May 14, 1968 R. E. NUTTER 3,382,771

LOAD RELEASE INHIBITOR FOR LOAD-HANDLING APPARATUS

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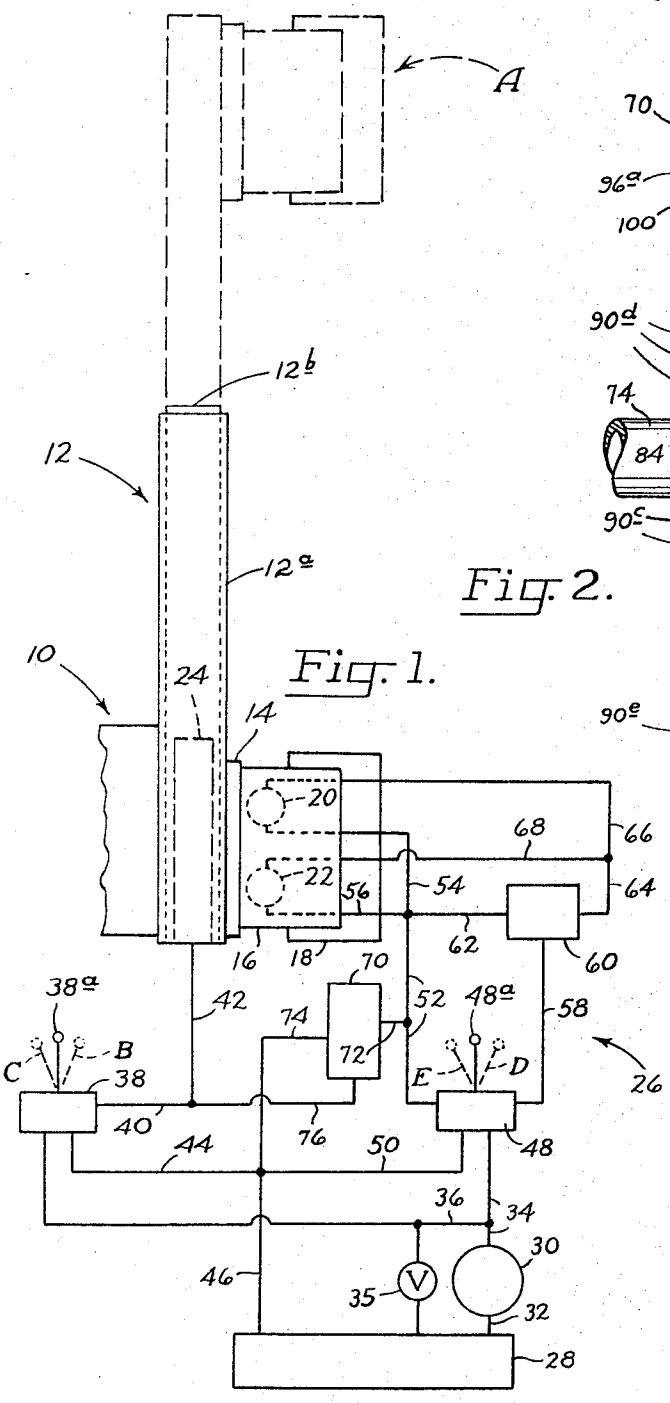


Fig. 1.

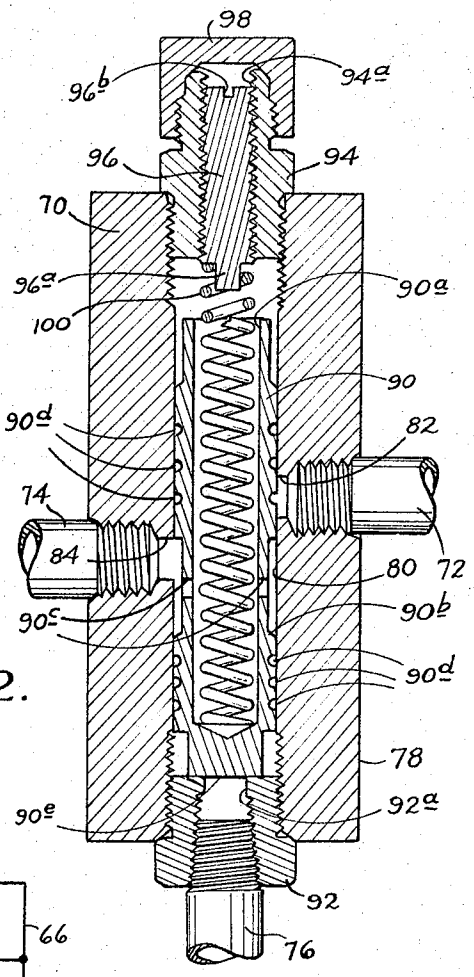


Fig. 2.

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LOAD RELEASE INHIBITOR FOR LOAD-HANDLING APPARATUS

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This invention relates to load-handling apparatus, and more particularly, to means for preventing such apparatus from accidentally releasing a load which is held above the ground.

A common form of load-handling apparatus comprises a lift truck, and load-lifting structure mounted thereon including a vertically extensible mast assembly and a pair of laterally spaced clamps mounted for vertical movement on the mast assembly. The mast assembly is extended (and the clamps raised) by means of a hoist ram connected to the mast assembly. The clamps are operated to move toward and away from one another by fluid-operated motor means connected to the clamps.

With such apparatus fully supporting a load above the ground, it is important to prevent an operator from accidentally actuating the motor means connected to the clamps causing the clamps to move apart, since this would result in dropping of the load, with possible damage thereto and injury to personnel.

A general object of the present invention, therefore, is to provide, in load-handling apparatus of the type described, novel means for preventing accidental release of a load which is supported by the apparatus above the ground.

More particularly, an object of the invention is to provide such means which will automatically prevent the motor means connected to the clamps of the apparatus from being actuated to move the clamps away from the sides of the load.

To accomplish these objects, the invention features a novel pressure-sensitive device which is operatively connected to the conduit supplying fluid to the hoist ram and to the conduit through which pressure fluid is supplied to the motor means connected to the clamps. The device operates, upon elevation of the clamps above the ground, and in response to a rise in the pressure of fluid supplied to the hoist ram, to open a passage which by-passes fluid from the motor means.

With such apparatus, if an operator accidentally attempts to open the clamps with the same holding a load above the ground, pressure fluid that ordinarily would be supplied to the motor means producing separation of the clamps by-passes the motor means, and the clamps remain firmly against the sides of a load.

A further object of the invention is to provide means of the type described above, which is 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 is a schematic diagram illustrating portions of a lift truck, and a fluid circuit embodying features of the invention connected to rams or motor means on the lift truck producing extension of the mast assembly and clamp movement; and

FIG. 2 is a cross-sectional view illustrating a pressure-sensitive device, more particularly a valve, employed in the fluid circuit of FIG. 1.

Turning now to the drawings, and with reference first to FIG. 1, 10 indicates portions of a lift truck which may be used in handling various loads. Suitably mounted on the truck, and indicated generally at 12, is a mast assembly including an outer, fixed or stationary mast section 12*a* fastened to the truck, and an inner mast section 12*b* which is vertically extensible from the outer mast section.

Appropriately mounted for vertical movement on the inner mast section is a carriage 14. Suitably mounted on and extending forwardly from carriage 14 is a pair of laterally spaced, laterally shiftable, elongated mounting arms, such as the arm 16 shown, each of which carries adjacent its forward end a clamping pad, such as clamping pad 18. It should be understood that the clamping pads face one another, and are adapted to clamp against opposite sides of a load positioned between the pads. A mounting arm and the clamping pad which it carries is referred to herein as a clamp, and the pair of clamps is referred to broadly as load-clamping means.

Means for shifting the clamps toward and away from one another to clamp against and release a load comprises a pair of double-acting, extensible, hydraulic rams, or motor means illustrated in dashed outline at 20, 22. These rams extend between and are suitably connected to mounting arms 16. Upon extension of the rams the clamps are moved apart, and upon contraction of the rams the clamps are moved toward each other.

Indicated in dashed outline at 24 is a single-acting, extensible, vertically disposed hydraulic hoist ram. Ram 24 is suitably mounted adjacent the front of truck 10, and connected to the inner mast section and carriage 14 in such a way that upon extension of the hoist ram, the mast assembly is extended and the carriage and clamps are elevated, to such a position as illustrated in dashed outline at A.

Shown generally at 26 is a hydraulic circuit, which is connected to rams 20, 22, 24, and which is employed to produce operation of these rams. The hydraulic circuit includes a reservoir 28 containing a suitable hydraulic fluid, and a hydraulic pump 30 connected to the reservoir by a conduit 32. The pump is driven by suitable drive means (not shown). A by-pass for the pump preventing overloading is shown at 35.

The pump is connected by a pair of conduits 34, 36 to a control valve 38, having a control handle 38*a*, which controls the flow of hydraulic fluid to hoist ram 24. Valve 38 is connected to the cylinder of ram 24 by means of a pair of conduits 40, 42, and the valve is connected to reservoir 28 by a pair of conduits 44, 46.

Valve 38 is a conventional valve provided for controlling the supply and exhaust of fluid to hoist ram 24. Explaining the operation of the valve, with its control handle 38*a* in an upright position, as shown by the solid outline for the handle in FIG. 1, the spool of the valve occupies a neutral position wherein flow between any of the conduits connecting with the valve is prevented. The valve handle, when shifted to the position indicated by the dashed outline at B, shifts the spool of the valve to a hoist position, wherein conduits 36 and 40 are connected to each other through the valve. With the handle of the valve shifted to the position shown in dashed outline at C, the valve's spool is shifted to a lowering position, with exhaust of fluid from hoist ram 24 then permitted through conduit 40, the valve and conduit 44.

Continuing now with a description of the fluid circuit, previously-mentioned conduit 34 also connects pump 30 to a control valve 48, having a control handle 48*a*, which is used to effect supply of hydraulic fluid to rams 20, 22. Valve 48 is connected to the reservoir by a conduit 50 and previously-mentioned conduit 46. The valve is connected to one set of ends of rams 20, 22 by means of a conduit 52, and a pair of conduits 54, 56, which are connected between conduits 52 and rams 20, 22, respectively. Pressure fluid introduced into the rams through conduits 54, 56 causes extension of the rams. Valve 48 is also connected by a conduit 58 to a pilot-operated check valve shown in block form at 60.

Valve 48 is also a conventional valve and includes the usual valve handle 48*a* for controlling through adjustment of the valve's spool flow through the valve. With handle 48*a* upright, as shown in solid outline in FIG. 1, the spool and the valve occupy the neutral position, and no flow is permitted through the valve between any of the conduits connected thereto. With the handle in the position indicated in dashed outline at D, the valve is adjusted to its clamping position, and pressure fluid in conduit 34 is permitted to flow through the valve to conduit 58, and thence to pilot-operated check valve 60. At the same time, a path for fluid flow is provided between conduit 52 and conduit 50. With the handle shifted to the position indicated in dashed outline at E, the valve is adjusted to its releasing position, with fluid flow accommodated from conduit 34 to conduit 52, and with a path provided for the exhaust of fluid from conduit 58 to conduit 50.

Further describing the fluid circuit, check valve 60 is connected by a conduit 62 which functions as a pilot line for the valve, to the junction of previously-mentioned conduits 52, 54, 56. The check valve is also connected to rams 20, 22 by means of a conduit 64 and a pair of conduits 66, 68. Pressure fluid introduced into the rams through conduits 66, 68 causes contraction of the rams.

Check valve 60 is a commercially available pilot-operated check valve which operates, in the absence of pressure fluid in the pilot line (conduit 62), to enable fluid to flow through the valve from conduit 58 to conduit 64, but to prevent any fluid flow in the reverse direction. However, with fluid under pressure present in conduit 62, flow between conduits 58, 64 may take place through the valve freely in either direction.

Shown in block form at 70 is a pressure-sensitive device, more specifically a valve, connected to conduit 52 by a conduit 72, to reservoir 28 by a conduit 74 and previously-mentioned conduit 46, and to the junction of conduits 40, 42 by a conduit 76.

Considering the contruction of device 70, and with reference now to FIG. 2, it comprises an elongated housing 78 having a substantially cylindrical bore 80 extending along the inside thereof between opposite ends of the housing. Extending into the sides of the housing and communicating with bore 80 at locations spaced from one another along the length of the bore are ports 82, 84. Conduits 72, 74 connect with these ports.

Mounted for reciprocation in bore 80 is an elongated valve spool or closure means 90 having an elongated bore 90*a* extending longitudinally downwardly from the upper end thereof as viewed in FIG. 2. Extending around the outside of the spool, approximately midway between its ends, is an annular channel 90*b*. This channel connects to the interior of bore 90*a* through vents 90*c*. Also extending around the piston, and distributed along the length thereof in the regions between the channel and the ends of the spool, are annular passages 90*d*, included for the purpose of gathering any foreign matter introduced into the fluid handled. At the lower end of the spool in FIG. 2 is a piston surface 90*e*.

Screwed into the lower end of the housing is a fitting 92, having a port 92*a* communicating with the interior of bore 80. This fitting receives conduit 76. At the upper end of housing 78, a fitting 94 is provided having a threaded bore 94*a* extending therethrough. Screwed into this bore, and extending into the interior of bore 80, is an adjustable element 96. The lower end of this element terminates in a projection 96*a* of reduced diameter, and presented at the upper end of the element is a slot 96*b* accommodating the blade of a screwdriver. A protective cap 98 closes off the upper end of bore 94*a*.

A biasing spring 100, with one end seated about projection 96*a*, is interposed between device 96 and spool 90 which biases the spool downwardly in the housing. In FIG. 2 the spool is illustrated in the position which it normally occupies by reason of the bias of spring 100.

With the spool in this position, the lower end thereof (pressure surface 90*e*) seats against fitting 92, and channel 90*b* registers with port 84 exclusively of port 82.

With fluid at a sufficiently high pressure present in conduit 76, a force is produced on the spool (surface 90*e* being exposed to this pressure) which shifts the spool upwardly against the bias of spring 100. With such movement in the valve spool, fluid communication is established between ports 82, 84 by reason of channel 90*b* moving into registry with both of these ports.

Explaining now how the apparatus of the invention may be operated, the clamps are moved toward each other by shifting handle 48*a* to the position shown at D, whereby fluid under pressure from the pump is permitted to flow from conduit 34 through valve 48, conduit 58, pilot-operated check valve 60, conduit 64 and conduits 66, 68, to one set of ends of rams 20, 22, to produce contraction of the rams. Fluid exhaust from the opposite set of ends of the rams which accompanies such contraction takes place through conduits 56, 54, conduit 52, valve 48, and conduits 50, 46 to reservoir 28. If the clamps are brought together in this fashion against opposite sides of a load, and valve 48 is then adjusted to its original neutral position, the circuit described is effective then to keep the clamps in their position snugly against opposite sides of the load. This is because in the absence of fluid under pressure in pilot line 62, pilot-operated check valve 60 prevents any extension of rams 20, 22 by preventing the exhaust of fluid which such would produce from conduit 64 through the check valve to conduit 58.

To release a load by moving the clamps apart, handle 48*a* is shifted to the position shown at E, with pressure fluid then being supplied from conduit 34 to conduit 52 and the opposite ends of rams 20, 22. The pressure of fluid in line 62 opens up pilot-operated check valve 60, permitting exhaust from the rams to take place from conduits 66, 68 through the check valve to conduit 58, and thence through the valve 48 to conduit 50.

When the lift truck operator desires to raise the clamps by extension of the hoist ram, and assuming for the moment that no load is being handled, handle 38*a* of control valve 38 is shifted to the position shown for the handle at B, with pressure fluid then being supplied from pump 30 through conduit 36 and control valve 38 to the base of the ram. With the ram extended the desired amount, control handle 38*a* is returned to its neutral position, which has the effect of maintaining the ram at its extended height. With the hoist ram at its selected extended height and devoid of any load, the pressure of fluid in conduit or line 76 is substantially below the full pressure of the fluid developed by pump 30. This relatively low pressure condition existing in line 76 is not sufficient to lift valve spool 90 in device 70 against the bias of spring 100. As a consequence, the fluid flow path between conduits 72, 74 is restricted. Thus, opening of the clamps by separating them is still permitted by adjustment of valve 48 through adjustment of valve 48 to place its control handle in position E with the admission of pressure fluid to conduit 52.

Assuming now that the lift truck operator wishes to extend hoist ram 24 with the clamps attached to a load, extension of the ram is produced in the same manner as before by suitable adjustment of control valve 38. In this instance, however, with the load lifted, a considerably higher fluid pressure is developed in conduits 40, 42 and conduit or line 76. This relatively high pressure condition is effective to shift valve spool 90 of device 70 upwardly against the bias of spring 100, to connect conduits 72, 74 through the valve. With such a connection established, it is impossible for the vehicle operator to produce separation of the clamps, since as soon as handle 48*a* of control valve 48 is shifted to position E to introduce pressure fluid to conduit 52, valve 70 provides a channel whereby

the pressure fluid by-passes rams 20, 22 and returns to the reservoir through conduit 74.

It should be obvious from this description that what is contemplated in broader terms is a pressure-sensitive system inhibiting accidental load release. The embodiment herein illustrated is a relatively simple organization, requiring little modification of existing systems. Regular operation of the lift truck is in no way affected, other than when a load is being handled.

The particular construction contemplated, wherein pressure-sensitive device 70 provides a by-pass for the pressure fluid in preventing accidental release, has peculiar advantages. Specifically, and as compared to a system which would absolutely block the flow of fluid under pressure to the rams to prevent actuation, the particlar construction contemplated prevents actuation by providing an alternate path for fluid flow to the reservoir paralleling the path provided by pump by-pass 35. This is advantageous in minimizing wear in by-pass 35. Furthermore, in a system where fluid flow is blocked, any leakage interferes with the operability of such a system, whereas with the present system any leakage through the pressure-sensitive device 70 does not effect proper operation.

It will be noted that no seals are provided in the pressure-sensitive device sealing the valve spool to bore 80 which extends through the housing of the device. No seals are necessary since, as already indicated, some leakage of fluid from conduit 72 to conduit 74 may take place with the inconsequential fluid flow which does occur being insufficient to affect significantly the pressure of fluid developed in conduit 52 when it is desired to extend the rams and move the clamps apart.

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

It is claimed and desired to secure by Letters Patent:

1. In load-handling apparatus including elevatable fluid-operated load-clamping means for clamping against and releasing a load, first fluid-actuated motor means operatively connected to said load-clamping means actuatable to produce clamping and releasing of a load by said load-clamping means, and a second fluid-actuated motor means operatively connected to said load-clamping means for raising and lowering the same,

conduit means for supplying fluid to and exhausting it from said first and second motor means,

a control valve operatively connected to said conduit means adjustable to effect clamping and releasing of a load by said load-clamping means by controlling the flow of fluid to said first motor means, and

a pressure-sensitive device operatively connected to said conduit means responsive to the pressure of fluid in said second motor means operable, with said load-clamping means elevated and said control valve adjusted to effect releasing of a load by said load-clamping means, and said pressure exceeding a predetermined pressure, to prevent such releasing of a load by said load-clamping means.

2. The apparatus of claim 1, wherein said pressure-sensitive device prevents releasing of said load-clamping means by inhibiting the supply of pressure fluid through said conduit means to said first motor means.

3. The apparatus of claim 2, wherein said pressure-sensitive device comprises a valve connected to said conduit means, and said valve inhibits the supply of pressure fluid through said conduit means to said first motor means by channeling fluid whereby it by-passes said first motor means.

4. The apparatus of claim 3, wherein said valve comprises a passage through which such fluid is channeled when by-passing said first motor means, closure means operable to open and close said passage, and biasing means operatively connected to said closure means biasing the closure means to a position closing said passage.

5. The apparatus of claim 4, wherein said closure means includes a surface which pressure fluid acts upon, said surface is exposed to fluid at a pressure related to the pressure of fluid in said second motor means, said pressure surface when acted upon by fluid pressure producing a force upon said closure means opposing the bias exerted thereon by said biasing means, and such pressure-produced force, upon the pressure of fluid in said second motor means exceeding a predetermined pressure, urging said closure means to a position opening said fluid passage.

6. The apparatus of claim 4 which further includes an adjustable device operatively connected to said biasing means for adjusting the bias exerted by said biasing means on said closure means.

No references cited.

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