

Nov. 15, 1949

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2,487,920

HYDRAULIC RAM

Filed May 25, 1948

2 Sheets-Sheet 1

Fig. 1.

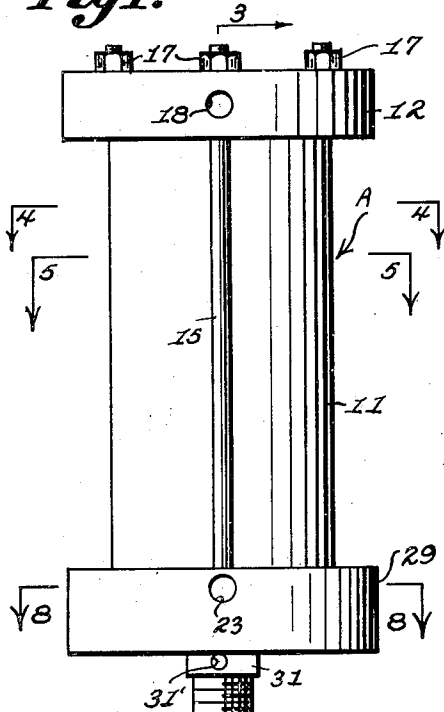


Fig. 2.

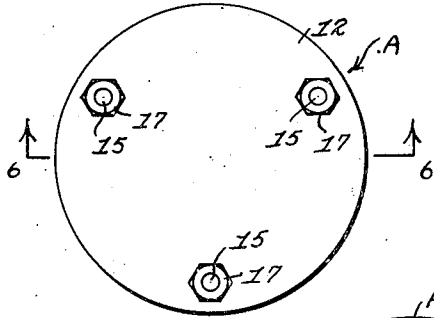


Fig. 4.

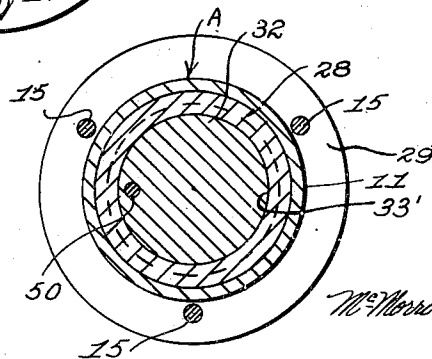


Fig. 3.

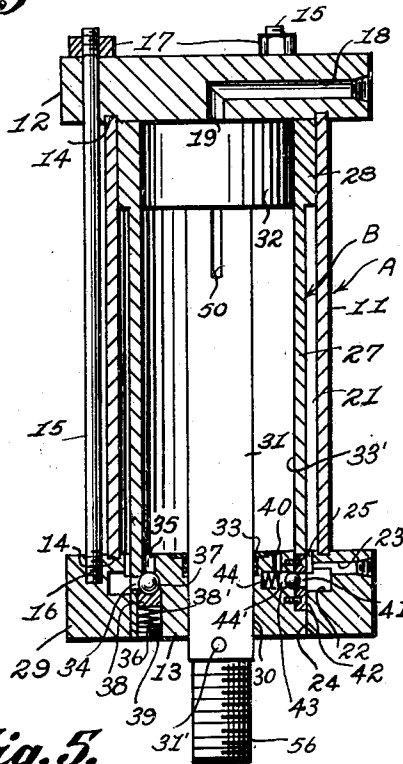
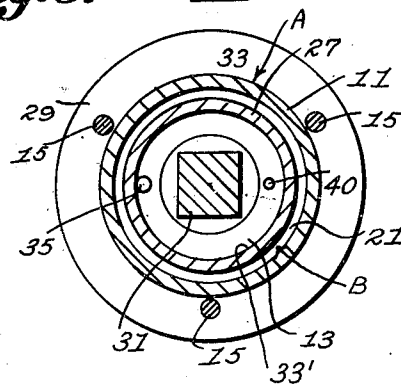


Fig. 5.



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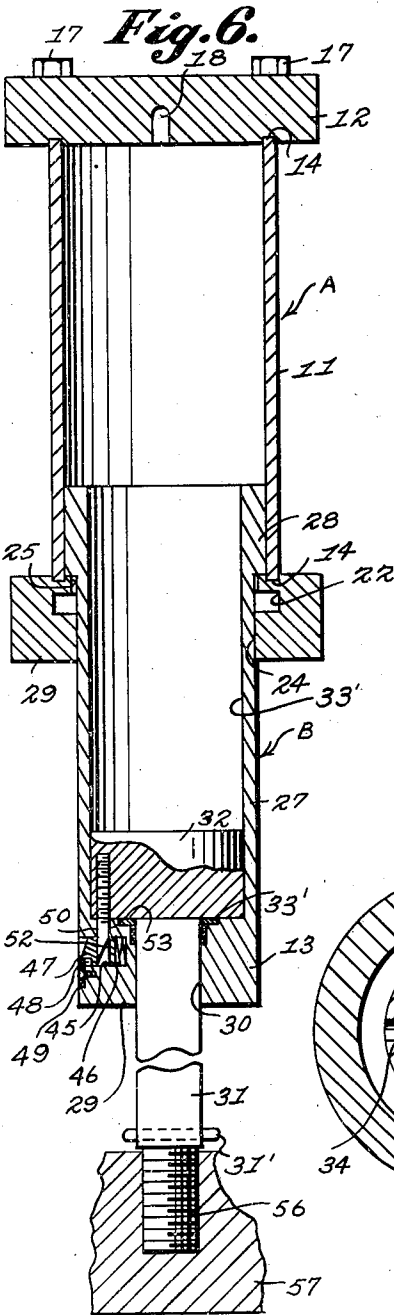
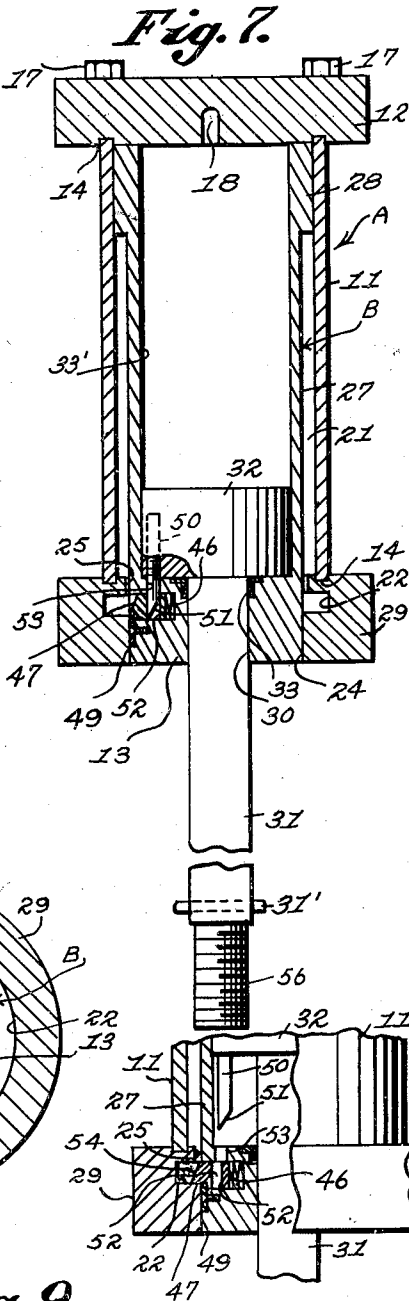
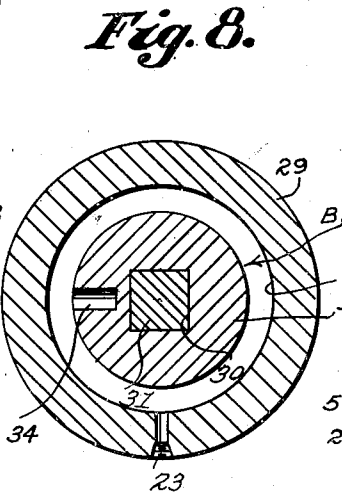


Fig. 9
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2,487,920

HYDRAULIC RAM

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Application May 25, 1948, Serial No. 29,185

4 Claims. (Cl. 121-46)

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This invention relates to improvements in hydraulic cylinders, and more particularly to a novel double-acting hydraulic cylinder of the type having telescopic pistons, the primary object of the invention being to provide a more compact and efficient arrangement of this kind which is of mechanically superior construction, and which can be manufactured in a serviceable and rugged form at relatively low cost, and which is adaptable for hydraulic rams of different kinds or in any machine wherein a comparatively heavy pressure and reciprocating motion are required, along with a relatively long power stroke.

Other important objects and advantageous features of the invention will be apparent from the following description and accompanying drawings, wherein merely for purposes of illustration, a specific embodiment of the invention is set forth in detail.

In the drawings:

Figure 1 is a side elevation of said embodiment with the telescopic piston retracted,

Figure 2 is a top plan view thereof,

Figure 3 is a transverse vertical section taken on line 3-3 of Figure 1,

Figures 4 and 5 are horizontal sections taken on lines 4-4 and 5-5, respectively, of Figure 1,

Figure 6 is a transverse vertical section taken on line 6-6 of Figure 2, showing the telescoped pistons extended,

Figure 7 is a transverse vertical section similar to Figure 6, showing the inner piston of the inner cylinder extended and the inner cylinder retracted,

Figure 8 is a horizontal section taken on the line 8-8 of Figure 1, and

Figure 9 is a vertical sectional detail, showing the latch in projected locking position.

Referring in detail to the drawings, the letter A generally designates the outer cylinder comprising the barrel 11, the upper and lower relatively heavy heads 12 and 29, respectively, the facing sides of the heads being formed with grooves 14, 14 receiving the barrel ends, and the bolts 15 which assemble the heads on the barrel, the lower ends of the bolts being threaded at 16 into the lower head and the upper ends of the bolts extending through the upper head and provided on their upper ends with tightening nuts 17.

The upper head 12 is provided with a fluid passage 18 opening through the edge thereof and terminating at 19 at the center of the head. The lower head 29 is formed, as particularly clearly shown in Figure 8, with an annular chamber or passage 22, which has a reduced radial passage or

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port 23 leading from one side thereof through the edge of the head. The annular passage 22 is in the nature of a groove formed in the sidewall of the axial bore 24 formed in the lower head 29. The upper end of the bore 24 has a slightly enlarged diameter upper portion 25 opening into the annular passage 22, whereby constant communication is provided between the passage 22 and the space existing between the interior of the outer cylinder barrel 11, and the inner tubular piston B, which slides in the bore 24.

The inner piston B comprises a tubular body portion 27 slidably fitting the lower cylinder head bore 24 and a larger diameter head portion 28 at its upper end which slidably engages the bore of the cylinder barrel 11. The lower part of the inner cylinder B includes a solid portion 13 provided with an axial squared bore 30 slidably accommodating the squared shaft on piston rod 31 on whose upper end is fixed a solid, relatively heavy, piston 32 working in the bore 33 of the inner cylinder B. The upper end of the squared bore 30 is enlarged to accommodate shaft packing 33. The shaft 31 has an external cross pin 31' arranged to abut the underside of the solid portion 13 of the inner cylinder to limit upward travel of the piston 32 to a point close to the upper head 12 of outer cylinder A.

The heavy lower portion 13 of the inner cylinder B is formed at the side opposite the port 23 of the lower head 29 of the outer cylinder A, with a reclining T-shaped passage, including the standard portion 34 which registers with the annular passage 22 only in the retracted position of the inner cylinder B, as shown in Figure 3, the branch 35 which opens through the top of the solid portion 13 to communicate with the interior of the tubular inner cylinder B, and the branch 36 which opens through the bottom of the solid portion 13. Communication between the interior of the inner cylinder B and the annular passage 22, through the passage branch 35 and standard portion 34, is normally cut off by a check valve, including a ball 37 urged into blocking relation to the passage portions 35 and 34 by a concaved block 38 pressed against the ball by a spring 38' compressed by a screw plug 39 threaded in the passage branch 36.

The opposite side of the solid portion 13 of the inner cylinder B is formed with an inverted T-shaped passage, including the vertical branch 40 opening through the top of the solid portion 13 and the horizontal branch 41 opening through the side of the portion 13 and adapted to register with the annular passage 22, only in the retracted

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position of the inner cylinder B, as shown in Figure 3. The passage branch 41 is augmented by a valve seat 42 set into the side of the portion 13 for accommodating a ball check 43 pressed thereagainst by a concaved block 44' by a spring 44 in the passage branch 41, thereby cutting off communication between the interior of the inner cylinder B and the annular passage 22 during application of fluid pressure through the port 18 for expanding the device. When for contracting the device fluid pressure is applied through the port 23 the ball check 43 yields to pass fluid under pressure into the interior of cylinder B for driving the piston 32 upwardly therein.

In a position at 90° from these passages, the outer piston solid portion 13 is formed in its side with a radial recess 45 containing an expanding spring 46 behind a latch 47 having a notch 48 in the lower side of its outer end for engaging a retaining plate 49 located thereunder, in the manner shown in Figure 9. The latch is arranged to engage in the annular passage 22, in the retracted position of the inner cylinder B, so as to retain the same in such position until its latch 47 is retracted by descent of the latch pin 50, depending from the solid piston 32, as the solid piston 32 moves downwardly toward the fully extended position shown in Figure 7. The lower end of the latch pin 50 has a cam face 51 arranged to engage the inner side of an opening 52 in the latch, as the latch pin moves downwardly through an access opening 53 in the solid portion 13, in a manner to retract the latch 47 in a radially inward direction, as shown in Figures 6 and 7, wherein the latch 47 is out of engagement with the annular passage 22 so that the inner cylinder B can move downwardly toward the extended position, shown in Figure 6. On upward return movement of the inner cylinder B, engagement of the cam surface 54 on the latch 47 with the underside of the lower head 29, of the outer cylinder A retracts the latch 47 sufficiently to permit the inner cylinder B to pass upwardly freely to its retracted position. However, under ordinary conditions of operation, wherein the inner piston 32 is first fully extended, followed by the inner cylinder B, the inner piston 32 will have the latch pin 50 in continuous engagement with the latch 47 in a manner to hold the latch in retracted position during retracting movement of the inner cylinder B, the main function of the latch arrangement being to prevent the inner cylinder B from moving toward extended position until the inner piston 32 has first been fully extended from the inner cylinder B.

To extend the telescopic piston assembly from the retracted position shown in Figure 3, fluid under pressure is injected through the passage 18 in the upper head 12 of outer cylinder A, whereby the inner piston 32 and its rod or shaft 31, is moved downwardly the required distance. If a greater extension of the piston assembly is wanted than is afforded by extension of the inner piston 32 alone, injection of the fluid is continued until the inner piston 32 reaches bottom position, wherein its latch pin 50 retracts the latch 47. As the inner piston 32 moves downwardly, the space in the inner cylinder B being full of fluid, fluid is forced through the branch 35, 34 of the reclining T-shaped passage in the solid portion 13, into the space 21 existing between the outer cylinder barrel 11 and the inner cylinder barrel 27, the ball check 37 being unseated in the process, and the ball check 43 in the inverted T-shaped passage holding closed,

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and the annular passage 22 being filled with fluid from the reclining T-shaped passage, so that fluid is exhausted through the port 23 in the lower head 29 of the outer cylinder A back to the hydraulic system (not shown).

As the latch 47 is retracted and the inner cylinder B is thereby freed to move out of cylinder A, and injection of fluid under pressure is continued through the port 18 in the upper head 12 of outer cylinder A, the pressure on the inner piston 32 forces the inner cylinder B downwardly the desired distance or to the fully extended position shown in Figure 6, if desired, in which the piston head 28 engages the lower head 29 of the outer cylinder A. In the downward movement of the inner cylinder B the head 28 forces the fluid in the space 21, existing between the cylinders A and B, through the annular opening 25 into the annular passage 22 and then out of the port 23 in the lower head 29 of cylinder A back to the hydraulic system.

To retract the piston assembly, fluid pressure is exerted through the port 23 in the lower head 29 of outer cylinder A, with the port 18 in the upper head 12 of cylinder A acting as exhaust. With the piston assembly in the fully extended position shown in Figures 6 and 7, the fluid under pressure coming through the lower port 23 fills the annular passage 22 and acts upwardly against the underside of piston head 28, thereby filling the space 21 existing between the cylinder barrel 11 and the outer cylinder body 27. This causes the inner cylinder B to rise and to continue rising in the outer cylinder A until the piston head 28 engages the upper head 12 of outer cylinder A, and the latch 47 re-engages in the annular passage 22, as shown in Figure 7.

The space 21 existing between the cylinder barrels 11 and 27 then being filled with fluid, as well as the annular passage 22, further injection of fluid under pressure through the lower port 23 exerts pressure against the bottom of the inner piston 32 through the branch 40 of the inverted T-shaped passage, thereby causing the inner piston 32 to rise in the inner cylinder B until the piston 32 approaches the upper head 12 of outer cylinder A and is stopped close thereto by engagement of the shaft cross pin 31' with the underside of the solid lower portion 13 of the inner cylinder B. In all of the upward or retracting movement of the inner cylinder B and the inner piston 32 the fluid displaced thereby is exhausted through the upper port 18 in the upper head 12 of the outer cylinder A.

In an application of the above described device, the plate 12 may be attached to or abutted against a stationary part of a mechanism, and, as shown in Figure 6, the threaded end 56 of the piston rod 30 may be threaded into a movable part 57 of the mechanism whereby the device is connected to reciprocate or merely to spread the parts relative to each other.

What I claim:

1. A hydraulic cylinder comprising a cylinder barrel having upper and lower cylinder heads, an outer piston comprising a tubular body smaller in diameter than said barrel and concentrically spaced therefrom, an enlarged tubular head on the upper end of said tubular body working in said barrel, and a solid portion on and closing the lower end of said tubular body, an inner piston working in said tubular body and tubular head having a shaft working through an accommodating opening formed in said solid portion of said outer cylinder, said upper cylinder head being

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formed with a fluid port opening into the upper end of said tubular body, said lower cylinder head being formed with a fluid port arranged to have communication with the space between said tubular body of said outer piston and said cylinder barrel below said outer piston head and with the space within said tubular body between said solid portion of said outer piston and said inner piston, said upper and lower ports being arranged to alternate as fluid injection and fluid exhaust ports, with said upper port acting as injection port and said lower port as exhaust port while said outer and inner pistons are in their elevated retracted positions, for driving said pistons downwardly toward their extended positions, and said lower port acting as injection port and said upper port as exhaust port for driving said pistons upwardly from downwardly extended positions toward retracted positions, normally engaged latch means operating between said outer piston and said lower cylinder head for locking said outer cylinder in its retracted position while said inner piston is in a retracted position and until said inner piston is moved to its extended position from a retracted position, and latch operating means on said inner piston for releasing said latch means as said inner piston reaches its extended position.

2. A hydraulic cylinder comprising a cylinder barrel having upper and lower cylinder heads, an outer piston comprising a tubular body smaller in diameter than said barrel and concentrically spaced therefrom, an enlarged tubular head on the upper end of said tubular body working in said barrel, and a solid portion on and closing the lower end of said tubular body, an inner piston working in said tubular body and tubular head having a shaft working through an accommodating opening formed in said solid portion of said outer cylinder, said upper cylinder head being formed with a fluid port opening into the upper end of said tubular body, said lower cylinder head being formed with a fluid port arranged to have communication with the space between said tubular body of said outer piston and said cylinder barrel below said outer piston head and with the space within said tubular body between said solid portion of said outer piston and said inner piston, said upper and lower ports being arranged to alternate as fluid injection and fluid exhaust ports, with said upper port acting as injection port and said lower port as exhaust port while said outer and inner pistons are in their elevated retracted positions, for driving said pistons downwardly toward their extended positions, and said lower port acting as injection port and said upper port as exhaust port for driving said pistons upwardly from downwardly extended positions toward retracted positions, a chamber formed in said lower piston head communicating with said lower port and having restricted communication with the space between said cylinder barrel and said tubular body of said outer piston below the head, first and second passage means formed in said solid portion extending between said chamber and the interior of said tubular body of said outer piston, and first and second check valves in said first and second passage means, respectively, said first check valve being arranged to be closed while said second check valve is open and said second check valve open while said first check valve is closed depending upon said pistons being in retracted or extended positions and fluid being injected through said upper port or said lower port, said first and second passage means having communi-

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cation with said chamber only while said outer piston is in its fully retracted position.

3. A hydraulic cylinder comprising a cylinder barrel having upper and lower cylinder heads, an outer piston comprising a tubular body smaller in diameter than said barrel and concentrically spaced therefrom, an enlarged tubular head on the upper end of said tubular body working in said barrel, and a solid portion on and closing the lower end of said tubular body, an inner piston working in said tubular body and tubular head having a shaft working through an accommodating opening formed in said solid portion of said outer cylinder, said upper cylinder head being formed with a fluid port opening into the upper end of said tubular body, said lower cylinder head being formed with a fluid port arranged to have communication with the space between said tubular body of said outer piston and said cylinder barrel below said outer piston head and with the space within said tubular body between said solid portion of said outer piston and said inner piston, said upper and lower ports being arranged to alternate as fluid injection and fluid exhaust ports, with said upper port acting as injection port and said lower port as exhaust port while said outer and inner pistons are in their elevated retracted positions, for driving said pistons downwardly toward their extended positions, and said lower port acting as injection port and said upper port as exhaust port for driving said pistons upwardly from downwardly extended positions toward retracted positions, a chamber formed in said lower piston head communicating with said lower port and having restricted communication with the space between said cylinder barrel and said tubular body of said outer piston below the head, first and second passage means formed in said solid portion extending between said chamber and the interior of said tubular body of said outer piston, and first and second check valves in said first and second passage means, respectively, said first check valve being arranged to be closed while said second check valve is open and said second check valve open while said first check valve is closed depending upon said pistons being in retracted or extended positions and fluid being injected through said upper port or said lower port, said first and second passage means having communication with said chamber only while said outer piston is in its fully retracted position, normally engaged latch means operating between said outer piston and said lower cylinder head for locking said outer cylinder in its fully retracted position while said inner piston is in a retracted position, and latch operating means on said inner piston for releasing said latch means as said inner piston is moved into its fully extended position, so as to free said outer piston for movement toward the extended position.

4. A hydraulic cylinder comprising a closed cylinder barrel having ports opening through its upper and lower ends, a telescopic piston assembly within said barrel comprising a tubular outer piston and a solid inner piston, said outer piston comprising a head working in the bore of said barrel and a depending body concentrically spaced from the sidewalls of said barrel, and closure means closing the lower end of said tubular body portion, said inner piston comprising a piston body working in the bore of said tubular body and head of said outer piston and having a piston rod working through an accommodating opening formed in said closure means,

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said upper port opening into the upper end of the bore of said tubular outer piston above said solid inner piston whereby injection of fluid under pressure through said upper port can drive said inner piston downwardly from an upwardly retracted position to reach its fully downwardly extended position wherein said inner piston engages said closure means of said outer piston in a manner to force said outer piston downwardly from its fully retracted position to its fully extended position, the lower end of said barrel being formed with a chamber communicating with said lower port and with the space between said barrel and said tubular body of said outer piston below its head, whereby fluid under pressure injected through said lower port with said upper port acting as an exhaust portion can force said fluid to move said outer piston upwardly from its fully extended position to its fully retracted position, and valved passage means in said closure means on the lower end of said outer piston arranged to have communication with said chamber in the lower cylinder head only while said outer piston is in its fully retracted position, said valved passage means being arranged to transfer fluid under pressure from said chamber to the interior of said tubular outer piston beneath said solid inner piston while said outer

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piston is in its fully retracted position, so as to move said solid inner piston upwardly from an extended position to a retracted position while fluid under pressure is being injected through said lower port, and normally engaged latch means operating between said outer piston and said lower end of said barrel for positively locking said outer piston in its retracted position as said outer piston resumes its retracted position, and latch operating means on said solid inner piston for releasing said latch means to free said outer piston for movement toward an extended position as said inner piston is moved downwardly into its fully extended position by injection of fluid under pressure through said upper port.

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