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HOIST RAM CONTROL APPARATUS

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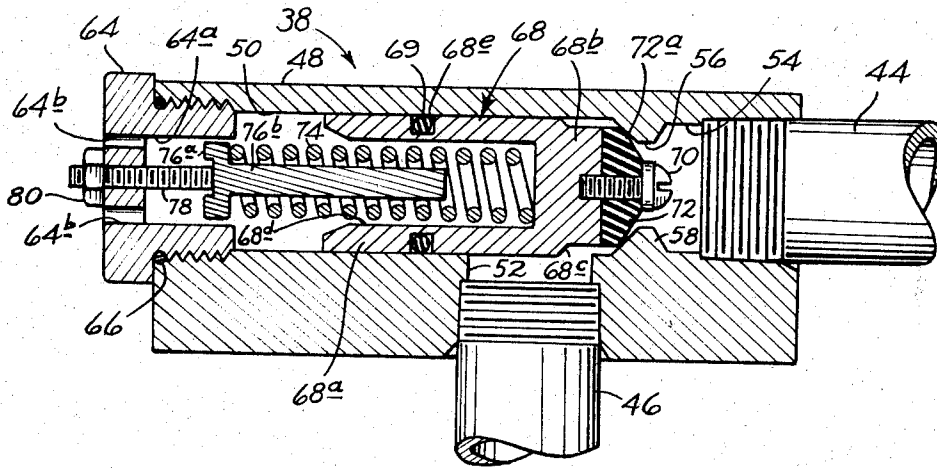


Fig. 2.

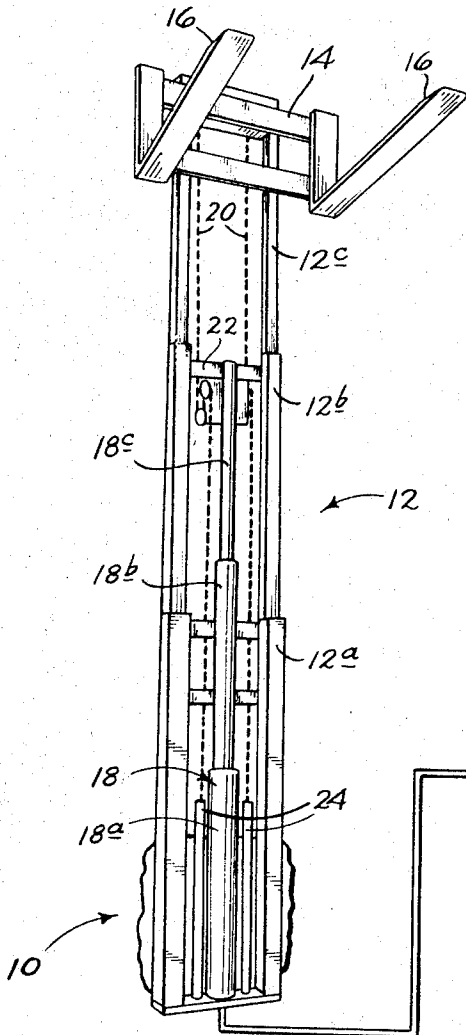
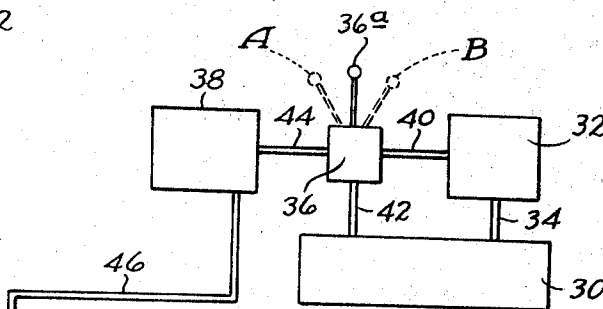


Fig. 1.



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1

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HOIST RAM CONTROL APPARATUS

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5 Claims

ABSTRACT OF THE DISCLOSURE

Lift apparatus including a vertical extensible hoist ram, a conduit joined to the ram through which fluid is supplied to extend the ram and is exhausted to contract the ram, and a pressure-sensitive valve mechanism connected to the conduit. The pressure-sensitive valve mechanism is responsive to the pressure of fluid in the conduit, and operable with the pressure of such fluid below a predetermined level to block the exhaust of fluid from the ram, and with the pressure of such fluid above the predetermined level to permit the exhaust of the fluid.

This invention relates to lifting devices, and more particularly, to apparatus for controlling operation of a hoist ram in such a device.

A conventional type of lifting device takes the form of a lift truck including forks mounted by means of a carriage on an extensible mast assembly. The forks may be raised and lowered by extension and contraction of a fluid-operated hoist ram which is connected to the carriage through chains extending up and down in reaches within the mast assembly.

Such lift trucks are commonly used in the handling of loads carried on pallets or other devices providing a space at the bottom of the load for the insertion and retraction of the lift truck forks. When depositing a load at a high elevation, as on the top of an already formed stack, the operator of the lift truck raises the forks with the pallet and load supported thereon to a suitable elevation producing clearance between the base of the pallet and the top of the stack. The load and pallet may be shifted over the stack by proper maneuvering of the truck and the base of the pallet caused to come to rest on top of the stack by permitting fluid to exhaust from the hoist ram with the weight of the load, pallet and forks in the raised structure causing contraction of the ram. Frequently an operator's vision is obscured, whereby he is unable to tell exactly the time at which the pallet comes to rest on top of the stack, and some additional dropping of the forks will occur after the deposit of the load, with the forks moving downwardly in the clearance space defined at the base of the load by the pallet, until such time as the bottom of the forks rest on the top of the stack. With the forks at rest, and with the lift truck operator still permitting exhaust of fluid from the hoist cylinder, some additional contraction of the ram will still take place under the urging of the weight of the cross-head and other movable parts in the mast assembly, with such additional contraction producing slack in the chains interconnecting the hoist ram and carriage.

With this condition set up, and when the truck is then backed off after depositing the load, the forks drop abruptly on moving away from what was previously supporting them, to take up the slack in the chains. This produces severe stress in the chains, and often results in breaking of the chains, particularly if continuously repeated over any period of time.

A general object of the present invention is to provide apparatus for controlling the operation of a hoist ram of the type described which on lowering of the forks prevents the ram from contracting after such time as any

2

appreciable portion of the weight of the forks becomes borne by some external support.

More particularly, an object of the invention is to provide means whereby the exhaust of fluid from the ram is stopped automatically upon the forks being supported by means external to the lift truck, featuring a pressure-sensitive device responsive to fluid pressures in the conduit system provided for the supply of fluid to and the exhaust of fluid from the ram. The pressure-sensitive device operates, upon contraction of the ram, and in response to the pressure of fluid in the system dropping below a certain predetermined pressure, to block off the exhaust of fluid from the ram thus to prevent ram contraction.

A further object is to provide such apparatus which is relatively simple in construction and reliable in operation.

These and other objects and advantages attained by the invention, will become more fully apparent as the description which follows is read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates, diagrammatically, portions of a lift truck including an extensible hoist ram, and apparatus as contemplated herein for controlling operation of the hoist ram; and

FIG. 2 is a cross-sectional view of a pressure-sensitive device employed in the apparatus in FIG. 1.

Turning now to the drawings, and with reference first to FIG. 1, shown generally at 10 are portions of a lift truck, having mounted thereon an extensible mast assembly (or lifting device) 12. The mast assembly includes an outer mast 12a, and extensible intermediate and inner masts 12b, 12c, respectively. Slidably mounted on inner mast 12c is a carriage 14 joined to a pair of lift forks (or supporting means) 16 which project forwardly of the truck. Masts 12b, 12c, carriage 14, and forks 16 constitute vertically shiftable structure in the assembly.

The means shown for raising and lowering the lift forks includes an extensible, hydraulically-operated single-acting hoist ram 18, and a pair of chains 20. The ram includes an outer cylinder portion 18a mounted adjacent the base of the mast assembly, a telescoping sleeve 18b, and a rod 18c. The upper end of rod 18c is suitably connected to a crosshead 22 which is mounted on inner mast 12c. Chains 20 and have one set of ends suitably anchored to carriage 14, and their opposite set of ends connected through fasteners 24 to the base of the mast assembly. The chains between their ends are trained over suitable sprocket assemblies, whereby on extension of the hoist ram raising of the inner mast, intermediate mast, and carriage results.

In FIG. 1, the forks are shown fully raised with the ram and mast assembly extended. This typifies the position that the forks may have on depositing a load at a high elevation on the top of a stack.

Apparatus for actuating ram 18 is provided comprising a fluid reservoir 30 containing suitable hydraulic fluid, and a hydraulic pump 32 which is connected to the reservoir by a conduit 34. Pump 32 is driven by suitable drive means (not shown) and operates to draw fluid from the reservoir through conduit 34. In the diagrammatic illustration forming FIG. 1, these elements which constitute a fluid supply are shown disassociated from the lift truck, but it should be understood that the elements normally are mounted on and form part of the lift truck.

Also provided is a control valve 36 and what is referred to herein as a pressure-sensitive device 38. The control valve receives fluid from the pump through a conduit 40, and is connected to the reservoir by a conduit 42. The control valve, pressure-sensitive device and ram are connected in series with one another by conduit means including a conduit 44 connecting the control valve to device 38 and a conduit 46 connecting device 38 to the bottom end of ram 18.

Considering for a moment valve 36, the valve includes a handle 36a which is illustrated in solid outline in an upright position in FIG. 1. With the valve handle in this upright position, valve 36 is placed in what is referred to herein as its neutral position. The dashed outline for the valve handle indicated at A illustrates the position of the handle when valve 36 is adjusted to its hoist position. The dashed outline for the valve handle indicated at B illustrates the position of the valve handle with valve 36 adjusted to its exhaust position. The valve itself is a conventional valve, and with the valve handle upright and the valve in its neutral position, conduit 44 is blocked off from conduits 40, 42, with isolating of any pressure fluid within the hoist ram. With adjustment of the valve handle to its position A, the valve connects conduit 40, 44 permitting pressure fluid to flow from the pump through the valve to the ram. With the valve handle adjusted to its position B, conduits 44, 42 are connected through the valve with blocking off of conduit 40, permitting the exhaust of pressure fluid from the ram through conduits 46 and 44 into reservoir 30.

Considering now the construction of pressure-sensitive device 38, and with reference to FIG. 2, it comprises a valve mechanism including a housing 48 having an axial bore 50 extending inwardly from one end of the housing. Bore 50 joins with a port 52 extending into the side of the housing, and also joins through a passage 56 with an axial port 54. An annular flange 58 of tapered cross section bounds passage 56 and separates bore 50 from port 54. Conduits 44, 46 connect with ports 54, 52, respectively, and the passages in the conduit communicate with the interiors of the ports.

Screwed into the left end of bore 50 in FIG. 2 is a plug 64. The plug has a hollow interior 64a which communicates adjacent one end of the plug with the interior of bore 50, and adjacent the other end of the plug with the atmosphere through vents 64b. A suitable annular seal 66 is interposed between the plug and the housing.

Mounted for reciprocation in bore 50 is a piston, or valve plunger, 68 having a large diameter end 68a formed integrally with a small diameter end 68b. Between the large and small diameter ends of the piston, an annular shoulder having a surface 68c is defined. Extending into the piston from its large diameter end is a bore 68d. Sealing the piston to the interior of bore 50 is an annular sealing element 69 seated in a channel 68e extending about the piston.

Fastened to the small diameter end of the piston, by a screw 70, and having substantially the same outer diameter as end 68b of the piston, is an annular element, or valve part, 72. Element 72 may be formed of any suitable material such as rubber. The element has a closed position (the position in which it is shown) where it is effective to close off passage 56 by seating against a side of annular flange 58, and an open position (not shown) where it opens passage 56.

A spring or biasing means 74 extends into bore 68d of the piston and has one end abutting the base of the bore. The opposite end of the spring abuts head 76a of a spring keeper, which also includes a shank 76b extending into the interior of the spring. The head of the spring keeper is received within bore 64a of plug 64, and the keeper is held against the spring by means of a screw 78, also referred to herein as an adjustable element, screwed into the left-hand end of plug 64 in FIG. 2. With adjustment of screw 78, the amount of compression in spring 74, and hence the biasing force exerted by the spring on piston 68 and element 72, may be varied. The screw may be locked in place by means of a locking nut 80.

Explaining briefly the operation of device 38, element 72 normally seats against annular flange 58 due to the biasing force exerted on the piston by spring 74. With element 72 in this position, passage 56 is closed. With fluid under pressure introduced into conduit 44, this fluid acts against a face 72a of element 72 tending to force the ele-

ment and piston 68 to the left against the biasing force exerted by spring 74. When this fluid pressure-produced force is sufficient to overcome the bias of spring 74, piston 68 shifts to the left to open passage 56 and connect conduits 44, 46.

With element 72 seating against shoulder 58, fluid under pressure in conduit 46 can also cause opening of passage 56 by shifting the element to the left against the biasing spring 74. Pressure fluid in conduit 46 acts on surface 68c against an effective piston area thereon which is the difference between the cross-sectional area of large diameter end 68a and the cross-sectional area of small diameter end 68b.

Explaining now how the lift truck described may be operated, it will be assumed that initially lift forks 16 are fully lowered and inserted under a pallet supporting a load and that control valve 36 is in its neutral position with handle 36a upright. Piston 68 of device 38 is in a position closing off passage 56, whereby conduits 44, 46 are blocked off from each other.

To lift the load, the lift truck operator through manipulation of handle 36a adjusts valve 36 to place it in its hoist position. With this adjustment fluid at the relatively high pressure level produced by the pump is introduced to conduit 44 and port 54 of pressure-sensitive device 38. The pressure of such fluid when acting upon element 72 is sufficient to cause shifting of piston 68 to the left and opening of passage 56. This results in pressure fluid being admitted to the hoist ram and extension of the ram with lifting of the load. With the load elevated, the lift truck operator adjusts control valve 36 to its neutral position which shuts off the supply of pressure fluid to the ram and also cuts off any path for the exhaust of fluid from the ram so that the ram remains at the particular extended position in which it has just been placed.

At such a time as the operator wishes to deposit the load, and it will be assumed that such is at a relatively high elevation and on top of the stack where visibility is obscured and the organization of the invention has particular utility, the truck is maneuvered to place the forks and the loaded carriage over the stack. To produce load lowering, control valve 36 is adjusted to its exhaust position which establishes an exhaust connection from conduit 44 through valve 36 and conduit 42 to reservoir 30. The weight of the load, pallet, forks, carriage and extended parts of the mast assembly produces a force urging contraction of the ram with a resultant buildup in pressure in the fluid within conduit 46. The pressure of such fluid is sufficient to cause piston 68 within device 38 to move away from passage 56, whereby fluid is enabled to exhaust from conduit 46 into conduit 44 and the reservoir.

With such exhaust of fluid, the forks and the load they carry drop with the pallet and load thereon coming to rest on top of the stack. After this occurs, there is still some load supported by the hoist ram in the form of the lift forks, carriage and extensible parts of the mast assembly. This load produces a pressure of fluid in conduit 46 which is sufficient to maintain element 72 backed off from passage 56, and an exhaust connection between conduits 46, 44.

With continued lowering of the forks in the space provided by the pallet at the base of the load, the bottom of the forks contact the top of the stack with the forks themselves then coming to rest. Upon such happening, there is a further decrease in the loading of the hoist ram reflected in a drop in the pressure of fluid in conduit 46. With such drop in fluid pressure the force exerted by the fluid on piston 68 is not sufficient to maintain passage 56 open against the biasing of spring 74, and element 72 moves to close off passage 56. Further exhaust of fluid from the hoist ram is then prevented.

The biasing force exerted by spring 74 is adjusted through positioning of screw 78 to produce closing of passage 56 before any substantial movement of the cross-

5

head and hoist ram parts independently of the forks and carriage occurs as permitted by the usual slack existing in any chain arrangement interposed between the hoist ram and forks. The biasing action of the spring is not so great, however, as to prevent unhindered raising and lowering of the forks in normal operation of the lift truck with such forks free of any load.

It will be apparent from the above that this invention contemplates an automatic control of fork movement which is sensitive to pressure variations in the conduit means provided for the supply and exhaust of fluid to the hoist ram. While other pressure-sensitive systems may be useable to produce the result contemplated, the organization disclosed has particular advantages in view of its simplicity and the fact that little modification is required of existing systems to permit incorporation of the invention.

It should also be obvious that safe and proper handling of the lift truck or similar type device is greatly facilitated by reason of the invention. An operator need not carefully watch the forks of the truck to determine the exact time at which fork lowering should be stopped if the destructive effects arising from chain slack are to be prevented.

It is claimed and desired to secure by Letters Patent:

1. In combination with a lifting device having vertically shiftable load-supporting means, and an extensible fluid-actuated hoist ram operatively connected to said supporting means to raise and lower the supporting means on operation of the ram,

a supply of fluid under pressure,

a control valve connected to said supply adjustable to effect raising and lowering of said load-supporting means,

a conduit connected to said control valve including a passage joining with the hoist ram for supplying fluid to and exhausting it from the ram,

and a pressure-sensitive device connected to said conduit disposed with said passage starting at the device and thence extending from the device to the hoist ram, said pressure-sensitive device including

a valve part having a closed position effective to block the exhaust of fluid from the ram through the passage and by so doing to produce a non-flowing column of fluid in the passage, and an open position effective to permit the exhaust of fluid from the ram through the passage,

means sensing in the column of fluid that is produced upon said passage being blocked a pressure of fluid which is above a predetermined level and operative automatically on sensing said pressure to move the valve part to its open position,

and biasing means urging said valve part to its said closed position with the pressure of fluid in the passage under said predetermined level.

2. The combination of claim 1, wherein said pressure-sensitive device comprises valve mechanism including a valve plunger, said valve part is joined to said plunger, and said sensing means comprises a surface formed on said valve plunger.

3. The combination of claim 2, wherein said biasing

6

means comprises a spring in said valve mechanism engaging and acting on said valve plunger.

4. The combination of claim 1, which further includes means for varying said predetermined level comprising an adjustable element in said pressure-sensitive device operatively connected to said biasing means operable to control the amount of bias exerted by said biasing means on said valve part.

5. In combination with a lifting device having vertically shiftable structure including load-supporting means, and an extensible fluid-actuated hoist ram operatively connected to said vertically shiftable structure operative to raise the same on extension of the ram by introducing a body of fluid thereinto, said vertically shiftable structure on being elevated by said ram and when devoid of any load and not supported by any external structure being effective by gravity pulling thereon to produce a pressure of a given magnitude in the body of fluid contained within the ram,

a supply of fluid under pressure,

a control valve connected to said supply adjustable to effect raising and lowering of said vertically shiftable structure,

a conduit connected to said control valve including a passage joined to said ram for supplying fluid to and exhausting it from said ram,

and a pressure-sensitive device connected to said conduit disposed with said passage starting at the device and thence extending from the device to said ram, said pressure-sensitive device including

a valve part having a closed position effective to block the exhaust of fluid from the ram through the passage and by so doing to hold a non-flowing column of fluid in said passage which connects with the body of fluid in the ram, and an open position opening the passage for the exhaust of fluid therethrough from the ram,

means sensing in the column of fluid that is produced upon said passage being blocked a pressure which is above a predetermined level and which is under said given magnitude of pressure and operative automatically on sensing such pressure to move the valve part to its open position,

and biasing means urging said valve part to its said closed position with the pressure of fluid in said passage under said predetermined level.

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