Oct. 24, 1967 R. A. NIEMINSKI 3,348,635

CONTROL SYSTEM FOR LOAD LIFTING APPARATUS

Filed Aug. 26, 1966 2 Sheets-Sheet 1

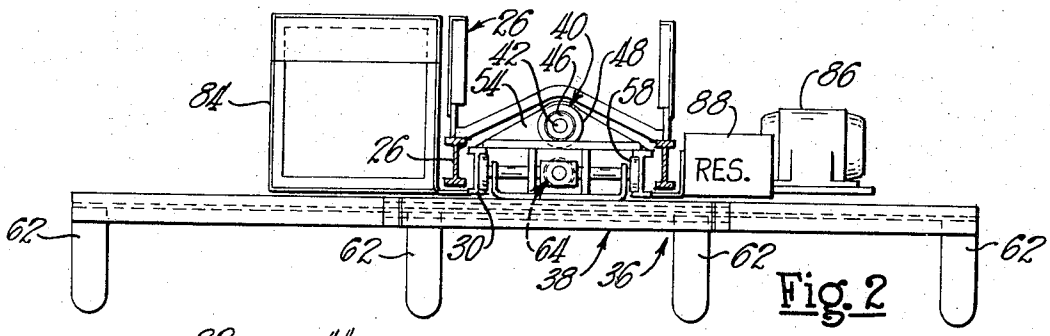


Fig. 2

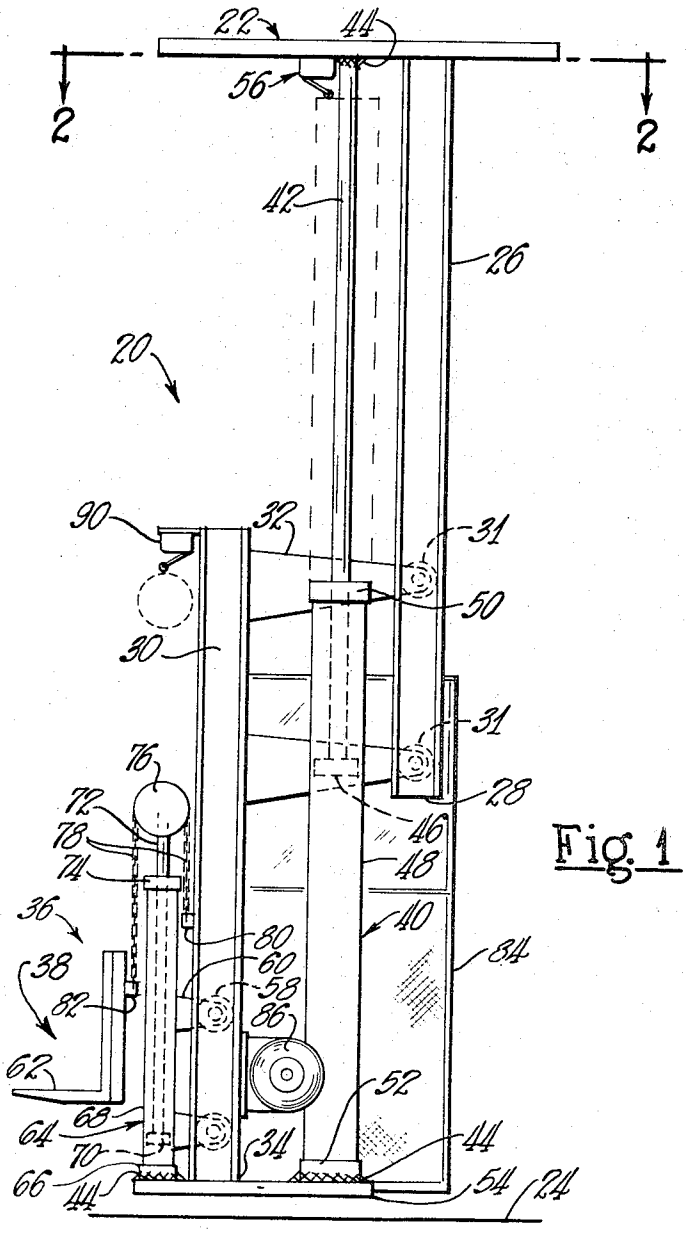


Fig. 1

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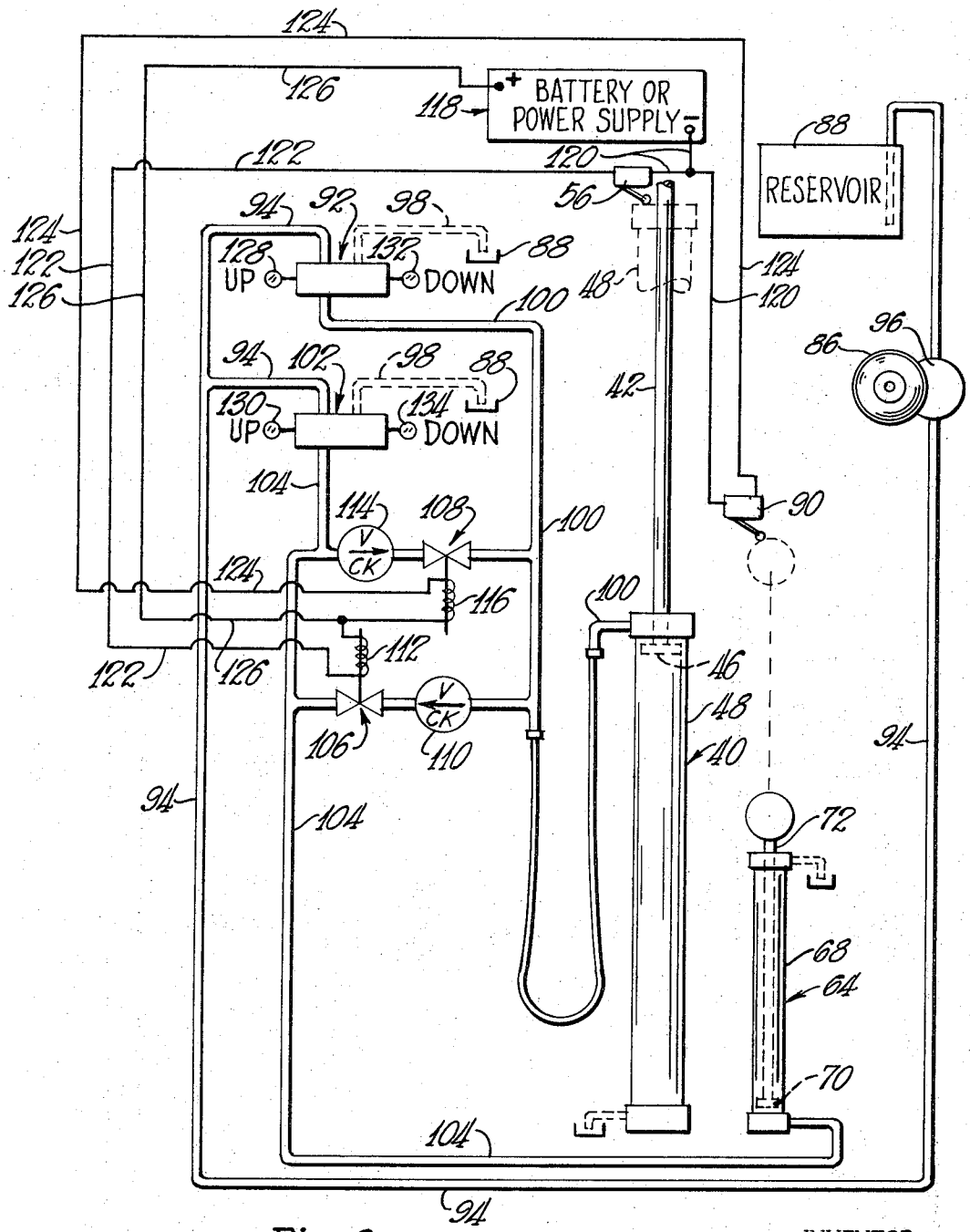


Fig. 3

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CONTROL SYSTEM FOR LOAD LIFTING APPARATUS

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This invention relates to the control of hydraulic rams used for lifting loads. More particularly, this invention relates to control means for rams utilized in the movement of a load carriage relative to supporting uprights such as are standard in industrial load lifters including stacker cranes, industrial lift trucks, and the like.

The problem

A stacker crane usually comprises a pair of vertically disposed primary uprights mounted for lateral movement on a horizontal rail system supported near the ceiling. The upper ends of the primary uprights are positioned near the ceiling rails and, accordingly, the lower ends thereof terminate a substantial distance above the floor in order not to interfere with the movement of men and materials about the floor. A pair of secondary uprights is supported by the primary uprights. The secondary uprights are mounted on the primary uprights for vertical movement so that the lower ends can be brought down to the floor level for the purpose of picking up and lifting a load, by means of a load carriage including a lift fork or the like.

A hydraulic ram can be utilized for moving the secondary uprights relative to the primary uprights to effect the load lifting operation. Thus, a primary ram extending between the primary and secondary uprights contributes the movement of the secondary uprights from an extreme lowered position at the floor, to an extreme high position.

As indicated, a load carriage is mounted on the secondary uprights for vertical movement so that the load can be moved from the floor to the tops of the secondary uprights. By so operating, the load can be moved between the floor and ceiling for stacking purposes; the lateral rail system provides lateral movement relative to the floor between one area and another.

A hydraulic ram can be mounted between the load carriage and the secondary uprights. This load or secondary ram contributes the movement of the load carriage relative to the secondary uprights from a fully lowered floor position to a fully elevated position relative to the secondary uprights. Load carriage movement relative to the secondary uprights can be brought about by direct thrust of the ram, or through the intermediary of chains or other means as those skilled in the art will fully appreciate.

Thus, it may be said that my invention is particularly related to a stacker crane in which a load carriage moves relative to secondary uprights, and the secondary uprights and load carriage move together relative to the primary uprights, a secondary ram contributing movement of the load carriage relative to the secondary uprights and a primary ram contributing movement of the secondary uprights and load carriage relative to the primary uprights.

The principles enumerated above are equally applicable to a fork lift truck which can be considered an inversion of a stacker crane. Thus, the primary uprights of a fork lift truck are mounted for lateral movement over a floor on a wheeled vehicle. The secondary uprights are movably mounted on the primary uprights for first vertical lift movement, and the load carriage is movably mounted on the secondary uprights for secondary vertical lift movement. This is the converse arrangement of the stacker crane, but embodies the same principles of operation.

The problem arises in the operation of a stacker crane or a lift truck embodying primary and secondary lifting rams. Thus, it will be appreciated that two basic movements are involved in moving a load: (1) vertical movement in the picking up of a load; and, (2) lateral movement relative to the floor after the load has been picked up and before it is set down again.

Heretofore, it has not been possible for the operator to laterally move the crane while load lifting is in progress because his attention must be kept constantly fixed on the vertical lifting which involves the strictly manual operation of the primary and secondary rams. Only after the lifting is completed, can he then remove his hands from the operating buttons for the lift rams and then actuate the crane by means of separate control buttons for lateral load movement.

Sequential lifting is not alleged to be new, per se, in the present invention. However, the particular system disclosed herein for providing sequential lifting is novel. Sequential lifting is presently obtained by relying on variations in pressure between rams, because of differing loads. However, in the pressure variation sequential lifts, there is the possibility that friction will cause lifting in a sequence that is not desirable, and sometimes latches must be utilized to provide proper sequencing. The present invention may be utilized as the basis for contributing sequential lifting in stacker cranes and industrial lift trucks while eliminating holding latches. Thus, a hydraulic circuit is provided that will hold each ram that is not energized, so that during the period in which the particular ram is not energized, it functions to hold whatever mechanism it controls.

From the foregoing, it will be evident that automatic and sequential, as well as individual, operation of the lifting rams will contribute substantially to the advancement of the stacker crane art. Thus, automatic sequential operation of the rams would permit the operator to start the lifting and then proceed immediately with the lateral crane movement while load lifting continues under automatic control. Operation would be substantially expedited and efficiency and safety would be improved.

Accordingly, it is an important object of this invention to improve the art of stacker cranes and analogous lifting devices by contributing a more effective and efficient mechanism and means for controlling the operation of the lifting rams.

My invention provides a substantial contribution to the operation of the stacker crane principle by providing both individual and automatic sequential operation of the lift rams. Thus, the control means or system of this invention permits the individual operation of the load ram, as I call it, operating to lift the load carriage relative to the secondary uprights. Also, the control means of this invention permits individual operation of the main hydraulic ram, as I call it, operating to lift the carriage and secondary uprights together, relative to the primary uprights. Thus, should the operator desire to lift the load through movement first of the secondary uprights and load carriage relative to the primary uprights, e.g., by actuating the main hydraulic ram, he need merely bring about the operation of the main hydraulic ram.

But, as a special feature of the invention, automatic sequential operation is also provided. Thus, upon completion of the full operation of the main hydraulic ram, the load ram will be automatically and sequentially operated to bring about the full movement of the load carriage relative to the secondary uprights. Because of this automatic sequential operation, the operator can start the lift operation and proceed immediately to maneuver the

stacker crane laterally relative to the floor, once he has set the main ram in operation, knowing full well that the load will be automatically lifted to and stopped at the maximum without further attention on his part.

Also, the automatic operation of the invention provides that if the load ram is actuated first, sequential operation of the primary ram will follow. Thus, if the load ram is actuated first, upon completion of the full operation of the load ram, the main ram will be automatically and sequentially operated to bring about the full movement of the load. Thus, if the load ram is first to receive hydraulic fluid, it will move the load carriage to an extreme elevated position relative to the secondary uprights, after which the main ram will be automatically actuated to complete the full lifting movement by elevating the secondary uprights and load carriage together on the primary uprights. In this situation, the operator can also proceed with lateral movement of the crane without further attention to the lifting operation, knowing that it will terminate either when maximum lifting has been achieved, or when he removes his hand from the valve actuator button if he so desires.

It is important to appreciate that this automatic sequential lifting will be brought about without, in any way, interfering with the individual operation of each ram, if such operation is desired.

A feature of the invention is that in moving the load downwardly, the two rams must be individually operated. The reason for this is brought out below.

I have thus outlined the general nature of my invention and its relation to the prior art in order that the description thereof that follows may be better understood, and in order that my contributions to the art may be better appreciated. There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as the basis for the designing of other structures for carrying out the reversal purposes of my invention. It is important, therefore, that the claims granted to me shall be construed sufficiently broadly to prevent the appropriation of my invention by others skilled in the art.

Referring now to the drawings, FIGURE 1 is a vertical elevation showing schematically the arrangement of a stacker crane having the control means of the invention applied thereto and including details such as the operator's compartment and the pump motor; FIGURE 2 is a top plan view taken as along the line 2—2 of FIGURE 1, but of an actual stacker crane, showing the arrangement of the operator's compartment on the secondary uprights, the pump and reservoir for hydraulic fluid, and the lift forks; and, FIGURE 3 is a hydraulic piping and flow diagram in schematic form, showing the flow control valves, forming part of the invention; the tilting cylinders and nonpertinent flow rate valves have not been shown because it is not believed that they are necessary for the effective showing and claiming of my invention; but the two manually movable valves are shown, but more broadly and without detail, since their specific construction is not significant.

Referring now more particularly to the drawings, and more especially to FIGURE 1, a stacker crane is designated by the reference numeral **20**. A movable carriage **22** is supported for transverse movement relative to the floor line **24**, and is mounted on a horizontal rail system supported near the ceiling of a warehouse bay. Though not shown, because conventional, the rail system customarily comprises a pair of parallel longitudinal rails extending the length of the warehouse bay, with a large beam transversely straddling the rails with wheels at each end operably engaged with the rails. The beam carries a cross rail, or rails, and the movable carriage **22** operates on the cross rails. The combination rail sets provide for

lateral movement all over a given warehouse bay floor area.

Supported from the movable carriage **22** is a pair of primary uprights **26**. It will be evident that the upper ends of the primary uprights **26** are thereby positioned near the ceiling rails and, accordingly, the lower ends **28** terminate a substantial distance above the floor line **24** in order not to interfere with the movement of men and materials about the floor.

A pair of secondary uprights **30** is mounted for vertical movement on the primary uprights **26**. The movement is provided in part by wheels **31** mounted to the secondary uprights by means of exemplary brackets **32**. The wheels **31** operate within channel tracks carried by the primary uprights **26**. By this arrangement, the lower ends **34** of the secondary uprights **30** can be brought down to floor level for the purposes of picking up and lifting a load, by means of a load carriage **36**, including a lift fork **38**.

A primary hydraulic ram **40** is utilized for moving the secondary uprights **30** relative to the primary uprights **26** to effect the load lifting operation. The upper end of the piston rod **42** of the primary ram **40** is secured to the bottom of the movable carriage **22** as by welding at **44**.

A piston **46** is attached to the lower end of the piston rod **42** for reciprocation with the cylinder **48** of the primary ram **40**. The piston rod **42** operates through a head **50**, containing a suitable packing, not shown, to provide a sliding seal relative to the piston rod as the primary cylinder **48** moves up and down the piston rod.

The lower end **52** of the primary cylinder is attached to, for the purpose of carrying, the base plate **54** by means of a weld **44**. The base plate **54** bridges and holds together the secondary uprights **30** in aligned relationship. Incidentally, other cross-bridging, not shown, is used across the tops of the secondary uprights **30** to provide a rigid secondary upright unit.

Thus, the primary ram **40**, extending between the primary uprights **26** and the secondary uprights **30**, contributes the movement of the secondary uprights from an extreme lowered position at the floor **24** to an extreme high position. The extreme high position is achieved when the head **50** of the primary cylinder **48** engages the primary or #1 limit switch **56**.

The load carriage **36** is mounted on the secondary uprights **30** for vertical movement, so that the load can be moved from the floor line **24** to the tops of the secondary uprights. The movement is provided, in part, by wheels **58** mounted to the load carriage **36** by means of exemplary brackets **60**. The wheels **58** operate within channel tracks, not shown, carried by the secondary uprights **30**. By this arrangement the horizontal tines **62** of the lift fork **38** of the load carriage **36** can be brought down to the floor level **24** for the purpose of picking up and lifting the load. The load thus can be moved from floor to ceiling for stacking purposes and the rail system provides lateral movement relative to the floor between one storage area and another.

A secondary hydraulic ram **64** is utilized for moving the load carriage **36** relative to the secondary uprights **30**. Thus, the base **66** of the cylinder **68** of the secondary ram **64** is attached to the upper surface of the base plate **54** as by welding at **44**. A piston **70** operates within the cylinder **68** of the secondary ram **64** and is connected to a piston rod **72** which extends out the top of the cylinder. The piston rod **72** operates through a head **74**, containing a suitable packing, as described for the head **50** of the cylinder **48** of the primary ram **40**.

The exposed upper end of the piston rod **72** is attached to a pulley having a suitable rotatable sheave **76**, over which a lift chain **78** is lapped. One end of the lift chain **78** is fastened to the secondary upright **30** at the point **80**. The other end of the lift chain **78** is fastened to the lift fork **38** at the point **82**. The lift chain **78** is maintained in an upwardly extending vertical bight. By this arrangement, movement of the piston rod **72** of the secondary

ram 64 will act on the lift chain 78 to lift the load carriage 36 relative to the secondary uprights 30, the rate of movement of the load carriage being twice the speed of movement of the piston rod.

Thus, the load or secondary ram 64, extending between the secondary uprights 30 and the load carriage 36, contributes the movement of the load carriage relative to the secondary uprights from a fully lowered floor position 24, to a fully elevated position relative to the secondary uprights. The fully elevated position is achieved when the sheave 76, carried by the secondary ram piston 72 engages the secondary or #2 limit switch 90.

It should also be noted that an operator's compartment 84 is mounted on the secondary uprights 30, outboard of, but adjacent to the secondary uprights and directly behind the load carriage 36. By this arrangement, the operator is provided with a clear view of the horizontal tines 62 for picking up and laterally moving a load. Along with the operator's compartment 84, the secondary uprights 30, at the base end, also carry a pump motor 86, for a pump, hidden behind a reservoir 88 for hydraulic fluid, all as shown more particularly in FIGURE 2 of the drawings.

Having explained the manner in which my invention is related to a stacker crane, I will now proceed to describe fully and in detail the specific aspects of the invention.

By reference more particularly to FIGURE 3 of the drawings it will be observed that the primary ram 40 receives pressurized fluid under control of a manually operated primary up-down valve 92. The valve 92 is connected to a supply line 94 that in turn is connected to to the pump 96, driven by motor 86. Pump 96 receives strained hydraulic fluid from the reservoir 88. The primary up-down valve 92 is also connected by means of a line 98 to the reservoir 88 for the purpose of dumping the primary ram 40 during a lowering operation, to be described later. The other side of the primary up-down valve 92 is connected to a line 100 that leads to the top of the cylinder 48 of the primary ram 40 for raising the cylinder as indicated in dotted outline in FIGURE 3, and also in FIGURE 1.

The secondary hydraulic ram 64, for lifting the load carriage 36 relative to the secondary uprights 30, receives hydraulic fluid under pressure and under control of manually operated secondary up-down valve 102. The valve 102 is also connected to the supply line 94; and by means of a line 98 is connected to the reservoir 88 for dumping the secondary ram 64 during a lowering operation, to be later described. The other side of the secondary up-down valve 102 is connected to a line 104 that leads to the bottom of the cylinder 68 of the secondary ram 64, being connected in beneath the piston 70 to push up the piston rod 72, as indicated in dotted outline, and as also described relative to FIGURE 1.

There are two automatic sequence control valves in the left system; one, the primary, being designated by the reference numeral 106; and the other, the secondary, being designated by the reference numeral 108. The primary automatic sequence control valve 106 provides one-way flow from the line 100 to the line 104. The one-way check valve element 110 assures the one-way flow. The primary automatic sequence valve 106 is normally closed, but a solenoid 112, which is adapted to be actuated by the #1 or primary limit switch 56 being engaged by the cylinder 48 of the primary ram 40, is used for the purpose of opening the valve.

The secondary automatic sequence control valve 108 is also a one-way unit, providing one-way flow from the line 104 to the line 100. The one-way check valve element 114 assures the one-way flow. The secondary automatic sequence valve 108 is also normally closed, but a solenoid 116, which is adapted to be actuated by the #2 or secondary limit switch 90 being engaged by the piston rod 72 of the secondary ram 64, is used for the purpose of opening the valve.

The electrical control circuit includes a battery or power supply 118, having one side connected to a line 120 which leads to each of the limit switches 90 and 56. The limit switch 56 is in turn connected by means of line 122 to the solenoid 112 of the primary automatic sequence control valve 106. The limit switch 90 is in turn connected via line 124 to the solenoid 116 of the secondary automatic sequence control valve 108. The other sides of each solenoid 116 and 112 are connected to the other side of the power supply 118 by means of line 126.

In summary, both automatic sequence control valves 106 and 108 are normally closed, thereby preventing flow between lines 100 and 104 in either direction. However, the valves 106 and 108 are adapted for opening by solenoids 112 and 116, in turn energized by the limit switches 56 and 90, respectively, under control of primary ram 40 and secondary ram 64.

The present description relates particularly to the load lifting operation. The lowering of the rams will be discussed at the end of this lifting description.

When the up button 128 of the manual primary up-down valve 92 is pressed by the operator, e.g., to be moved to the right from its position in FIGURE 2, pressurized hydraulic fluid will flow through the line 100 into the primary ram 40, above the piston 46, to force the primary cylinder 48 to rise. This action is effective to elevate the secondary uprights 30, FIGURE 1, relative to the primary uprights 26. It will be noted that hydraulic fluid cannot flow from line 100 through the secondary automatic sequence control valve 108 to line 104 to cause lifting of the secondary ram 64, because of the check valve element 114. Fluid can flow, however, from line 100 to line 104 through the primary automatic sequence control valve 106, but will not, since that valve is normally closed. However, as soon as the secondary uprights 30, FIGURE 1, have been raised to a fully lifted position by the primary ram 40, engagement of the cylinder 48 of the primary ram with the limit switch 56 will excite the solenoid 112 to open the valve 106. This stops further lifting of the primary ram 40. With the valve 106 opened, fluid will then flow from the line 100 to the line 104 and thence to the secondary ram 64. This will bring about the up movement of the piston rod 72 of the secondary ram to lift the load carriage 36 and the lift fork 38, FIGURE 1, relative to the secondary uprights 30.

Should the up button 130 of the manual secondary up-down valve 102 be pressed by the operator, e.g., to be moved to the right from its position in FIGURE 3, rather than manual valve 92, the secondary ram 64 will be the first to be actuated. Thus, fluid will flow through line 104 into the secondary ram 64 beneath the piston 70 to force the piston and the piston rod 72 to rise. Relative to FIGURE 1, this action is effective to elevate the load carriage 36 relative to the secondary uprights 30. It will be noted that hydraulic fluid cannot flow from line 104 through the primary automatic sequence control valve 106 into line 100 because of the check valve element 110, under any circumstances. Fluid can flow, however, from line 104 into line 100 through secondary automatic sequence control valve 108, but will not since the valve is normally closed. However, as soon as the load carriage 36 has been raised to a fully lifted position by the piston rod 72 of the secondary ram 64, engagement of the upper end of the piston rod with the #2 or secondary limit switch 90 will excite the solenoid 116 to open the valve 108. This stops further lifting by the secondary ram 64. With the valve 108 opened, fluid will then flow from line 104 through secondary automatic sequence valve 108 into line 100 and into the primary ram 40. This will bring about the automatic sequential up movement of the cylinder 48 of the primary ram 40 to lift the secondary uprights 30 and the load carriage 36 together relative to the primary uprights 26.

From the foregoing, it will be appreciated that either the primary ram **40** or the secondary ram **64** can be actuated first and sequencing of the other ram will automatically follow.

It will also be appreciated that at all times either of the rams **40** or **64** can be operated to lift, or lower, individually, without in any way bringing about movement of the other ram, provided the limit switches **56** and **90** are not brought into play.

Also, if one of the limit switches **56** and **90** is brought into play, after full extension of one of the rams **40** or **64**, the other ram can be controlled to lift by either one of the manual up-down valves **92** or **102**.

Lowering is effected manually because once the limit switches **56** and **90** have been opened the sequence valves **106** and **108** are automatically closed. Thus, lowering of the primary ram **40** and the secondary ram **64** is effected individually. To lower the primary ram **40**, the down button **132** of the manual primary up-down valve **92** is pressed by the operator, e.g., to be moved to the left from its position in FIGURE 3. This causes fluid from line **100** and the primary ram **40** to dump through line **98** into the reservoir **88**. To lower the secondary ram **64**, the down button **134** of the manual secondary up-down valve **102** is pressed by the operator, e.g., to be moved to the left from its position in FIGURE 3; this causes fluid from line **104** and secondary ram **64** to dump through line **98** to reservoir **88**.

No sequential movement is possible for the lowering operation. Sequential movement is not desirable during a lowering operation because of the danger that the load might move, without direct supervision of the operator, into a position to create danger or to injure personnel.

I believe that the considerable merits and the great simplicity of my invention will now be understood and appreciated by those skilled in the art.

I claim:

1. In a combination of the class described, a fluid pressure source having a high pressure side and a low pressure side, a primary upright extending from a base, a secondary upright movably mounted on said primary upright, a load carriage movably mounted on said secondary upright, a main hydraulic ram operable between said primary upright and said secondary upright for moving said secondary upright relatively to said primary upright, a second hydraulic ram operable between said secondary upright and said load carriage for moving said load carriage relatively to said secondary upright, operating valve means for said rams, the movement of said operating valve means to particular lift positions directing fluid from the high pressure side of said pressure source to one of said rams while the other ram remains inoperative, control valve means for said rams, and means whereby the operation of either of said rams to a particular extended position actuates said control valve means to effect the movement of fluid to the other ram during positioning of said operating valve in lift position so that the two rams operate automatically in sequence regardless of which ram is first energized.

2. In the combination of claim **1**, the feature that said control valve means comprise two valves with one or the other of said valves actuated respectively by the movement of one or the other of said rams to an extended position.

3. In the combination of claim **1**, the feature that said control valve means comprises two one-way solenoid valves, with one of said valves being actuated respectively by the movement of one of said rams to an extended position to actuate the solenoid of said one valve, and with the other of said valves being actuated respectively by the movement of the other of said rams to an extended position to actuate the solenoid of said other valve.

4. In the combination of claim **1**, the feature that there are two manual operating valves comprising said operating valve means, one for each ram.

5. In the combination of claim **4**, the feature that said other ram may be controlled to lift by either operating valve once one of said rams has been extended.

6. In the combination of claim **5**, the feature that each of said operating valves controls lowering of the load by its ram through flow of fluid from its ram through the operating valve to the low pressure side of said fluid pressure source.

7. In the combination of claim **5**, the feature that each of said rams lowers the load through movement of fluid therefrom through its operating valve.

8. In a combination of the class described, a fluid pressure source having a high pressure side and a low pressure side, a primary upright extending vertically from a base, a secondary upright movably mounted on said primary upright, a load carriage movably mounted on said secondary upright, a main hydraulic ram operable between said primary upright and said secondary upright for moving said secondary upright relatively to said primary upright, a second hydraulic ram operable between said secondary upright, and said load carriage operable to lift said load carriage relatively to said secondary upright, an operating valve for said main ram and an operating valve for said second ram, each of said valves communicating with its ram through a passage for hydraulic fluid, the movement of one of said valves to a lift position directing fluid from the high pressure side of said pressure source to one of said rams while the other ram remains inoperative, a control valve for each of said rams, said valves being in reverse, parallel arrangement between the said passages for hydraulic fluid, and means whereby the operation of either of said rams to a particular extended position actuates one of said control valves to effect the movement of fluid therethrough to the passage connecting the other operating valve with the other ram so that the two rams operate automatically in sequence regardless of which ram first receives fluid.

9. In the combination of claim **8**, the feature that each control valve comprises a one-way solenoid valve, with one of said solenoid valves being actuated respectively by movement of one of said rams to an extended position to actuate the solenoid of said one valve, and with the other of said solenoid valves being actuated respectively by movement of the other of said rams to an extended position to actuate the solenoid of said other valve.

10. In the combination of claim **8**, the feature that said other ram may be controlled to lift by either operating valve once one of said rams has been extended.

11. In the combination of claim **8**, the feature that each of said rams lowers the load through movement of fluid therefrom through its operating valve.

12. In the combination of claim **8**, the feature that each of said operating valves controls lowering of the load by its ram through flow of hydraulic fluid from its ram through the said operating valve to the low pressure side of said fluid pressure source.

13. In a combination of the class described, a fluid pressure source, a main hydraulic lifting ram, a second hydraulic lifting ram, operating valve means for said rams, the movement of said operating valve means to particular lift positions directing fluid to one of said rams while the other ram remains inoperative, control valve means for said rams, and means whereby the operation of either of said rams to a particular extended position actuates said control valve means to effect the movement of fluid from said pressure source to the other ram during positioning of said operating valve in lift position so that the two rams operate automatically in sequence regardless of which ram is first energized.

14. In a stacker crane having a carriage mounted for lateral movement on a horizontal rail system,

a vertically disposed primary upright having the upper end secured to said movable carriage,

a vertically disposed secondary upright mounted for vertical movement on said primary upright,

a primary ram having one operating portion secured to said movable carriage and the other operating portion secured to said secondary upright for movement of said secondary upright relative to said primary upright upon application of pressurized hydraulic fluid into said primary ram,

said secondary upright having a load carriage vertically movable thereon,

a secondary ram having one operating portion secured to said secondary upright and the other operating portion engageable to move said load carriage relative to said secondary upright upon application of pressurized hydraulic fluid into said secondary ram,

first limit switch means on said primary upright and second limit switch means on said secondary upright,

a source of pressurized hydraulic fluid having a high pressure side and a low pressure side,

first manually operated valve means connected to supply pressurized fluid from said high pressure side through a first passage to said primary ram and second manually operated valve means connected to supply pressurized fluid from said high pressure side

through a second passage to said secondary ram,

first and second control valve means connected in reverse parallel flow relation between said first and second passages,

and connection means between said first and second control valve means and said first and second limit switch means, respectively.

15. The invention of claim **14** wherein the first control valve means, on actuation, provides flow only from said first to said second passage means, and wherein the second control valve means, on actuation, provides flow only from said second to said first passage means.

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