A piston and cylinder assembly, comprising a cylinder, a piston reciprocable in the cylinder, an elongate ram connected at one end thereof to the piston for movement with the piston and extending at its other end axially outwardly of the cylinder, an abutment fixed in one end of the cylinder against which the piston is engageable to limit outward movement of the piston and ram, an adjustable safety stop carried by the ram externally of the cylinder and manually movable along the length of the ram into engagement with an adjacent end of the cylinder to prevent retraction of said ram into said cylinder, and cooperating structure on said safety stop and said ram to limit inward movement of said safety stop along said ram toward said cylinder so that with said ram extended and said safety stop moved fully inwardly along said ram toward and against said cylinder, there is a space between adjacent ends of said piston and said abutment so that the piston and ram can be moved outwardly a distance equal to said space to thus disengage said safety stop from said cylinder and consequently enable said safety stop to be easily manually moved along said ram away from said cylinder and said ram can then be retracted into said cylinder.
Piston and Cylinder Assembly with External Mechanical Lock

Background of the Invention

This invention relates to a piston and cylinder assembly having an extensible and retractable ram carried by the piston and a safety mechanical lock means adjustably movable along the ram into engagement with the end of the cylinder for locking the ram against retraction into the cylinder, with the ram in either a fully or partially extended position, to support a load on the ram.

More particularly, the present invention relates to a hydraulically actuated piston and cylinder assembly such as used, for example, in outrigger jacks, or on mobile crane equipment, or back hoes or other machinery, or in retractable dolly wheel assemblies for semi-trailers and combination rail and highway travel vehicles and the like, or for crane boom hoist cylinders where exceptionally heavy or dangerous lifts may have to be made, or in any other application where heavy machinery or equipment must be jacked up for servicing or installation positioning, and the like. In any of these applications, there is a danger of failure of the hydraulic lines serving the piston and cylinder assembly or of failure of the cylinder itself and consequent collapse of the cylinder with serious personal injury or property damage resulting. Moreover, even in the absence of failure of a hydraulic hose or line or of the pressure vessel or cylinder itself, there is a possibility of slight leakage of the hydraulic fluid from the cylinder, thus enabling the cylinder to collapse under sustained heavy compressive loading.

In the prior art, various attempts have been made to overcome these serious problems and one such prior art attempt has been to provide a hydraulic lock to prevent collapse of the cylinder in the event of a hydraulic hose or line failure. However, this type of hydraulic lock cannot prevent a sudden collapse of the cylinder in the event that the pressure vessel itself ruptures or bursts open under high pressure loading or because of defective materials.

Other prior devices have utilized various types of mechanical locks to prevent a cylinder under heavy compressive loading from collapsing in the event of failure of a hydraulic hose or line, or in the event of failure of the pressure vessel. However, such prior art mechanical devices are relatively bulky in construction and, accordingly, with such prior art devices it is impossible to design a compact hydraulic piston and cylinder assembly for applications where a compact design is necessary or desirable.

Further, some prior art devices have internal mechanical locks which are not visible to the operator and, accordingly, there is no assurance that the lock means is in its proper operative condition and under some circumstances, the lock means may become jammed in the cylinder, thus creating a false impression of being properly locked, so that the event of hydraulic hose or line failure, the cylinder is enabled to collapse, with serious consequences. Other prior art mechanical devices utilize external locks, but such locks are constructed in a manner that requires the hydraulic piston and cylinder assembly to be oriented in a particular way for proper operation of the lock, thus reducing the uses which can be made of the hydraulic piston and cylinder assembly, or the lock can easily become jammed or tightened against the cylinder and thus require considerable forces to release it. Further, other prior art devices can be locked to prevent collapse of the cylinder upon hydraulic hose or line failure, but the lock means is not effective to prevent collapse of the cylinder in the event of rupture of the cylinder itself, or of failure of the mounting flange welds which normally mount the cylinder in operative position for supporting a load.

Still further, because of the complicated construction of some prior art devices, neither the hydraulic cylinder nor the lock means is easily serviced, and complete disassembly of the cylinder assembly is required for cleaning or servicing of the components. Similarly, many prior art devices require specially designed and constructed cylinder assemblies which are not readily adapted to use with conventional, existing equipment and the mechanical and hydraulic components of these devices are not separated, so that contamination due to wear of the mechanical parts is transmitted into the hydraulic system, and vice versa. Further, on many prior art devices external port tubes and oil lines are required for exhausting and supplying hydraulic fluid to the piston and cylinder assembly and the possibility of damage to these lines, and failure of the hydraulic cylinder is significantly increased.

In the present invention, a unique and simple hydraulic piston and cylinder assembly is provided which has a double lock valve on one end of the cylinder and with internal ports and oil lines extending from the pilot valve directly into the extend and retract chambers in the cylinder, thus reducing the possibility of damage to the oil lines, as may occur with prior art devices, wherein the oil lines are externally situated.

Further, positioning of the double lock pilot valve on the end of the cylinder in the present invention enables a much more compact design to be utilized, with the result that the piston and cylinder assembly can be easily used in many applications where prior art devices are not capable of being used.

Moreover, the mechanical lock nut of the present invention is constructed so that it seats against the end of the cylinder, and it may be constructed to seat against the mounting flanges for the cylinder, so that even in the event of failure of the pressure vessel or cylinder itself, or even of the flange mounting welds, the cylinder is not enabled to collapse.

With the present invention, the mechanical lock nut is exposed and fully visible to anyone close to the cylinder so that it can be quickly and easily ascertained whether or not the lock nut is in proper position and, thus, the danger of forgetting to properly position the lock nut, or of obtaining a false impression as to proper position of the lock nut, is eliminated.

Also, the cylinder assembly of the present invention is interchangeable with existing devices on jacks and the like and can either be provided as a part of the original equipment or can be an optional sales item or an after market device to place on machines already in the field.

The particular construction of the hydraulic cylinder of the present invention enables the lock nut to be removed from the cylinder ram for cleaning or servicing without the necessity of disassembly of the entire hydraulic cylinder, and the ram screw threads can be cleaned and serviced by merely hydraulically extending the ram. Furthermore, the mechanical and hydraulic
components of the present invention are completely separated so that contamination due to the wear of the mechanical parts is not transmitted into the hydraulic system and, likewise, any contamination within the hydraulic system is not transmitted into the mechanical locking arrangement to cause binding or sticking of these components.

Further, in the present invention no external port tubes or oil lines are required and all oil is transmitted directly from the lock valve into the pressure vessel, thereby reducing the possibility of failure or damage to the hydraulic ports or lines during positioning of the cylinders and prior to locking of the mechanical lock. Still further, the construction of the present invention enables the hydraulic cylinder to be used with any type mounting, and particularly with a blind end type mount for application where heavy machinery or buildings must be reeled and mechanically located in their new position.

Still further, the hydraulic cylinder of the present invention is uniquely constructed such that the ram can be extended outwardly a greater distance than the lock nut can be moved inwardly along the ram, so that the ram can be extended slightly, even with the lock nut moved fully inwardly along the ram, to disengage the lock nut from the end of the cylinder and thus enable the lock nut to be threaded outwardly along the ram whereby the ram can be retracted into the cylinder. This enables all work to be hydraulically performed, and the lock nut can be easily manually manipulated without requiring excessive force to free the lock nut from the end of the cylinder when a heavy load is resting on the ram.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a piston and cylinder assembly having external, readily visible, manually operated mechanical lock means thereon to prevent accidental collapse of the cylinder in the event of hydraulic hose or line failure or failure of the pressure vessel.

Another object of the invention is to provide a hydraulic piston and cylinder assembly having external mechanical lock means thereon for locking an extendible and retractable ram against retraction in various extended positions thereof, and wherein a double lock pilot valve is used to supply hydraulic pressure fluid to the cylinder to extend and retract the ram and wherein the position of the double lock pilot valve on the cylinder is such as to enable various mounting arrangements for the cylinder, and particularly, a blind end type mounting arrangement.

A further object of the invention is to provide a hydraulic piston and cylinder assembly having an extendible and retractable, externally threaded ram with an internally threaded lock nut threaded on the ram externally of the cylinder for engagement with one end of the cylinder to prevent collapse of the cylinder in the event of hydraulic failure and the like, and wherein the ram can be extended outwardly of the cylinder a greater distance than the nut can be threaded inwardly of the ram so that the ram can be extended to disengage the nut from the end of the cylinder and enable the nut to be threaded outwardly along the ram to thus enable the ram to be retracted into the cylinder. A still further object of the invention is to provide a hydraulic piston and cylinder assembly having an external safety lock nut thereon, wherein the lock nut can be easily removed for cleaning or servicing without requiring disassembly of the entire piston and cylinder assembly, and the piston and cylinder assembly can be easily assembled and disassembled for service or cleaning.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the hydraulic piston and cylinder assembly of the present invention showing the ram in its fully extended position.

FIG. 2 is a greatly enlarged end view of the assembly of FIG. 1, showing the double lock pilot valve on one end of the cylinder.

FIG. 3 is an enlarged, exploded, perspective view of the piston and cylinder assembly of the present invention showing the various components thereof.

FIG. 4-4' is an enlarged sectional view in elevation with portions broken away of the piston and cylinder assembly in a fully retracted, rest position with both valves of the double lock pilot valve in closed position.

FIG. 5-5' is a view similar to FIG. 4-4' with hydraulic fluid being admitted to the cylinder through the double lock pilot valve and with the ram partially extended and the lock nut carried outwardly therewith.

FIG. 6 is a view in elevation with portions broken away and portions shown in section of the piston and cylinder assembly in fully extended position and with the lock nut threaded along the ram into engagement with one end of the cylinder to prevent collapse of the cylinder in the event of hydraulic line failure and with the double lock pilot valve shown in closed position to effect a hydraulic lock.

FIG. 7 is a greatly enlarged, fragmentary sectional view with portions broken away of the piston and cylinder assembly of the invention showing the lock nut threaded fully inwardly along the ram, but with the ram extended outwardly its full limit of travel to disengage the lock nut from the end of the cylinder so that the lock nut can be easily manually threaded outwardly along the ram to enable retraction of the ram into the cylinder.

FIG. 8 is a view similar to FIG. 7 with pressure fluid being admitted through another of the valves of the double pilot lock valve into the cylinder to retract the ram into the cylinder.

DETAILED DESCRIPTION OF THE INVENTION

In the drawings, wherein like reference numerals indicate like parts throughout the several views, the hydraulic piston and cylinder assembly of the invention is indicated generally at 10 and comprises an elongate cylinder 11 having opposite open ends 12 and 13 and an inner surface 14. The inner surface 14 of the cylinder 11 at open end 13 is slightly diametrically enlarged and threaded as at 15 and the threaded portion 15 is joined to the inner surface 14 by an inwardly sloping, conically shaped portion 16 to facilitate assembly of the components of the invention and to prevent damage to seal means for the piston by the threads 15 when the components are assembled.

A circular, disc-shaped end closure or cylinder cap 17 is suitably secured in the open end 12 of cylinder 11, as by means of a weld W or the like, and the weld preferably comprises a J-type weld to relieve stress risers and the like. The closure 17 has parallel, planar inner and outer faces 18 and 19, respectively, and a central opening 20 therethrough extending between faces 18.
and 19. The opening 20 is diametrically enlarged to define a recess 21 in faces 19 of the closure.

A radially extending fluid port 22 extends from the outer surface of closure 17 to the central opening 20 therethrough and the port 22 is closed at its outer end by a threaded plug 23. An axially extending fluid port 24 extends from face 19 to the port 22 intermediate the central opening 20 and outer surface of closure 17 and a second fluid port 25 extends between faces 18 and 19 intermediate the outer surface of the closure 17 and the central opening 20 therethrough on the diametrically opposite side of closure from port 24.

An elongate, cylindrical tube 26 having opposite open ends 27 and 28 and an inner surface 29 is fitted at one end thereof in the bore 20 through closure 17 and extends at its other end outwardly beyond the open end 13 of cylinder 11. Said one end 27 of the tube 26 is closed by a solid cylindrical plug 20 secured in the open end, as by means of a weld W or the like, with said plug flush with said one end of said tube.

A radially extending port 31 extends through the side of tube 26 in registry with port 22 in end closure 17 and a snap ring 32 is received over said one end of the tube 26 in the recess 21 to hold the tube in the position shown in FIG. 4-4' with the ports 31 and 22 in registry.

A pair of seal receiving channels or grooves 33 are formed in the bore 20 of closure 17 and a pair of sealing rings 34 are positioned in the channels on opposite sides of the port 22 for effecting a fluid tight seal between the tube 26 and closure 17.

A similar solid, cylindrical plug 35 is suitably secured within the open end 28 of tube 26, as by means of a weld W or the like, for closing the other open end of the tube 26.

An annular, combination seal and spacer ring or bushing 36 is suitably secured to the outer surface of said other end of the tube 26, between a retaining ring 36' welded to the end of tube 26 as at W, and a snap ring 32' on the tube 26 spaced axially inwardly from ring 36'. The combination seal and spacer ring 36 has an annular seal receiving channel 37 in the inner surface thereof, in which is positioned a seal ring 38 for effecting a fluid tight seal between the ring 36 and tube 26.

A plurality of axially spaced seal ring receiving channels or grooves 29 are also formed in the outer surface of the ring 36 and wiper and sealing ring means 40 are positioned in the seal receiving grooves 39.

An elongate, cylindrical, extensible and retractable ram 41 is telescopically received within the cylinder 11 in radially outwardly spaced relationship to the tube 26 and radially inwardly spaced relationship to the inner surface 14 of cylinder 1. The ram 41 has a cylindrical inner surface 42 slidably received on the ring 36 and the seal rings 40 carried by the ring 36 effect a fluid tight seal between the ram 41 and the ring 36. The ram 41 has an open inner end 43 and an open outer end 44 spaced axially outwardly of the end 13 of cylinder 11. The open inner end 43 of the ram 41 is diametrically enlarged relative to the inner surface 42 and is joined to the surface 42 by a conically flared portion 45, the enlarged open end 43 of the ram 41 defining an axially facing shoulder 46 at the inner end of the conically flared portion 45.

An annular, combination seal and spacer ring or piston means 47 is carried by the ram 41 in the enlarged, open inner end 43 thereof between a pair of spaced mounting rings or washers 48 and 49 clamped between the shoulder 46 and a snap ring 50 spaced axially from the shoulder 46. The ring 47 is slidably sealed to the tube 26 by means of an annular seal ring 51 carried in a seal ring receiving groove 52 in the inner surface of ring 47, and the ring 47 is sealed to the ram 41 by means of a ring 53 carried in a groove 54 in the outer surface of ring 47. The tube 26, ram 41, seal ring 36 or piston means 47 define a "retract" chamber 55 therebetween, to which pressure fluid is admitted to act against the ring or piston means 47 and draw or retract the ram 41 into the cylinder. A radial port 56 extends through the tube 26 adjacent the open end 28 thereof but spaced axially inwardly from the ring 36 for admitting and exhausting pressure fluid to and from the retract chamber 55.

The outer surface of the inner end of ram 41 is recessed at 57 defining an axially facing shoulder 58, and a combination seal and spacing ring or piston means 59 is carried by the ram in said recess and is held in position in the recess between an annular clamping ring or washer 60 abutted against shoulder 58, and a snap ring 61.

An annular, resilient wiping and sealing ring 62 is carried in a channel 63 in the ring 60 in wiping, sealing engagement with the surface of cylinder 11 and a plurality of seal ring receiving channels 64 are in the outer surface of ring 59 and sealing wiping ring means 65 are carried in the channels 64 for effecting a seal between the ring or piston means 59 and the inner surface 14 of cylinder 11. The ring or piston means 59 is sealed to the inner end of ram 41 by means of an O-ring 66 or the like carried in a channel 67 in the inner surface of ring 59.

The seal and spacer rings, or piston means, 47 and 59, the inner surface 14 of cylinder 11, the outer surface of tube 26, and the inner face 18 of closure 17 define an "extend" chamber 68 through which pressure fluid is admitted through port 25 in the end closure 17 for extending the ram 41 outwardly through the open end of cylinder 11. The rings 59 and 47 together comprise, in effect, a piston means for the ram 41.

The outer surface of the ram 41 is threaded as at 69 from a point spaced axially from the clamp ring 60 to the outer end of the ram. An abutment means, comprising an annular guide ring or bushing 70 has an externally threaded portion 71 thereon threadably engaged with the threads 15 in the open end 13 of cylinder 11 and has a cylindrical inner surface 73 slidably engaged with the outer surface of the ram 41 for guiding the outer end of the ram in its movement relative to the cylinder 11.

A plurality of tool engaging openings 74 are in the outer end surface of the guide sleeve or bushing 70 for attaching and removing the guide sleeve from the open end of cylinder 11. The inner end of guide sleeve 70 has an axially facing shoulder 75 thereon defining a positive stop or abutment for limiting outward travel of the piston means and ram and against which the ring 76 abuts at the extreme limit of travel of the ram in its extended position.

A safety lock nut 76 is threadably engaged on the ram 41 axially outwardly of the cylinder 11 and has internal threads 77 therein matingly engaged with the threads 69 on ram 41, so that the nut 76 may be easily manually threaded along the ram 41 into and out of engagement with the outer end surface of the cylinder 1.
The outer surface of the nut 76 is knurled as at 78 so that a more secure grip thereon can be effected, and an annular stop plate 79 is secured to the outer end surface of the nut 76 by means of a plurality of cap screws 80 or the like extended through the plate 79 and into the nut 76. The nut 76 is retained against accidental axial displacement from the end of ram 41 by means of a snap ring 81 or the like positioned on the outer end of ram 41.

A combination felt oiler and wiper ring 82 is positioned in one of the thread grooves in the ram 41 for cooperation with the inner surface of lock nut 76 to be moved along the threads of the ram nut 76 to clean and lubricate the threads.

The length of the unthreaded portion of ram 41 between the inner end of threads 69 and the outer end surface of ring 60 is greater than the distance or length of bushing 70 between the abutment surface 75 and the outer end surface thereof, so that with the ram fully extended and the piston means abutting the abutment surface 75, the nut 76 is disengaged from the end of the cylinder, or conversely, when the nut 76 is threaded all the way in along threads 69 and into engagement with the end of cylinder 11, the piston means or ring 60 is spaced from abutment surface 75, and the piston means may thus be moved farther outwardly and into engagement with abutment 75 to disengage nut 76 from the end of cylinder 11 to thus enable the nut to be easily manually threaded outwardly along the ram and consequently the ram can be retracted into the cylinder.

A solid, axially projecting rod end 83, having a convex outer end portion 84 thereon, is suitably secured in the open end 44 of ram 41 and has a planar end surface 85 abutted against a shoulder 44' in the open end of ram 41 and is preferably secured to the ram 41 by means of a weld W.

An annular mounting flange 86 is suitably secured to the outer surface of cylinder 11 adjacent the open end 13 thereof, as by means of a pair of welds W on opposite sides thereof, and a plurality of axially extending, circumferentially spaced openings 87 extend through the mounting flange 86 for receiving bolts or the like (not shown) therethrough to mount the cylinder and piston assembly to a desired supporting structure.

As indicated in phantom line at 76' in FIG. 4-4', the lock nut 76 may be larger in diameter than the outer diameter of cylinder 11, so that the lock nut would be engageable with the mounting flange 86 to prevent collapse of the cylinder in the event of failure of the welds W by which the mounting flange is secured to the cylinder.

An oil fitting 88 is threadably attached to a tapped opening 89 in the side of cylinder 41 adjacent the guide sleeve 70 therein, by means of which the combination oiler and wiper ring 62 may be lubricated when the ram is in its extended position, as seen in FIG. 6, for example.

A double lock pilot valve 90 for controlling the supply and exhaust of pressure fluid to and from the "extend" and "retract" chambers 68 and 55, respectively, is suitably secured to the outer surface or face 19 of cylinder cap or end wall 17 and comprises a valve block 91 having a transverse bore or passageway 92 therethrough, with diametrically enlarged, internally threaded opposite ends 93 and 94. A pair of ball valve assemblies 95 and 96 are removably threaded engaged in the opposite threaded ends 93 and 94 of passage 92 in block 91, and the ball valve assemblies 95 and 96 are substantially identically constructed, and each comprises a valve housing or body 97 having an axially extending bore 98 therein and a transverse extending bore 99 opening through the sides of the housing and communicating with the bore 98 substantially intermediate the ends thereof.

The bore or ports 99 in the sides of ball valve assemblies 95 and 96 are in registry, respectively, with a pair of fluid ports 100 and 101 at opposite ends of the valve block 91. The ports 100 and 101 are, in turn, in registry with ports 24 and 25, respectively, in the cylinder cap 17.

Each ball valve assembly 95 and 96 includes a valve seat 102, which may be constructed with two symmetrical seating surfaces 102a and 102b on respective opposite sides thereof, see FIG. 5, and thus be reversible, if desired, in order to provide a "built in" spare seat for replacement of a worn seat, or the like. The seat is at the housing 97 adjacent the inner end thereof in surrounding relationship to the bore 98 therein, and ball valves 103 and 104 are positioned in the assemblies 95 and 96, respectively, for cooperation with the valve seats 102, and the ball valves 103 and 104 are urged toward their closed position against the seat by means of a coil spring 105 engaged between the ball and the closed end of bore 98 in the housing 97.

A stop element 106 is in each housing 97 rearwardly of the balls 103 and 104 to provide a positive stop against which the ball engages at its maximum open position.

Annular sealing rings 107 are positioned in seal rings receiving grooves in the inner surface of valve block 91 and are positioned in surrounding relationship to the ports 100 and 101, respectively, to effect a fluid seal between the valve block 91 and cylinder cap 17.

Housings 97 and seats 102 of ball valve assemblies 95 and 96 are also each suitably sealed in their respective end of the bore 92 by means of sealing rings 108 and 109, respectively, engaged between the housings 97 and seats 102 and adjacent portions of bore 92.

A piston 110 is slidably positioned in bore 92 and has a pair of elongate, axially extending ball actuating pins 111 and 112 on opposite ends thereof for engaging a respective ball 103 or 104 to unseat that ball when fluid pressure is admitted to the bore 92 on the opposite end of the piston 110.

A transverse, fluid inlet and outlet port 113 is in the valve block 91 inwardly of valve assembly 95 and extends through the block into communication with the bore 92 between the piston 110 and ball valve 103 for admitting and exhausting pressure fluid to the bore 92 and past the valve 103 through the bore 100 and bore 24 and thence to the transverse bore 22 and through port 31 into the hollow interior of tube 26, from which the fluid passes through port 56 into the retract chamber 55 to retract the ram into the cylinder. Pressure fluid entering port 113 also acts against piston 110 and moves it downwardly and the pin 112 engages ball 104 and unseats ball 104 to exhaust fluid from the extend chamber 68.

A fluid inlet and outlet port 114 is formed in valve block 91 in communication with the bore 92 in the valve block at the opposite end of the piston 110, between the piston and ball valve 104, and through which the fluid is exhausted from the extend chamber 68.
when fluid is introduced through port 113 to retract the ram. Conversely, if fluid is admitted through port 114, the piston is moved upwardly to engage ball 103 with pin 111 and unseats ball 103, so that fluid in retract chamber 55 can be exhausted through port 113, and the fluid admitted through the port 114 unseats ball 104 and passes through ports 101 and 25 to the extend chamber 68 to extend the ram 41 outwardly of cylinder 11 while the fluid in retract chamber 55 is exhausted through the tube 26, ports 22, 24 and 100 and past the open ball valve 103 and through port 113.

A "thermal relief" bypass ball valve assembly 115 is threadably secured in a bore 116 in the valve block 91 adjacent valve assembly 95 and includes a ball valve 117 biased to seat against a valve seat in a passage 118 communicating with opposite sides of the ball 103 so that the ball 117 is normally closed upon the introduction of pressure fluid to port 113, but is enabled to be opened by an increase in pressure of the fluid in retract chamber 55 above a predetermined value when the fluid is heated and thus expands, to prevent damage to the piston and cylinder assembly. Only a small amount of fluid is vented from the retract chamber, and this enables the piston to move and thus slightly expand the extend chamber to reduce pressure in the device. No pressure fluid is vented from the extend side of the piston, and the minute movement of the piston upon venting of a small amount of fluid from the retract chamber is sufficient to protect the assembly.

As seen in FIGS. 1 and 2, the double pilot lock valve 90 is secured to the surface 19 of end cap 17 on cylinder 11 by means of a plurality of bolts 119 extended through the block 91 into the end cap 17. A fluid inlet fitting 120 is connected with the block 91 in communication with port 113 for admitting and exhausting pressure fluid to and from the double pilot lock valve and thus to and from the retract chamber 55, and a fluid inlet fitting 121 is similarly connected with port 114 for supplying and exhausting pressure fluid to and from the extend chamber 68.

Alternate positions of the inlet fittings 120 and 121 are shown in phantom lines at 120' and 121' in FIGS. 1 and 2.

**OPERATION**

The device of the present invention is shown at rest in FIG. 4-4' and no pressure fluid is being supplied to the ports 113 and 114 and both balls 103 and 104 are closed. Also, the ram 41 is in its fully retracted position, with the inner end of ram 41 abutting against the inner surface 18 of end cap or closure 17. The nut 76 is threaded completely out on the end of ram 41 against the snap ring 81 and is in engagement with the outer end of cylinder 11.

In FIG. 5-5', pressure fluid is being supplied to port 114 through inlet fitting 121 and the pressure fluid has unseated ball 104 and is passing through ports 101 and 25 to extend chamber 68 through is acting against the piston means 47 and 59 to extend the ram axially outwardly of the cylinder 11. As seen in this Figure, the ram is only partially extended and the lock nut 76 is being carried outwardly with the ram. Also, the pressure fluid entering bore 92 through port 114 has moved the piston 110 upwardly and the pin 111 on the piston is engaged with ball 103, unseating ball 103, so that the fluid within retract chamber 55 is exhausted through the hollow interior of tube 26 and through the ports 22, 24 and 100 and past ball 103 to the port 113. Also, the fluid being exhausted from retract chamber 55 has unseated ball 117 in bypassing relationship to ball 103 and is flowing through passage 118 to the port 113. If desired, the ram may be mechanically locked against retraction in the partially extended position of FIG. 5-5' by threading the lock nut 76 inwardly along ram 41 into engagement with the end of cylinder 11 as indicated in phantom lines at 76'. In FIG. 6 the ram is shown in substantially fully extended position and no pressure fluid is being admitted to the double pilot lock valve and both ball valves 103 and 104 are, therefore, in their seated position. Accordingly, the fluid is trapped in both the extend and retract chambers and a hydraulic lock is effected to maintain the ram in its extended position. As a safety measure, however, the nut 76 is threaded fully inwardly along ram 41 against the end of cylinder 11 to provide a mechanical lock so that the ram will not retract into the cylinder under a compressive loading in the event of failure in the hydraulic system for the ram. In this position, the ring 60 is spaced a slight distance from the guide sleeve 70 and abutment 75. Also, the combination oiler and wiper ring 62 is disposed immediately adjacent the oil fitting 88 and it is in this position that the oil is admitted through the fitting 88 to lubricate the piston and cylinder assembly of the present invention.

In FIG. 7, pressure fluid is once again being admitted through port 114 and into the extend chamber 68 to move the ram axially outwardly the remaining slight distance between the ring 60 and sleeve 70 to disengage the nut 76 from the end of cylinder 11 so that the nut 76 may be easily manually threaded outwardly along the ram 41 to enable the ram to then be retracted into the cylinder. It is clear from FIG. 7 that terminating the threads 69 a predetermined spaced distance from the ring 60, which distance is greater than the distance from ring 60 to the end of the cylinder, provides a means to insure that with the nut threaded fully inwardly along the ram, a slight distance, as for example 1/4 of an inch, is left between the ring 60 and sleeve 70 or abutment 75 so that the ram may be hydraulically actuated outwardly through said distance to disengage the nut from the end of the cylinder. The ball valves 103 and 104 are not shown in this figure, inasmuch as they have the same position as in FIG. 5-5'.

In FIG. 8 the double pilot lock valve 90 is shown in the retract position with pressure fluid being admitted through port 113 and past ball valve 103 through ports 100, 24, 22 and 31 into the interior of tube 26 and thence through port 56 into the retract chamber 55 to act against the ring or piston means 47 to urge the ram 41 axially inwardly of the cylinder 11, as indicated by the arrows. At the same time, the piston 110 moves downwardly, with pin 112 unseating ball 104, and the fluid in the extend chamber 68 is exhausted through ports 25 and 101 and past ball 104 to and through port 114. The lock nut 76 is threaded outwardly along the ram 41 away from the cylinder 11 in order to enable the ram to be retracted into the cylinder. The lock nut, when threaded against the end of the cylinder, will prevent accidental retraction of the ram into the cylinder even if the hydraulic system is actuated to retract the ram.

The unique structure of the piston and cylinder assembly of the present invention results in a compact, rugged design, which is durable in operation and which
may be utilized in a variety of applications where prior art devices could not be used, and the unique external safety lock nut arrangement of the present invention enables the device to be used in any desired position and provides a simple, effective means of preventing accidental collapse of the hydraulic cylinder assembly under compressive loading, and the position of the lock nut is readily visually observable.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

1 claim:

1. A double acting piston and cylinder assembly, comprising a cylinder, a piston means reciprocable in the cylinder, an elongate ram connected at one end thereof to the piston means for movement with the piston means and extending at its other end axially outwardly of the cylinder, an abutment means fixed in one end of the cylinder against which the piston means is engageable when in a fully extended position to limit further outward movement of the piston means and ram, said piston means and ram having an extended position with the piston means spaced a slight distance from said abutment means, a cylinder end cap fixed on the other end of the cylinder, a fluid supply and exhaust tube connected at one end thereof to said end cap and extending concentrically within said cylinder to a position adjacent said end one end of the cylinder, said ram being cylindrical and concentrically disposed between said tube and said cylinder, spacer means fixed to said tube at the other end effecting a sliding seal between the tube and the ram, said piston means secured to said ram at said one end thereof and slidably and sealably engaged between said tube and said cylinder whereby extension and retraction chambers are formed within said cylinder, an adjustable safety stop means carried by the ram externally of the cylinder and manually movable along the length of the ram into engagement with an adjacent end of the cylinder to prevent retraction of said ram into said cylinder, and cooperating means on said safety stop means and said ram to limit inward movement of said safety stop means along said ram toward said cylinder, so that when said ram is in its fully extended position, with the piston means engaged with the abutment means, and said safety stop means is moved fully inwardly along said ram as limited by said cooperating means, said safety stop means is spaced from said cylinder, thus preventing jamming of said safety stop means against the end of the cylinder when said piston and ram are fully extended, and thereby enabling said safety stop means to be easily manually moved along said ram away from said cylinder and said ram can then be retracted into said cylinder.

2. A piston and cylinder assembly as in claim 1, wherein said ram is externally threaded over substantially the entire portion of the length thereof projecting beyond said cylinder in the fully extended position of the ram, and said stop means comprises an internally threaded nut threaded on said ram for manual, threaded movement therealong.

3. A piston and cylinder assembly as in claim 2, wherein said cooperating means to limit inward movement of said nut along said ram toward said cylinder comprises an unthreaded portion of the ram at said one end of the ram, at least a part of said unthreaded portion being disposed outwardly of the end of the cylinder in the fully extended position of the ram.

4. A piston and cylinder assembly as in claim 1, wherein the abutment means comprises a cylindrical sleeve fixed in the end of the cylinder with an outer end thereof flush with the end of the cylinder and an inner end within the cylinder, said piston means abutting against said inner end of the sleeve in the fully extended position of the piston means and ram.

5. A piston and cylinder assembly as in claim 4, wherein said ram is externally threaded over substantially the entire portion of the length thereof projecting beyond said cylinder in the fully extended position of the ram, and said stop means comprises an internally threaded nut threaded on said ram for manual threaded improvement therealong.

6. A piston and cylinder assembly as in claim 5, wherein the length of said unthreaded portion of said ram is greater than the length of said sleeve, so that with said piston means abutted against the inner end of the sleeve, the nut is spaced from the end of the cylinder in the fully inwardly moved position of the nut on the ram.

7. A piston and cylinder assembly as in claim 6, wherein said nut is retained on said ram against accidental axial displacement from the end thereof by a snap ring on the end of the ram and against which the nut abuts in its fully outwardly moved position on the ram.

8. A piston and cylinder assembly as in claim 1, wherein said piston means comprises a first annular ring secured within said one end of said cylindrical ram, and a second annular ring secured to the outer surface of said one end of said ram, substantially concentric with said first ring.

9. A piston and cylinder assembly as in claim 8, wherein said cylinder end cap, said tube, said piston means, and the inner surface of the cylinder define a ram extending chamber to which fluid under pressure is admitted to extend the ram, and said tube, said spacer means, said first annular ring, and the inner surface of the ram define a ram retracting chamber to which fluid under pressure is admitted to retract said ram.

10. A piston and cylinder assembly as in claim 1, wherein a radially outwardly extending mounting flange is welded to the outer surface of said cylinder at said one end thereof, said ram is externally threaded over substantially the entire length of the portion thereof projecting out of said cylinder in the fully extended position of the ram, said stop means comprises an internally threaded nut threaded on said ram for manual, threaded movement therealong, and said nut has a larger diameter than the cylinder so that in the event of failure of the mounting flange welds, the nut engages the mounting flange to prevent collapse of the cylinder.

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