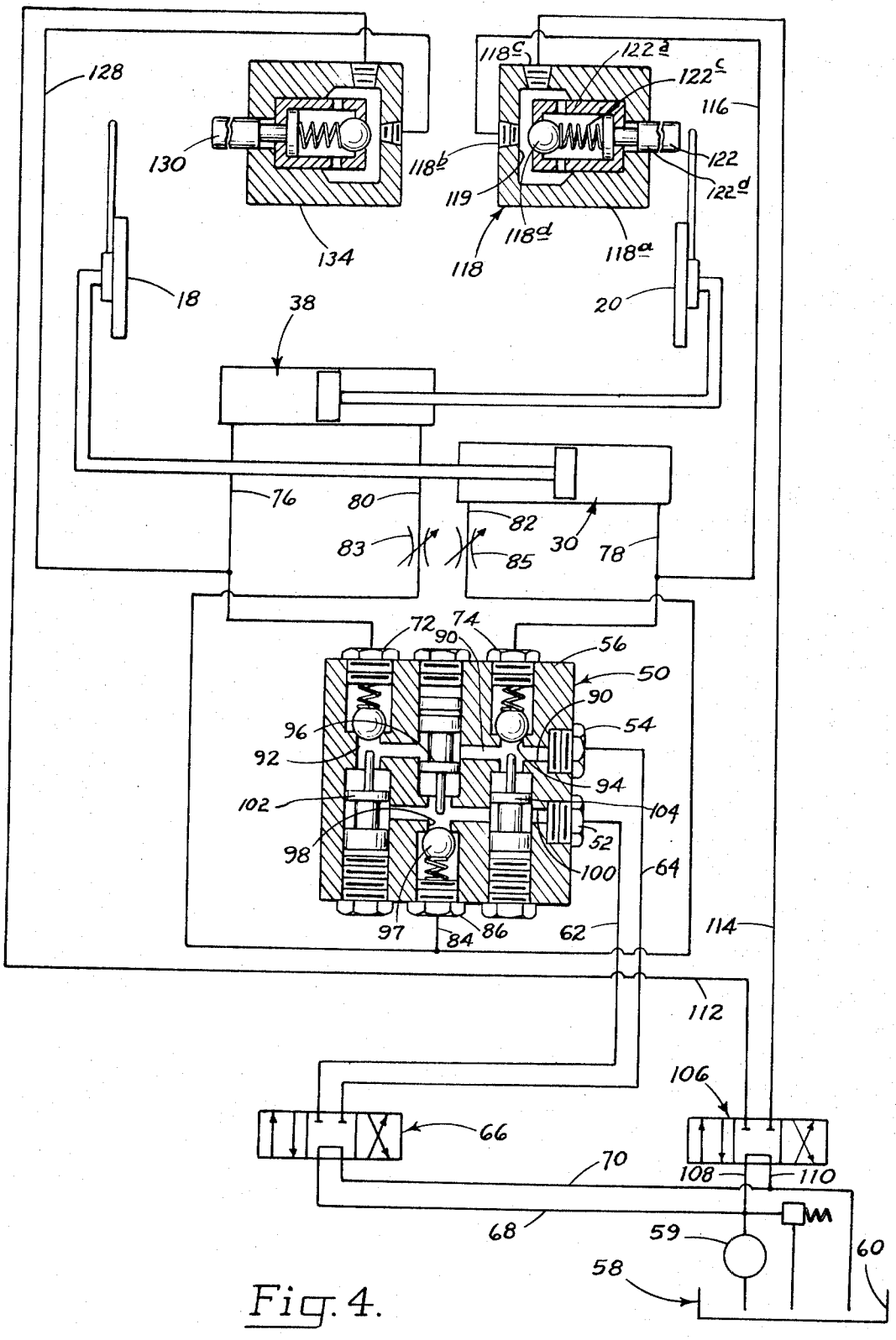

128
130
134
118b
118c
122a
122c
116
122
122d
119
118d
118
118a
18
20
38
76
80
82
83
85
30
78
72
74
90
56
50
90
96
54
92
94
102
104
52
98
100
64
97
84
86
62
114
112
106
66
70
108
110
68
59
60
58

Fig. 4.

CLAMP MECHANISM WITH TRAILING ARM CONTROL

This invention relates generally to clamp mechanism including a pair of opposed clamp members mounted on a frame movable toward and away from each other for the purpose of clamping onto and releasing a load. Such an organization is characteristic of a lift truck attachment utilized in clamping onto cartons and the like, to enable subsequent lifting of the cartons and their movement from one location to another.

Clamp mechanism of the type described may conventionally include a fluid-pressure operated ram associated with each clamp member for moving it under power. Hydraulic circuit means connects a source of fluid under pressure with these rams. With one adjustment of such circuit means, the rams are actuatable to move the clamp members toward and away from each other for the purpose of gripping onto and releasing a load. With another type of adjustment, the rams are actuatable to move the clamp members in the same direction, either to one or to the other side of the frame, for the purpose of side shifting a load.

This invention is directed to the problem of maintaining at all times full clamping pressure on the load during side shifting. Further explaining, it has been noted that with loads having a side to side dimension which is somewhat less than the maximum size of load that can be handled, what limits side shifting in any given direction is the ram which moves the trailing clamp member reaching the end of its stroke, for example, by the piston of the ram bottoming out in the ram's cylinder. The hydraulic circuit which is provided to deliver pressure fluid to the rams may be constructed so as to stop the supply of pressure fluid to the ram for the leading clamp member immediately on such bottoming out occurring. From a hydraulic standpoint, this should prevent relaxation of clamping pressure in the load at the end of side shifting. However, as a practical matter, such is not the case since with relatively heavy and with certain types of clamp constructions, momentum tends to cause the leading member to move away from the trailing one at the end of a side shifting cycle. This results in momentary loss of clamping pressure, and any such loss of clamping effort obviously is detrimental to the overall operation of the clamp.

This invention has as its general object the provision of clamp mechanism for handling loads with means whereby sustained clamping pressure is maintained on all load sizes during side shifting.

More particularly, this invention comprises a novel organization of opposed clamp members, and rams for moving these under power, with means operable hydraulically to stop ram actuation prior to the ram for the trailing clamp member on side shifting reaching the end of its stroke.

A more specific object is to provide, in an attachment such as a lift truck attachment, opposed clamp members for clamping onto a load, and valves means mounted on the frame of the attachment operated by portions movable with the clamp members operable to make adjustments in the hydraulic circuit means supplying pressure fluid to the rams, whereby the ram for the trailing clamp member is prevented from reaching the end of its stroke.

Yet another object is to provide clamp mechanism, such as might be provided in an attachment for a lift truck, with valve means operated by the clamp members preventing the supply of pressure fluid to a ram when the ram for the trailing clamp member nears the end of its stroke.

These and other object and advantages of the invention will become more fully apparent from the accompanying description, to be read in conjunction with the accompanying drawings wherein:

FIG. **1** is a view, in simplified form, illustrating a lift truck equiped with a mast, and clamp mechanism elevatable on such mast, as contemplated by an embodiment of the invention;

FIG. **2** is a view on a somewhat enlarged scale, viewing the back of the clamp mechanism or attachment;

FIG. **3** is a top view showing portions of the attachment as illustrated in FIG. **2**, and

FIG. **4** is a schematic drawing illustrating the hydraulic circuit means which, in conjunction with two fluid pressure operated rams, is utilized to effect controlled movement of the clamp members in the clamp mechanism.

Referring now to the drawings, and first of all more particularly to FIG. **1**, shown at **10** is a lift truck equiped at the forward end thereof with a mast assembly **12** carrying clamp mechanism generally shown at **14** mounted on the carriage of the mast assembly. The most assembly may be extended and the carriage raised on the mast assembly to effect lifting of a load clamped onto by clamp mechanism **14.** As will be hereinafter described, the clamp mechanism includes a pair of opposed clamp members mounted for movement on a frame for movement toward and away from each other, for the purpose of clamping onto and releasing a load. The clamp members are moved in the same direction, to one side of the frame or to the other, to effect side shifting of the load. Fluid pressure operated rams power such movement of the clamp members, such being supplied with pressure fluid from a source of pressure fluid located on the truck and connected through flexible hoses to the rams which form part of the clamp mechanism.

Referring now to FIGS. **2** and **3**, the frame of the clamp mechanism is indicated at **16.** The clamp members, indicated partially at **18** and **20,** are carried on the frame with such projecting forwardly of the frame. Guide tubes, such as those shown at **22** in the frame, slidably receive guide rods which are secured to the clamp member, thus to mount the clamp members in place on the frame while providing for movement in each of the clamp members along the frame to one or the other side thereof. End plates **24** join the guide tubes and make a rigid unit of the frame **16.**

Indicated at **30** is a fluid pressure operated ram having the cylinder end **30***a* thereof joined by fastener **32** to the end plate **24** shown at the right of the figure in FIG. **2.** The rod of the ram, given the reference numeral **30***b* is joined by a fastener **34** to the clamp member **18** as shown at the left in FIG. **2.**

Ram **30** is a double acting ram, and is shown in FIG. **2** at nearly the end of a completed stroke for the ram, i.e., its contraction stroke. The end of the stroke may be defined by the piston within the ram striking the end wall, or by other mechanical means which abruptly stops further ram contraction. It will be noted, and with reference to FIG. **3,** that the clamp member whose movement is powered by the ram, i.e., member **18,**

trails member **20** when moved left to right, as is performed with contraction of ram **30.**

Also shown in FIG. **2** is a ram **38** which has its cylinder end **38***a* connected by fastener **40** to the left end plate **24** in FIG. **2.** The rod **38***b* of the ram is connected by a fastener **42** to clamp member **20** at the right of FIGS. **2** and **3.**

With clamp member **20** moved from right to left, such trails clamp member **18** on side shifting. Such movement is produced with contraction of ram **38.** Again, the end of the contraction stroke is determined by the piston in the ram striking the ram's end wall, or alternatively by some mechanical means externally of the ram which prevents further contraction.

To grip onto a load the two clamp members are brought toward each other by directing pressure fluid to the rams **30, 38** in such a manner that both are contracted simultaneously. To release the load, both rams are extended simultaneously, through proper channeling of fluid under pressure. Side shifting to the left is accomplished by extending ram **30** simultaneously with contracting of ram **38,** and side shifting to the right is produced under power by extending ram **38** simultaneously with contracting of ram **30.**

With larger loads, where the clamp members are spread relatively far apart, and assuming side shifting to the right, the amount of side shifting will not be limited by ram **30** nearing the end of its contraction stroke, since ram **38** will reach the end of its extension stroke well before this occurs. With ram **38** moving the leading clamp member on side shifting to the right, and on ram **38** reaching the end of its extension stroke, there is no relaxing of clamping pressure. However, with narrower loads, and absent the concepts of this invention, side shifting to the right must cease upon ram **30** reaching the end of its contraction stroke. Even assuming that the supply of fluid under pressure to the rams is stopped immediately at this time, there is a possibility of some relaxation of clamping pressure on this happening, due to momentum tending to force the load and leading clamp member slightly ahead of the mechanically and abruptly stopped trailing clamp member. It should be obvious that the same considerations are involved with side shifting to the left.

Reference is now made to FIG. **4** where the hydraulic circuit connecting the source of fluid under pressure on the truck with the rams **30, 38** is illustrated. As shown in the figure, at **50** is a multiple pilot check valve assembly having a pair of ports **52, 54** in a housing **56** used in connecting the valve assembly with the source of fluid under pressure. The latter is shown at **58,** and includes a pump **59** and a sump **60.** The connection is made by way of conduits **62, 64,** which may be flexible hoses, since they extend from the valve assembly which is located on the attachment to a control valve **66** located on the lift truck. The control valve is a three position valve adjustable from a neutral position (shown), wherein conduits **62, 64** are closed off by the valve, to one position where conduit **68** leading to the pressure side of pump **59** connects with conduit **62** to supply pressure fluid thereto with conduit **64** being connected to a conduit **70** exhausting into the sump. The valve in another position of adjustment connects conduit **68** to conduit **64,** with conduit **62** connecting through the valve to conduit **70** and the sump.

The check valve assembly also includes ports **72, 74** connected by conduit **76** and conduit **78,** respectively, to the cylinder end of rams **38, 30,** respectively. The rod ends of these rams are connected by conduits **80** and **82,** respectively, and conduit **84,** to a port **86** in valve assembly **50.** Adjustable restrictors in conduits **80, 82** are shown at **83, 85.**

The pilot check valve assembly includes an internal passage **90** connecting with conduit **64,** and also connecting with ports **72** and **74** through ball controlled ports **92, 94.** With pressure fluid in passage **90,** ports **92, 94** open, with fluid under pressure being fed to ports **72, 74.** Fluid under pressure in passage **90** also operates a piston **96,** which moves downwardly to unseat a ball **97** closing port **98.**

Internal passage **100** in the valves assembly connects with port **52** and port **98.** With unseating of ball **97,** port **98** connects with port **86** and conduit **84.**

With pressure fluid introduced to passage **100** through port **52,** such will unseat ball **97** to connect passage **100** with port **86.** The pressure fluid also acts upon pistons **102, 104** to unseat the balls closing ports **92, 94,** thus to connect ports **72, 74** with port **54.**

The pilot check valve assembly, conduits **76, 78,** and conduits **62, 64,** constitute a hydraulic system in the hydraulic circuit illustrated utilized in actuating the rams to produce clamping and release movement in the members. During this type of operation, the rams **38, 30** are connected in parallel so to speak, with each receiving pressure fluid from one of the conduits **62, 64,** and exhausting fluid from the opposite end of the ram to the other of the conduits **62, 64.**

Further explaining, to bring the clamp members together, control valve **66** is adjusted to introduce pressure fluid to conduit **62** and connect conduit **64** to exhaust line **70.** This results in fluid under pressure being directed through ports **98** and **86** to conduits **84, 80, 82,** to cause contraction of the rams. Fluid exhausts through conduits **76,78** and ports **72, 74** and through passage **90.** To cause the clamping members to move apart, the control valve is adjusted to direct pressure fluid to conduit **64** and connect conduit **62** to exhaust conduit **70.** The pressure fluid is directed by the check valve assembly to conduits **76, 78** to cause extension of the rams **38, 30,** with fluid exhausting from the opposite ends of the rams through port **84** and conduit **62.**

To produce side shifting movement of the clamp members, a control valve **106** is utilized, mounted on the truck, which has conduits **108, 110** connected thereto connecting with the pump and sump, respectively. The control valve is a three position valve, similar to valve **66,** controlling the flow into and out of conduits **112, 114.**

Conduit **114** connects through a valve **118** with a conduit **116** which joins with previously mentioned conduit **78** to connect with the cylinder end of ram **30.**

Valve **118** includes a housing **118***a*, and as can be seen in FIGS. **2** and **3,** such housing is mounted on he frame of the clamp mechanism in a position generally on top of the frame, through a bracket **120.** Referring to FIG. **4,** the valve includes two ports **118***b* and **118***c*, such normally communicating with each other through internal passage **119** in the valve housing. Port **118***b* is closed when a ball **118***d* is moved to the left in FIG. **4** to come up against the port.

The ball is mounted within a reciprocable plunger, also referred to as an actuator or sensor, shown at **122.** The plunger includes telescoping parts **122***a*, **122***d* urged apart to a limit position by a spring **122***c*.

Referring to FIGS. 2 and 3, the valve housing is mounted so that plunger 122 has a protruding end which is in the path of an angle piece 124 secured to clamp 20 whereby such angle piece is in effect part of the clamp member. On the clamp member being moved to the left in FIGS. 2 and 3, by ram 38, to a position where the ram is near the end of its contraction stroke, angle piece or portion 124 engages the plunger, and then shifts it whereby the ball described closes port 118*b*. With the clamp member moved to the right to release plunger 122, and pressure fluid fed through conduit 114 to port 118*c*, such pressure fluid acts upon the plunger and ball to open up port 118*b*.

Conduit 128 is shown in FIG. 4 which connects a valve 134 with conduit 76. Associated with valve 134 is a protruding plunger 130 acted upon by angle piece 132 (see FIG. 2). Conduit 112 discussed earlier also connects with valve 134. Valve 134, plunger 130, and angle piece 132 perform a function for clamp member 18 corresponding to the functioning just described of valve 118, plunger 122, and angle piece 124 for clamp member 20.

Considering now how side shifting is performed, to produce side shifting to the left in FIG. 4 control valve 106 is adjusted to introduce pressure fluid to conduit 114, and to connect conduit 112 to exhaust conduit 110. Pressure fluid flowing through conduit 114 and valve 118 is introduced through conduit 116 to the cylinder end of ram 30 to produce extension of the ram and movement to the left of clamp member 18, this clamp member being the leading clamp member. Fluid exhausting from the rod end of ram 30 passes through conduit 82 into conduit 80 and to the rod end of ram 38, to produce contraction of this ram. Fluid exhausts from the cylinder end of ram 38 through conduit 76, conduit 128 into conduit 112. It will be noted that the rams in effect are connected in series with the exhaust from one ram entering into the other to actuate this other ram.

The trailing clamp member with side shifting movement to the left is clamp member 20. On ram 38 nearing the end of its contraction stroke, angle piece 124 which is part of the clamp member 18 engages plunger 122 to close valve 118. This stops the feed of pressure fluid to ram 30, and because ram 38 is supplied with fluid to actuate it from ram 30 this also stops actuation of ram 38. The two rams in effect are hydraulically locked before any bottoming out of the ram for the trailing clamp member occurs.

The same type of operation occurs with side shifting to the right, where control valve 106 is adjusted to introduce pressure fluid to conduit 112 with fluid exhausting through conduit 114. In this instance clamp member 18 is the trailing clamp member, and ram actuation stops upon angle piece 132 engaging plunger 130 to close valve 134.

The construction described is readily incorporated with clamp mechanism such as is found in an attachment for a lift truck, with a minimum amount of hosing, etc., required to connect the multiple pilot check valve assembly with the valves 118, 130. Further, it is an easy matter with the invention to mount the valves 118, 130 in a position where their associated actuating members or plungers may properly sense when the trailing clamp member is in such a position that the ram for the member is near the end of its stroke.

What is claimed and desired to secure by letters patent:

1. In a clamp mechanism having a pair of opposed clamp members mounted on a frame for movement in the same direction on the frame to one or the other side thereof thus to side shift a load, one member leading and one member trailing on such side shifting,

first bidirectional fluid-powered motor means connected to one clamp member for moving it under power to one or the other side of the frame, said one clamp member moving as a trailing member with movement to one side of the frame and said one clamp member and connected first motor means being mechanically limited with respect to the movement afforded to said one side of the frame, a first sensing means for said one clamp sensing independently of the position of the other clamp member a predetermined position of said one clamp member relative to said frame, said predetermined position being proximate where movement of said one clamp member is mechanically limited,

second bidirectional fluid-powered motor means connected to the other clamp member for moving it under power to one or the other side of the frame, said other clamp member moving as a trailing member with movement to the other side of the frame and said other clamp member and connected second motor means being mechanically limited with respect to the movement afforded to said other side of the frame, a second sensing means for said other clamp member sensing independently of the position of the one clamp member a predetermined position of said other clamp member relative to the frame, said predetermined position being proximate where movement of said other clamp member is mechanically limited, and

valve means actuated by said first and second sensing means checking movement of the clamp members in response to either sensing means sensing that its associated clamp member is in its said predetermined position.

2. In clamp mechanism having a pair of opposed clamp members mounted on a frame for movement in the same direction on the frame, to one or the other side thereof, thus to side shift a load, one member leading and one member trailing on said side shifting,

a fluid-powered ram for each clamp member mounted on said frame and connected to the clamp member whereby the clamp member is moved under power on actuation of the ram, each ram including a cylinder and an internal piston,

a source of fluid under pressure,

hydraulic circuit means connecting said source and said rams for the supply and exhaust of fluid thereto and therefrom,

said circuit means including a first hydraulic system where the rams are connected in parallel with said source and fluid under pressure is directed to the rams to move the clamp members apart and move them together to effect the release and clamping of a load, said hydraulic circuit further including a second hydraulic system wherein the rams are connected in series with fluid exhausting from one ram dumping into the other for the purpose of moving the clamp members to side shift a load,

said second system including a first valve on the feed side of both rams actuated to produce side shifting to one side of the frame, a second valve on the feed side of the rams with the rams actuated to produce side shifting to the other side of the frame, each of said valves being actuatable to stop the supply of pressure fluid to the rams thus to stop side shifting, each of said valves including a housing mounted on said frame and having an actuator associated with the valve for actuating the valve,

a part fixed to one clamp member to be movable solely with movement of said one clamp member which moves against the actuator for one valve said one clamp member moving as a trailing member on side shifting whereby the supply of pressure fluid to the rams is stopped, and a part fixed to the other clamp member to be movable solely with movement of the other clamp member which moves against the actuator of the other valve with said other clamp member moving as a trailing member on side shifting whereby the other valve is actuated to stop the supply of pressure fluid to the rams.

3. The clamp mechanism of claim **1** wherein said valve means includes housing structure fixedly secured to said frame, and the sensing means for each clamp member comprises an actuator for said valve means movably mounted in said housing structure and a cooperating part fixed to the clamp member to be movable only with movement of the clamp member in a path which brings said part into engagement with said actuator.

4. In clamp mechanism having a frame and a pair of opposed clamp members movably mounted on the frame, each for movement toward one or the other side of the frame, and a bidirectional fluid-powered motor for each clamp member connected to the clamp member for moving it under power, one clamp member trailing the other on movement in unison of the clamp members to a common side of the frame,

sensing means for sensing, independently of the position of the leading clamp member and on movement of the clamp members to said common side of the frame, a predetermined position of the trailing clamp member relative to the frame, the trailing clamp member and its connected motor being mechanically limited with respect to the movement afforded to said common side of the frame, said predetermined position for said trailing clamp member being proximate where movement of said trailing clamp member is mechanically limited,

a source of fluid under pressure,

and a hydraulic circuit connecting said source and said motor including valve means actuated by said sensing means to stop movement of both clamp members in response to said sensing means sensing said predetermined position of said trailing clamp member.

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