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ANTICOLLAPSING HYDRAULIC LIFTING CYLINDER  
SYSTEM FOR TIER-LIFT TRUCKS  
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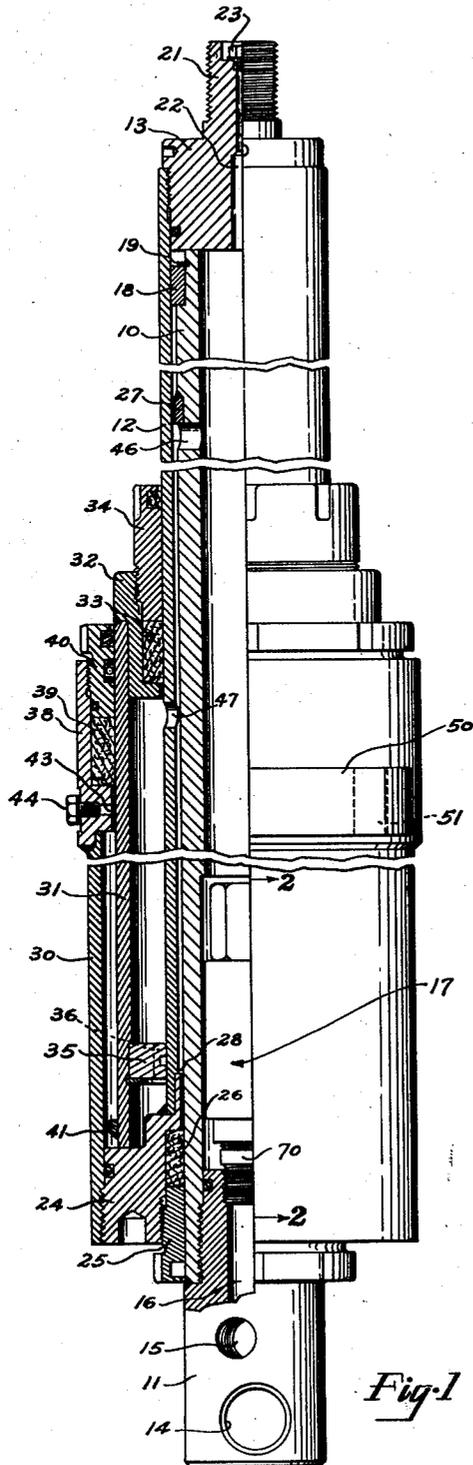


Fig. 2

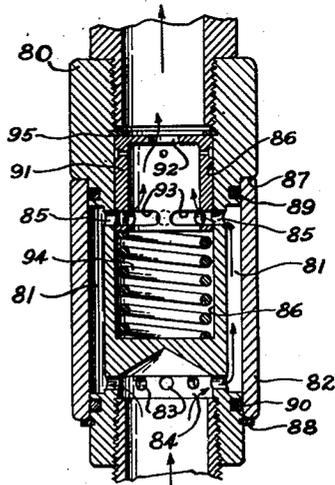
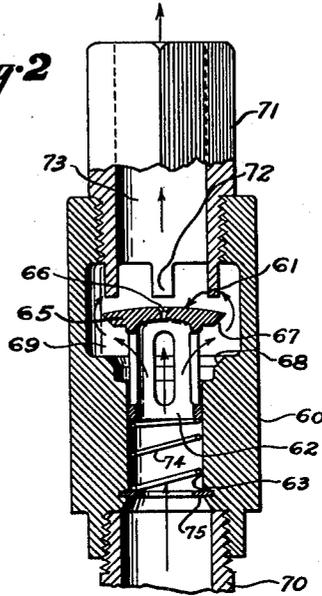


Fig. 3

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## ANTICOLLAPSING HYDRAULIC LIFTING CYLINDER SYSTEM FOR TIER-LIFT TRUCKS

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2 Claims. (Cl. 121-46)

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This invention is directed to improvements in hydraulic lifting cylinder systems for tier-lift trucks. The general object of the invention is the provision of an hydraulic lifting cylinder system for operating the load elevating mechanism of an industrial truck in which the load lowering stroke is automatically controlled in its rate of return.

Another object is the provision of a mechanism having a controlled rate of return stroke in which means for controlling the return stroke rate is incorporated within the hydraulic cylinder unit for protection of the control means and compactness of construction.

With the above and other objects in view, which will be apparent from the detailed description which follows, the invention consists in certain novel features of construction and combination of parts which will be readily understood by those skilled in the art to which the invention appertains. In the drawing, which illustrates an embodiment of the invention—

Fig. 1 is an elevational view in partial axial section of an hydraulic lifting cylinder system incorporating the present invention;

Fig. 2 is a fragmentary enlarged axial sectional view taken along the line 2-2 of Fig. 1, showing in detail the reverse flow control means for the hydraulic cylinder system; and

Fig. 3 is a view, similar to Fig. 2, of another form of reverse flow control means.

The present invention contemplates the use of a flow control valve similar to a check valve in the fluid passage of an hydraulic cylinder mechanism of a tier-lift truck to control the rate of the travel of the loading elevator in its lowering stroke, the control valve as hereinafter described being adapted to allow free flow of hydraulic fluid in one direction for a lifting operation, but to limit the reverse stroke flow during lowering of the load. Although such flow control means is shown in the drawings incorporated in a compound hydraulic cylinder mechanism such as that disclosed in co-pending application Serial No. 134,098, filed December 20, 1949 (the cylinder system alone being shown here), the present invention may be utilized for other hydraulic cylinder systems, either of the single or multiple cylinder type. As disclosed in the abovementioned co-pending application, the hydraulic cylinder system here shown is intended principally for use in a telescoping frame type lift truck in which a primary movement in the cylinder system causes the lifting of a load-carrying platform riding on the movable part of the tele-

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scoping frame and a secondary movement of the cylinder system causes the elevation of the movable part of the frame, and hence further lifting of the load carriage also. An inner or secondary cylinder plunger tube 10, closed at its lower end by a channelled plug 11, slides in the tube 12, closed at its upper end by the cylinder head or plug 13, the two tubes forming a piston and cylinder unit for producing the abovementioned movement. The plug 11, which also serves as a member for mounting the whole compound cylinder unit to a truck, is provided with a transverse bore 14 which pivots about a stud carried by the truck frame. A threaded aperture 15 is provided in the side of the plug for hydraulic piping to bring hydraulic fluid under pressure to the cylinder system and it communicates with the interior central channel 16, into the end of which is threaded a control device, generally indicated 17 and hereinafter described in detail. The upper end of tube 10 is provided with a guide ring 18 sliding on the inner wall of the tube 12 and retained in place by a split spring ring 19. The cylinder head or plug 13, threaded into the upper end of tube 12, has a reduced threaded extension 21 for mounting the upper part of a telescoping frame and also has an air bleeder channel 22, closed by the plug bolt 23. The lower end of tube 12 carries a head structure 24 with associated packing nut 25 and packing 26 which serve to slidably seal tube 12 on tube 10. Toward the upper end of tube 10 an outwardly projecting stop 27 near the upper end of tube 10 limits the travel of these tubes relative to each other in the secondary movement of the cylinders by abutting against the shoulder-like portion 28 formed by the upper end of the head.

An outermost cylinder 30, which at its lower end is threaded onto the head structure 24 in spaced relation from tube 12, acts as a primary cylinder in conjunction with the tube 31 disposed between the tube 30 and the tube 12. The upper end of the primary cylinder plunger tube 31 is closed by another head structure 32, packing 33 and gland nut 34 while its lower end is held in concentrically spaced relation to the tube 12 by the sliding guide ring 35 provided with longitudinal oil channels 36. The upper end of the primary cylinder tube 30 is closed and held in slidable sealed relation to the tube 31 by the head structure 38, packing 39 and gland nut 40. A stop 41 at the lower end of primary cylinder plunger tube 31, upon abutting against the head structure 38, limits the primary stroke. An air bleeding channel 43 for the hydraulic cylinder 30,

closed by a nut 44, is provided in the side of the head structure 38. To allow for passage of fluid from one cylinder to another, an aperture 46 is provided for tube 10 whereby the interior of tube 10 communicates with the space between tubes 10 and 12. Likewise an aperture 47 is provided in the tube 12 for communication from the space between tubes 10 and 12 to that space between tubes 12 and 31. On the exterior of the primary cylinder 30 lugs or ears 50 with bolt holes 51 are provided for attaching cables or chains which are connected at their other ends to the load-lifting carriage of the truck in which this cylinder system is used. Usually upon the shoulder formed by the top edge of the head structure 32 there rests a yoke carrying sheaves over which are passed the cables or flexible chains connecting the primary cylinder and the load carriage.

The flow control device, indicated generally by the reference numeral 17 in Fig. 1 and shown in detail in Fig. 2, comprises a control valve casing 60 and a movable valve member 61, having a hollow cylindrical stem 62 sliding in an axial bore 63 of the casing and a head portion 65. The cylindrical stem 62 is provided with longitudinal port slots 64 while the head portion 65 has a small orifice 66 and a beveled portion 67 adapted to seat on correspondingly beveled seat portion 68 formed in the valve body. Above the seat 68, an enlargement 69 of the body bore provides clearance about the valve head. The lower end of the body is threaded to receive a close nipple 70 connecting the control device to the upper internally threaded end of the channel 16 in the plug 11. The other end of the valve body is threaded to receive a valve member retainer 71 provided with lugs 72, by which the head of the valve member is spaced from the outlet channel 73 to insure free flow of hydraulic fluid into the cylinder system. The upper end of retainer 71 has an hexagonal outer form to provide wrench purchase in turning the flow control assembly into the plug 11. A spring 74, supported at its lower end by the spring retainer 75, bears against the lower end of stem 62 to urge the valve member to open position.

Thus, when hydraulic fluid is admitted under pressure through the aperture 15 and the channel 16 it passes through flow control device 17 in an unrestricted manner, the valve member 61 being lifted from its seat (as in Fig. 2), into the inner bore of tube 10, through the aperture 46 and 47 and through the longitudinal apertures 36 in the guide 35, causing the primary plunger tube 31 to move upwardly in the above mentioned primary motion, thereby moving the sheaves of the carriage cable system with respect to the ears 50 to elevate the load carriage. When the stop 41 abuts against head 38 the primary motion is stopped and continued fluid pressure will then extend the secondary cylinder unit by causing tube 12 to slide upward on tube 10, carrying the extended primary cylinder unit with it. When hydraulic pressure is released, however, and the cylinder system tends to collapse under the weight of the telescoping frame, the reverse flow of the hydraulic fluid through the control device 17, urges the valve member 61 toward the seat against the force of spring 74, so that reverse flow takes place through an effective flow opening which may vary to control the reverse flow and rate of descent of the telescoping frame and load carriage of the truck. The strength of spring 74 is chosen to determine the maximum flow rate, and hence cylinder collapse rate as de-

sired. If a heavy load is on the carriage of the truck when the supporting hydraulic pressure is cut off, the initial reverse flow surge is impeded by the seating of the valve member, allowing flow only through orifice 66, to prevent a sudden dropping of the loaded elevating system. Thereafter, flow may continue through the orifice 66 if the load is quite heavy, or the valve member may open somewhat under the action of spring 74 to allow flow through ports 64.

Another form of control device which may be used is shown in Fig. 3. The body 80 is bored axially from each end, the bores, however, not meeting; while part of the body length is turned down to provide a channel 81 formed between the sleeve 82 and the body, the channel serving to connect the radial ports 83 opening to the bottom bore 84 and radial ports 85 opening into the upper bore 86. The sleeve 82, with its upper end abutting against shoulder 87 is held in place by a split ring 88 in a groove on the body, while packing 89 and 90 seal the upper and lower ends of the sleeve to the body. A hollow piston 91, provided with an end opening 92, and circumferentially extended valving slots 93, serves as a valving member movable in the upper bore 86 as a cylinder. A compression spring 94 urges the piston upward to fully open position against stop means 95, a split ring expanded into a groove in the cylinder wall. In the open position the slots 93 and ports 85 are in correspondence. The lower bore 84 is threaded to receive the close nipple 70 connecting the control device to plug 11.

When hydraulic fluid is flowing into the cylinder system it passes freely through channel 16, the valve inlet bore 84, ports 83, the cylindrical channel 81 surrounding the body, the ports 85, valving slots 93, aperture 92, and out the upper bore 86 into the hydraulic cylinder space, as shown by the flow lines in Fig. 3. When hydraulic pressure is released, so that the cylinder system tends to collapse under the applied load, the upward bias of the spring 94 tends to keep the piston in open position despite the reversed flow as long as the reverse flow is not too great, that is as long as the cylinder system is not contracting too fast. With higher reverse flows, corresponding to greater rate of lowering of the load carriage and telescoping frame in a tier-lift truck, the piston 91 tends to move downward, thereby displacing the valving slots 93 with respect to ports 85 and hence closing the valve to some degree to decrease the flow. With a heavy reverse flow surge through the piston 91 the piston will move downward against the spring far enough to close off the flow, hence preventing a sudden drop of the load supported by the cylinder system. Then the spring will return the piston to some open position to allow a controlled reverse flow from the cylinder system, and hence a controlled rate of descent of the load elevating mechanism of the truck.

I claim:

1. For a hydraulically operated load elevating mechanism of an industrial tier lift truck, a hydraulic cylinder system adapted for extension against a load by supply of hydraulic liquid pressure thereto and for controlled contraction rate under said load upon release of said fluid pressure including a cylinder member, a piston member movable in the cylinder member, one of said members having formed therein a hydraulic liquid conduit opening interiorly of the cylinder system for introducing hydraulic liquid into the working fluid space between the said members

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and exteriorly for connection to a supply of such hydraulic liquid, and a flow control valve disposed interiorly of the two said members in said space and connected to the inner end of said conduit; said valve comprising a valve body having therethrough liquid passage means including a bore extending part way in from one end and having in the other end a fluid channel opening interiorly of said bore through apertures radial thereto and connected exteriorly to the inner end of said conduit, a hollow valve member sideable in said bore, said valve member having radial apertures registrable at an open position with the apertures of the body, and spring means in said bore biasing the said member outwardly to said open position to permit free flow of liquid into said system in extending the said members relative to each other, and said valve member having an axial passage provided with a constriction opening from said apertures of the valve member outwardly to said bore, whereby liquid flow upon contraction of said system tends to displace said valve member from open position against the bias of said springs to limit the rate of contraction of the system.

2. A hydraulic cylinder system adapted for extension against a load by supply of hydraulic liquid pressure thereto and for controlled contraction rate under said load upon release of said fluid pressure including a cylinder member, a piston member movable in the cylinder member, one of said members having formed therein a hydraulic liquid conduit opening interiorly of the cylinder system for introducing hydraulic liquid into the working fluid space between the said members and exteriorly for connection to a supply of such hydraulic liquid, and a flow control

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valve disposed interiorly of the two said members in said space and connected to the inner end of said conduit; said valve comprising a valve body having therethrough liquid passage means including a bore extending part way in from one end and having in the other end a fluid channel opening interiorly of said bore through apertures radial thereto and connected exteriorly to the inner end of said conduit, a hollow valve member slidable in said bore, said valve member having radial apertures registrable at an open position with the apertures of the body, and spring means in said bore biasing the said member outwardly to said open position to permit free flow of liquid into said system in extending the said members relative to each other, and said valve member having an axial passage provided with a constriction opening from said apertures of the valve member outwardly to said bore, whereby liquid flow upon contraction of said system tends to displace said valve member from open position against the bias of said spring to limit the rate of contraction of the system.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
635,848	Dutton	Oct. 31, 1899
820,701	Coleman	May 15, 1906
824,425	Johnson	June 26, 1906
1,840,311	Du Bois	Jan. 12, 1932
2,418,325	Wassall et al.	Apr. 1, 1947

FOREIGN PATENTS

Number	Country	Date
598,406	Germany	June 9, 1934