July 28, 1959 J. A. STIXROOD 2,896,583

COUNTERBALANCING HYDRAULIC CYLINDER

Filed Dec. 28, 1956 2 Sheets-Sheet 1

Fig. 1.

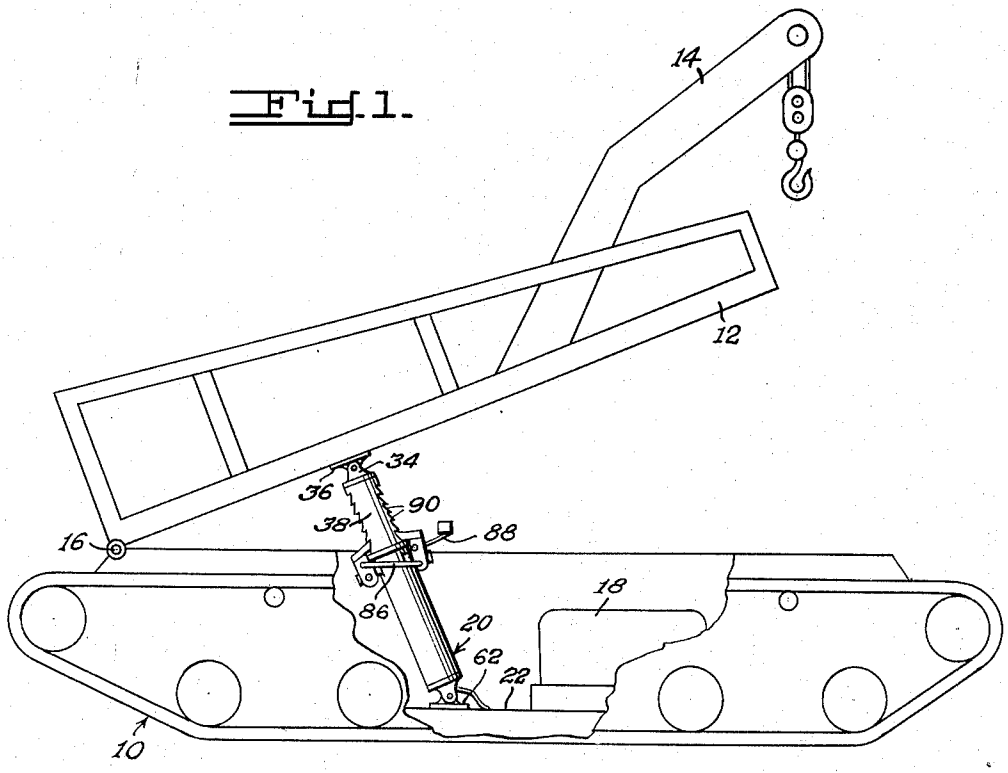
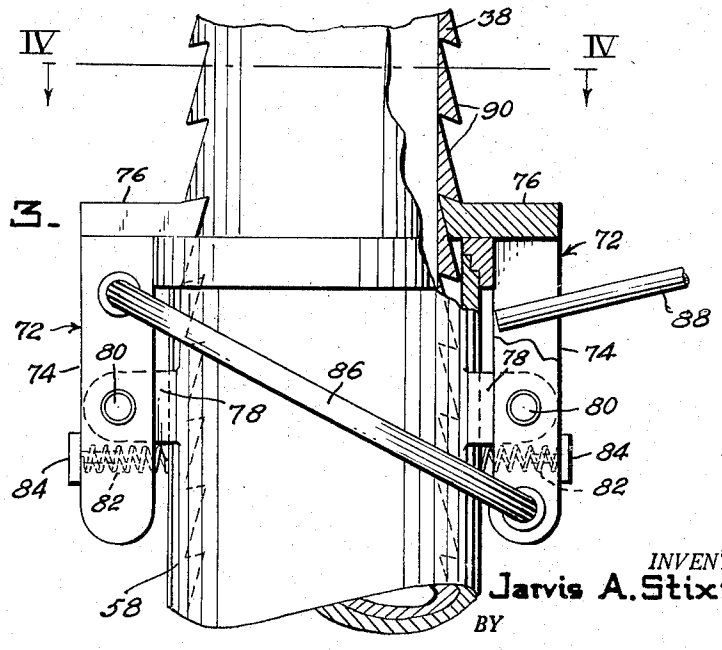


Fig. 3.



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Fig. 2.

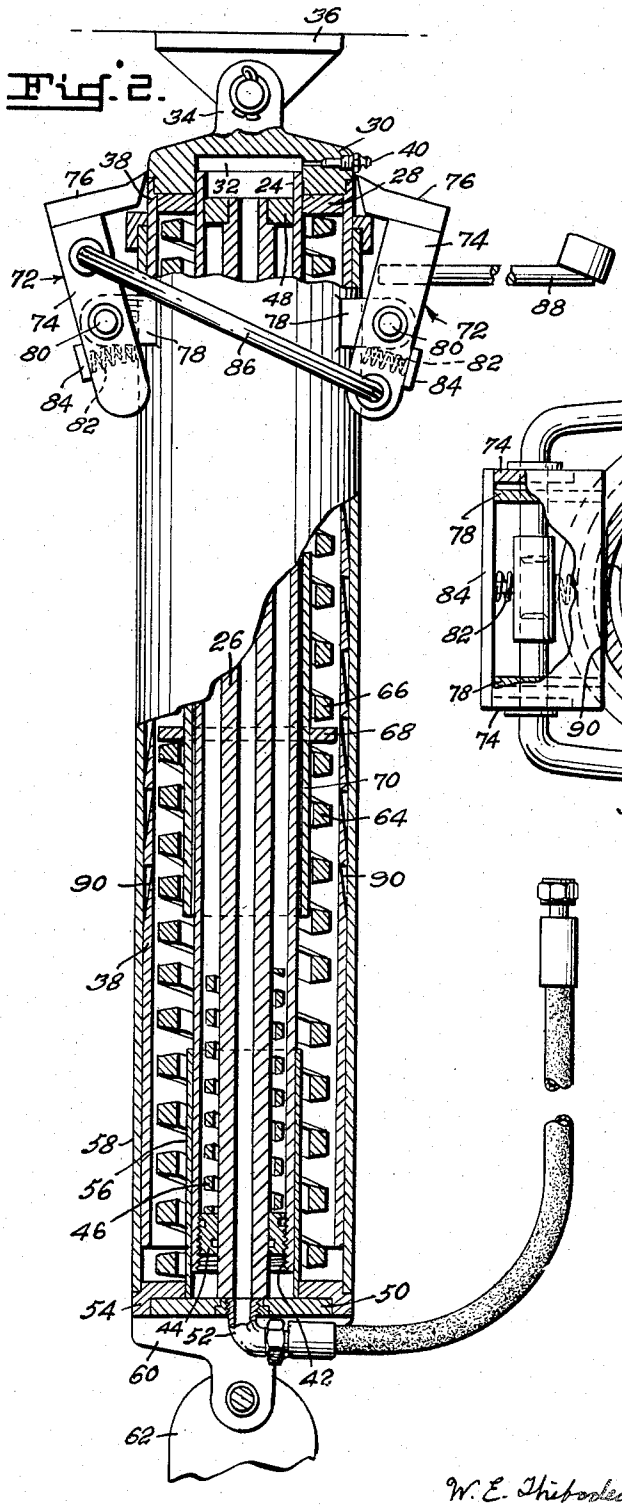
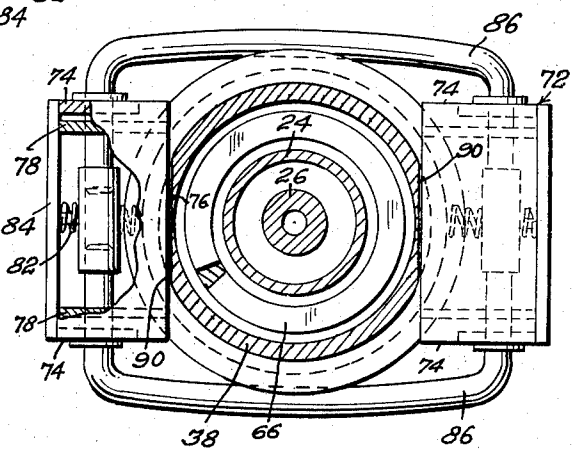


Fig. 4.



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COUNTERBALANCING HYDRAULIC CYLINDER

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4 Claims. (Cl. 121—40)

The present invention relates to hydraulic cylinders, particularly counterbalancing hydraulic cylinders wherein energy storing means are used to augment the force exerted by the hydraulic pressure.

In the construction of heavy equipment, hydraulic cylinders have been widely used to operate various elements of the equipment and hold the elements in any required position. A common illustration is the use of hydraulic cylinders to tilt the load boxes of dump trucks.

As the loads imposed on cylinders of this type are usually very heavy, the fluid pressure required to operate the cylinders must be correspondingly high, and consequently, large and expensive pumps are required to create the necessary fluid pressures. Also, when using high fluid pressure, there is a greater tendency for the oil seals to leak, fluid may be lost, and the cost of a hydraulic cylinder capable of high pressures is necessarily more than that required for a lower pressure cylinder because of the closer tolerances and more accurate construction required.

Thus, it is an object of the invention to design a single action hydraulic cylinder assembly, which is capable of exerting a large force, greater than that produced by the fluid pressure alone, whereby a low pressure cylinder may be used to replace a more expensive high pressure cylinder.

A further object of the invention is to produce a hydraulic cylinder for use in pre-loaded applications, wherein the initial load is counterbalanced by an energy storing element within the cylinder and the fluid pressure is used only to exert additional forces above the counterbalancing effect.

Yet another object of the invention is to construct a compact counterbalancing hydraulic cylinder assembly in which the cylinder may be securely locked in extended position by mechanical means, such that the fluid pressure may be released after the locking means are engaged.

Another object of the invention is to produce a single action hydraulic cylinder which will produce a large force, yet requires only a low pressure pump and cylinder and uses mechanical energy storing means to supplement the hydraulic pressure.

These and other objects of the invention will become apparent when viewed with respect to the accompanying specification and drawings wherein:

Fig. 1 is a schematic view of a vehicle on which the invention may be used.

Fig. 2 is a partly cross-section elevational view of the invention.

Fig. 3 is an elevational view, partly in section, of the locking members of the invention when the cylinder is in locked position.

Fig. 4 is a cross-section elevation of the invention taken along the line IV—IV of Fig. 3.

The invention may be utilized in many applications wherein a single action hydraulic cylinder may be used, however, for purposes of illustration the invention is disclosed as used with a tracked wrecker as shown in Fig. 1.

The wrecker 10 is mounted upon a track which is guided by the conventional drive, idler and bogey wheels and the superstructure of the vehicle consists of a platform 12 on which the boom 14 is mounted. As will be noted, the platform 12 is pivotally mounted at hinge 16 which permits the platform to be raised providing access to the motor 18 and other mechanism located within the vehicle.

As the platform 12 is very heavy, a hydraulic cylinder assembly 20 is interposed between the vehicle floor 22 and the platform 12 to facilitate raising the platform.

It is to the cylinder assembly 20 which the invention is directed and is best shown in Fig. 2.

The assembly 20 consists of a cylinder 24 in which the tubular piston rod 26 is located. The cylinder 24 is provided with a flange 28 which is machined with a series of threaded holes (not shown), whereby the cap 30 may be bolted to the flange 28. The cap 30 is provided with a recess 32 which cooperates with the cylinder 24 and closes off the end thereof. The outer side of cap 30 consists of a yoke 34 which pivotally supports the bracket 36. A sleeve 38 is welded to the periphery of cap 30 and extends parallel and concentric to the cylinder 24, and a bleeder valve 40 communicates with recess 32 to permit any air trapped in the cylinder to escape. The lower end of cylinder 24 is threaded as at 42, such that an annular plug 44 may be screwed therein and a spring 46 is placed in engagement with plug 44 between cylinder 24 and piston rod 26. The plug 44 is provided with oil seals to prevent fluid from escaping, and it will be noted that the plug 44 engages piston rod 26 and will serve as a guide during cylinder assembly operation. Thus, it will be observed that the cylinder 24, cap 30, sleeve 38, plug 44 and bracket 36 will all move together as a unit.

The piston rod 26 is provided with a plunger or piston 48 which engages the walls of cylinder 24. The other end of piston rod 26 is affixed to a mounting plate 50 and receives a coupling 52 threaded into the end thereof, such that fluid may be conducted into the bore of piston rod 26 and ultimately into the cylinder 24. The piston supporting structure also includes an annular ring 54 onto which are welded a spring guide 56 and a cover 58. The guide 56 and cover 58 consist of cylindrical shells extending parallel to the piston rod 26. The cover 58 slidingly engages the sleeve 38.

A cap 60 is provided with a series of holes (not shown) which align with threaded holes formed in plate 50 and ring 54, whereby these elements may be bolted together constituting the piston structure. The cap 60 is formed with a yoke in which the bracket 62 may be pivotally mounted.

Energy storing means in the form of a pair of compression springs 64 and 66 are carried by assembly 20 and are located between the cylinder 24 and the sleeve 38. Due to the large forces stored by the springs, it is advisable to use a pair of short springs, rather than a single long spring. The spring 64 bears on ring 54 while spring 66 abuts against flange 28. The inner ends of the springs abut the flange 68 of a spacer sleeve 70 which "floats" between the springs and cylinder 24. Thus, springs 64 and 66 will tend to bias the brackets 36 and 62 away from each other when under compression as shown in Fig. 2.

As it is often desired to hold the cylinder assembly 20 in expanded position, means are provided for this purpose.

The locking means include a pair of pawls 72 located at the open end of cover 58. The pawls 72 consist of a pair of parallel arms 74 connected together by a hardened tip 76, Figs. 3 and 4. The arms 74 are pivotally mounted to the cover 58 by brackets 78, which are welded to the cover, and pins 80 which extend through both arms and brackets. A spring 82 is interposed between cover

58 and a plate 84 affixed to arms 74, thereby biasing the tips 76 inwardly. Links 86 connect the two sets of pawls for identical simultaneous operation and a control rod 88 is connected to one pawl whereby the tips 76 may be lifted against the action of springs 82.

As will be noted in Figs. 2 and 3, the tips 76 extend over the end of cover 58 and are adapted to selectively engage in the notches 90 formed in the sleeve 38 as shown in Fig. 3, thereby preventing the sleeve 30 from telescoping back into the cover 58.

The operation of the invention is as follows:

As shown in Fig. 1, the cylinder assembly 20 may be interposed between the platform 12, on which the bracket 36 will be fixed, and the vehicle floor or frame 22 which supports bracket 62. The coupling 52 is connected to a low pressure hydraulic pump which may be either manually or power operated, and the control rod 88 is connected to suitable actuating means located near the pump controls.

During the normal operation of the vehicle, the platform 12 will be locked in a horizontal position to the vehicle frame in which location the springs 64 and 66 will be compressed due to the weight of platform 12. When it is desired to have access to the motor 18, the hydraulic pump is actuated forcing fluid through the piston rod 26 and into the cylinder 24, thereby causing the cylinder 24, cap 30, sleeve 38 and bracket 36 to move upwardly as viewed in Fig. 1, thereby raising platform 12 about hinge 16. As the cylinder assembly 20 is expanding, the spring 46 will be approaching the plunger 48, thus, near the completion of the expansion, the spring 46 and plunger or piston 48 will engage and cushion the termination of the movement.

The springs 64 and 66 are of sufficient strength to substantially counterbalance the weight of the platform 12, thus, the fluid pressure within cylinder 24 need only be high enough to overcome the energy loss due to friction and hysteresis in the springs. Thus, the pump and cylinder may be of the inexpensive low pressure type, yet will easily raise the platform 12.

Once the platform 12 has been raised to the desired height, the pawl tips 76 will engage the notches 90 and prevent the platform from lowering. The fluid pressure may be released from cylinder 24 once the pawls 72 are in locking position, and the motor 18 may be serviced as desired.

The platform 12 may be returned to the normal horizontal position by first introducing fluid into cylinder 24 to take the load from the tips 76. The control rod 88 is then actuated which will disengage both tips 76 from the notches 90. While the tips 76 are held in the retracted position, the fluid pressure will be slowly released from cylinder 24 and the weight of platform 12 will force the cylinder assembly 20 to return to the original unextended condition.

As the platform 12 is lowered, the springs 64 and 66 will automatically be compressed, thereby storing the energy required to counterbalance the platform during the raising operation. Once the platform 12 has returned to the original position, it may be locked in place and the vehicle put into operation.

It is thus seen that the invention produces a single action hydraulic cylinder which is capable of exerting a large force while utilizing low fluid pressures. The strength of the energy storing springs should be determined according to the weight to be lifted for the most effective use of the cylinder assembly, and in light duty applications a single spring may be substituted for the double springs 64 and 66.

If desired, the cylinder assembly 20 may be used in pairs or any other grouping to lift heavier loads, wherein the weight to be raised may be equally divided between a series of cylinder assemblies.

By concentrically mounting the various elements of the cylinder assembly, it is possible to produce a very compact unit of inexpensive design capable of replacing more expensive and troublesome high pressure hydraulic cylinders without sacrificing speed of operation, efficiency or safety.

It will be understood that various modifications of the disclosed embodiment may be apparent to those skilled in the art without departing from the spirit and scope of the invention, and it is intended that the invention be restricted only by the following claims.

I claim:

1. In a hydraulic cylinder assembly, a tubular cylinder, a piston within said cylinder, means for introducing fluid into said cylinder, a cap fixed to said cylinder, a tubular sleeve mounted to said cap enclosing and concentric to said cylinder, a mounting plate carried by said piston, a cylindrical cover attached to said plate concentric to said piston and encompassing said sleeve, a helical compression spring located between said sleeve and said cylinder engaging said cap and mounting plate and lock means mounted on said cover for engagement with said sleeve, whereby said cylinder assembly may be held in an expanded position.

2. In a hydraulic cylinder assembly as in claim 1, wherein the lock means comprises a pair of spring biased pivoted pawls diametrically located on the cover which engage with a series of notches formed on the sleeve.

3. In a hydraulic cylinder assembly, a tubular cylinder, a piston within said cylinder, an axial bore within said piston whereby fluid may be introduced into said cylinder, a cap fixed to said cylinder, a tubular sleeve fixed to said cap in spaced concentric relation to said cylinder, a series of notches formed on the outer surface of said sleeve, a mounting plate carried by said piston, a tubular cover fixed to said mounting plate in concentric relation to said piston and overlapping said sleeve, a pair of linked spring biased pawls pivotally mounted to said cover and extending over the end thereof adapted to engage said notches, a helical compression spring positioned between said cylinder and said sleeve and engaging said plate and said cap, and a control rod attached to said pawls, whereby said cylinder assembly may be selectively locked in various expanded positions.

4. In a hydraulic cylinder assembly as in claim 3, wherein said compression spring comprises a pair of springs, the inner ends of which bear on a floating spacer sleeve.

References Cited in the file of this patent

UNITED STATES PATENTS

684,843	Merker	Oct. 22, 1901
1,194,783	Rennerfelt	Aug. 15, 1916
1,512,837	Evenden	Oct. 21, 1924
1,548,394	Sumner	Aug. 4, 1925
1,902,532	Trinks	Mar. 21, 1933
2,163,982	Mercier	June 27, 1939
2,245,699	Miller	June 17, 1941
2,366,121	Martin-Hurst	Dec. 26, 1944
2,366,382	Burton	Jan. 2, 1945
2,476,228	Thornhill	July 12, 1949
2,780,063	Bacchi	Feb. 5, 1957