Sept. 18, 1951 H. D. FORSE 2,568,228

TWO STAGE FLUID PRESSURE CYLINDER

Filed Oct. 31, 1947 2 Sheets-Sheet 1

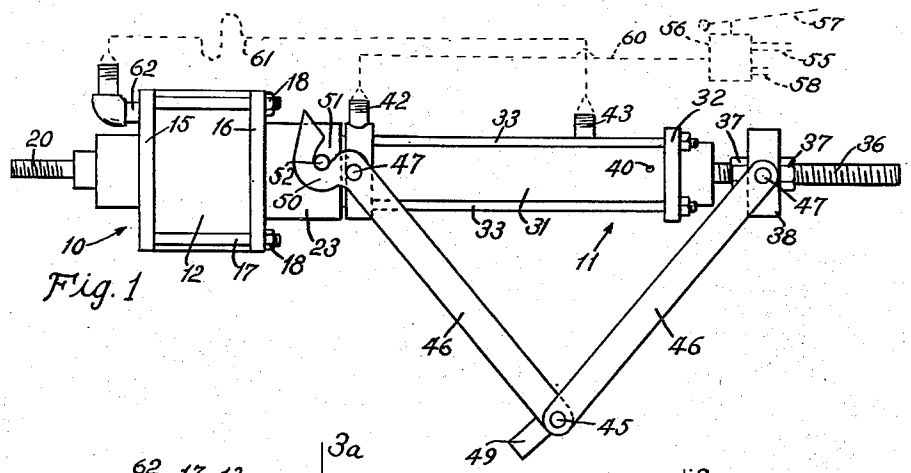


Fig. 1

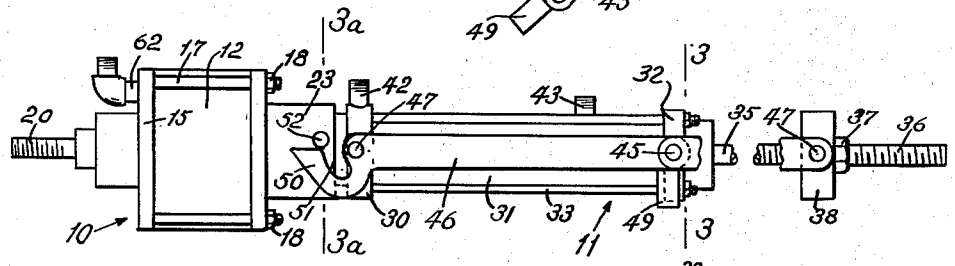


Fig. 2

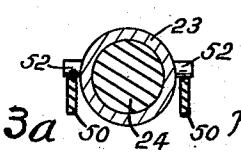


Fig. 3a

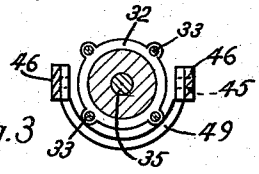


Fig. 3

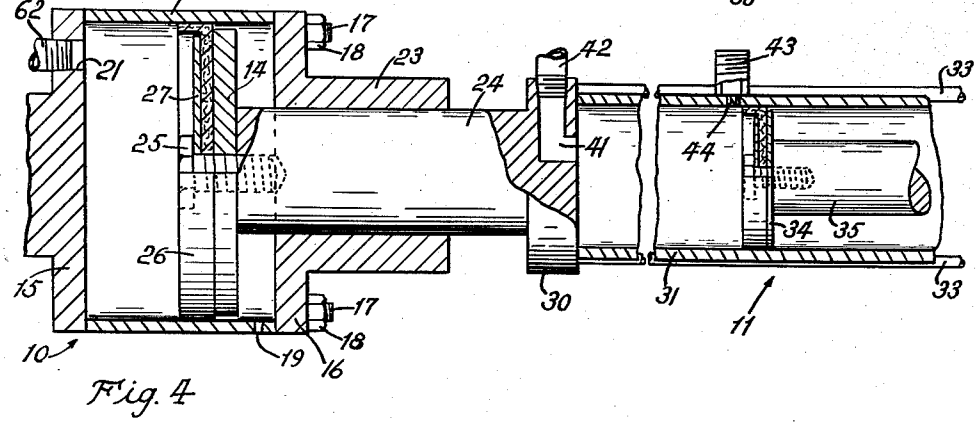


Fig. 4

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TWO STAGE FLUID PRESSURE CYLINDER

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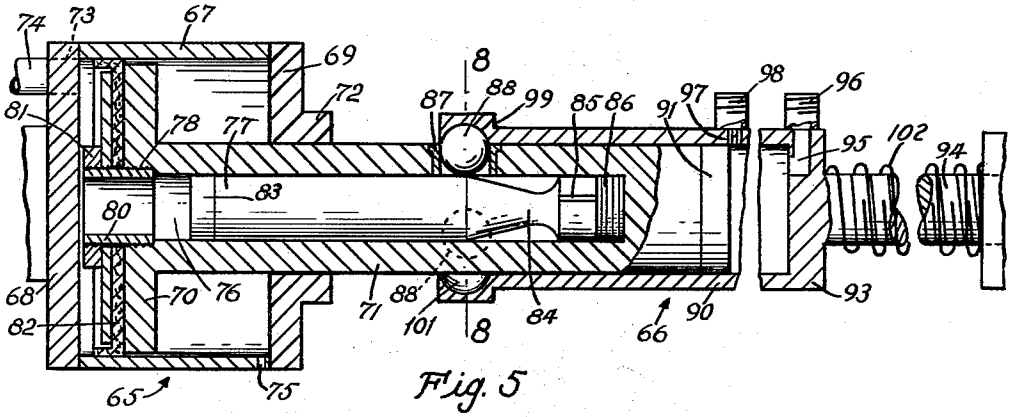



Fig. 5

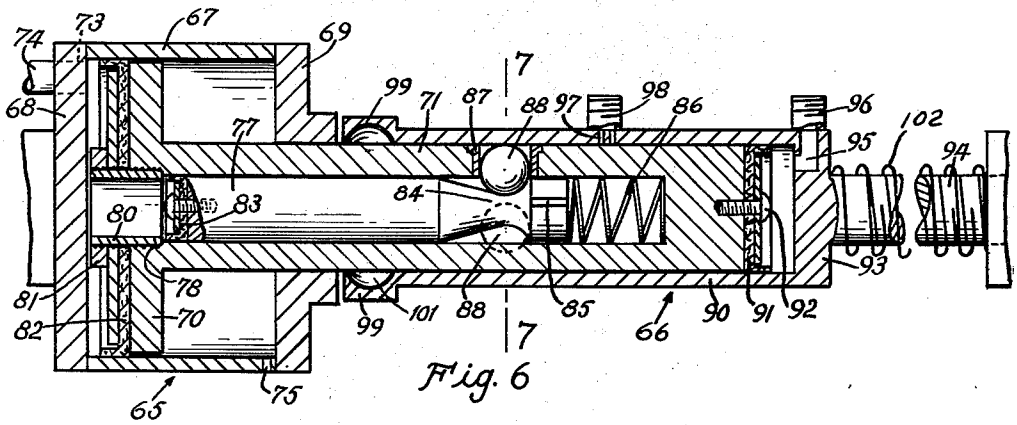



Fig. 6

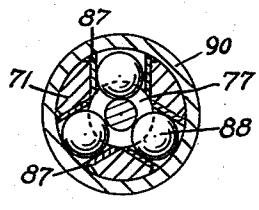



Fig. 7

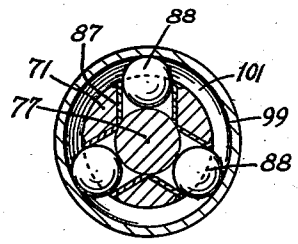



Fig. 8

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## TWO STAGE FLUID PRESSURE CYLINDER

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Application October 31, 1947, Serial No. 783,321

1 Claim. (Cl. 60—97)

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This invention relates to improvements in power transmitting apparatus and more especially to such apparatus for delivering a power stroke of limited force during the initial and intermediate portions of the stroke and of increased force thereafter.

The improved apparatus of this invention is especially adapted for use in operating laundry and garment finishing presses and other equipment wherein a two step operation or power stroke is both advantageous and desirable. In such an arrangement, the pressing head is moved from an open position into pressing position, wherein the pressing elements are in predetermined spaced relation, under the influence of a limited pressure and then to apply increased pressure to the head. It is to be noted that both safety and economy factors as hereinafter more fully explained, are involved in the use of the limited initial moving force. Only after the head has been moved into its predetermined pressing position is operating pressure delivered to the apparatus for the pressing operation. While the present disclosure associates the improved apparatus with a garment press, it will be apparent that its use is not confined to such a limited field.

Several varieties of power transmitting apparatus have from time to time appeared on the open market. These, however, have not met with complete public approval due to their high initial cost, excessive maintenance required for the numerous intricate parts, high operating costs, and their erratic and undependable operation. Moreover some of these prior structures included numerous close fitting parts requiring costly close tolerance machine work in production and frequent and delicate adjustment in operation.

Accordingly it is one of the chief objects of the present invention to provide a sturdy and rugged device consisting of but relatively few economically produced and easily assembled parts which in operation function accurately and precisely over long periods of hard use with little, if any, attention or maintenance care.

Another object of advantage and importance of the improved apparatus is the provision of means for arranging two pressure responsive units in tandem for independent sequential operation in delivering a single power stroke.

A further object of importance and advantage resides in the provision of means for energizing the second actuated unit to impart an increased pressure only after the first operated unit has completed its lighter pressure delivering operation. This constitutes a safety factor for preventing injury to an operator.

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Another and still further object of importance and advantage is the provision of control means for operating the tandem arranged pressure responsive units in a given sequence during the power stroke and of reversing the sequence of operation for the return movement of the units.

Still another object of advantage and importance is the provision of means for locking the first operated unit against further independent operable movement when the initial step is completed.

An additional object of importance resides in the provision of means for utilizing detent means operated by the energization of the second unit for preventing inadvertent unlocking of the locking means during the operable movement of the second operated unit.

Additional objects of advantage and importance will become apparent as the following detailed description progresses, reference being had to the accompanying drawings, wherein

Figure 1 is a side elevational view of a power transmitting apparatus which embodies the invention. Control elements for operating the apparatus are diagrammatically shown.

Figure 2 is a similar view of the apparatus in a different operating position, parts thereof being broken away.

Figures 3 and 3*a* are vertical sections taken on lines 3—3 and 3*a*—3*a*, respectively, of Figure 2.

Figure 4 is a slightly enlarged longitudinal section of a fragmental portion of the apparatus. The larger unit is shown in partly extended position and the smaller unit, parts of which are broken away, is shown in fully extended position.

Figure 5 is a longitudinal section of a slightly modified form of the invention, parts thereof being broken away.

Figure 6 is a similar view showing the apparatus in a different operating position.

Figure 7 is a vertical section taken on line 7—7 of Figure 6, and

Figure 8 is a vertical section taken on line 8—8 of Figure 5.

In the embodiment of this invention illustrated in Figures 1 to 4, inclusive, of the drawings, the reference numeral 10 indicates generally a pressure responsive unit comprising a cylinder 12 in which a piston 14 is operably positioned. The cylinder is provided with heads 15 and 16 which are preferably secured in position by bolts 17 and 18 and is vented as at 19. The head 15 is pro-

vided with an anchor stud 20, or other securing means, for attaching the apparatus to a suitable base, not shown. The head 15 is apertured to provide a port 21 for the passage of operating fluid to and from the cylinder 12. Extending from the head 16 and concentric therewith is a boss 23 through which a piston rod 24 extends. One end of the piston rod 24 is attached to the piston 14, as by a screw 25 or the like. The screw 25 also functions to maintain an expansible cup 26 and washer 27 in operable association with the piston 14, as is best shown in Figure 4.

The extending end of the piston rod 24 is enlarged to provide a head 30 for a cylinder 31 positioned in axial alignment with the piston rod 24. An apertured head 32 is positioned on the extending end of the cylinder 31 and the unit, indicated in its entirety by the reference numeral 11, is secured in operable position by a plurality of tie bolts 33. Thus pressure responsive unit 10 and pressure responsive unit 11 are operably secured to each other.

Operably positioned within the cylinder 31 is a piston 34 to which a piston rod 35 is attached. The rod 35 extends through the aperture in the head 32 and the extremity thereof is threaded, as at 36, to receive adjustment nuts 37 for a yoke 38. The aperture in the head 32 functions as a guide for the piston rod 35 and this aperture may be of sufficient size or shape to vent the cylinder 31. In addition thereto a vent port 40 is located in the cylinder 31 closely adjacent the head 32.

The head 30 is provided with a port 41, in which a nipple 42 may be secured, through which operating pressure is directed to and from the cylinder 31. Secured to the cylinder 31 intermediate the ends thereof is a nipple 43 which through a plurality of small perforations 44 in the cylinder wall communicates with the interior thereof, see Figure 4. These perforations 44 in conjunction with the piston 34 provide a control valve for the unit 10 as hereinafter more fully disclosed.

A double toggle element comprising a pair of hingedly joined bars 46 having their free ends operably joined to studs 47 projecting radially from the head 30 and yoke 38, is adapted to be moved to and from straight line position upon extending and retracting movement of the piston rod 35. The hinge is indicated by the reference numeral 45. In view of the fact that the hinged toggle bars 46 and their supporting studs 47 are precisely the same only one set is shown in Figures 1 and 2 of the drawings. Secured to the central portion of the toggle 46 closely adjacent the hinge 45 is a curved combination spacing and abutment member 49. Upon movement of the toggle 46 into straight line position, the member 49 engages the lower portion of the head 32 and thereby limits the upward movement of that member.

Extending beyond the end portion of the toggle 46 is an arm 50 which is recessed as at 51 to receive a stud 52 projecting from the boss 23 when the toggle 46 is in the position in which it is shown in Figure 1. The upper portion of the arm 50 extending beyond the recess 51 is flat, as is clearly shown in the drawings, to engage and be moved along the lower peripheral surface of the stud 52 when the toggle 46 is in straight line position and is moved longitudinally relative to the studs 52. The studs 52 in cooperation with the flat surfaces of the arms 50 provide a detent means for maintaining the toggle 46 in straight line position. Thus the toggle provides a means for locking the piston 34 and piston rod 35 in a predetermined position, as for the application of increased pressure by the unit 10, and the detent means prevents the locking means from being inadvertently released.

A pressure circuit for operating the improved apparatus is shown in dotted lines in Figure 1 and comprises a supply line 55 in which is positioned a three way valve 56 for the manual operation of which a suitable handle 57 is provided. The valve 56 is normally biased to closed position so that the interiors of both cylinders 12 and 31 are in communication with atmosphere through an exhaust line 58. A flexible conduit 60 extends from the three way valve 56 to the nipple 42 and is adapted to convey operating pressure to and from the apparatus. A second flexible conduit 61 extends from the nipple 43 on cylinder 31 to a nipple 62 in communication with the port 21 in cylinder 12. This conduit 61 directs operating fluid to and from the pressure responsive unit 10 as will hereinafter more fully appear.

*Operation*

In the operation of the improved apparatus of this invention it will be assumed that the anchor stud 20 is suitably anchored and that the threaded end 36 of the piston rod 35 is operably connected to the load to be moved. Now with operating pressure available in the supply line, the handle 57 is depressed to open the valve 56. As a result of this action the exhaust 58 is closed and operating pressure is delivered through conduit 60 and port 41 into the left end of the cylinder 31. Responsive to this flow of operating pressure the piston 34, piston rod 35 and yoke 38 carried thereby are moved longitudinally to the right as viewed in the drawings. This movement of the piston rod 35 and associated parts straightens the toggle element 46 so that the piston 34 and piston rod 35 are rigidly secured against movement relative to the cylinder 31. It is to be noted that when the apparatus is in this position the combination abutment and spacing member 49 is bearing against the under surface of the head 32 and the arm 50 engages the stud 52. During this portion of the operation the load, as for instance a pressing head, is moved from an open position into spaced association with its complementary pressing buck under a relatively light force. However, if some object of greater thickness than the predetermined space between the confronting pressure elements, as for instance an operator's hand, is interposed between the buck and the descending head the relatively light operating force is incapable of moving the apparatus into its locked up position.

As the apparatus moves into its locked up position the movement of the piston 34 uncovers the plurality of perforations 44 through the cylinder wall to supply operating pressure to the pressure responsive unit 10. This operating pressure flows through the nipple 43, conduit 61, nipple 62, port 21 and into the left end of the cylinder 12. As the operating pressure builds up in back of the large piston 14, an increased force is applied to the locked piston rod 35 through the piston rod 24, head 30, toggle element 46 and yoke 38. Thus a pressing force of increased intensity is applied to the pressing elements or other load. Concurrently with the application of this pressing force and the movement of the unit 11 the flat surface of the arm 50 is moved into engagement with the stud 52 to thereby lock the toggle element 46 in straight line position.

Now when the pressing operation is completed, the three way valve 56 is moved to its exhausting

position thereby cutting the supply of operating pressure to the cylinders 12 and 31. As the pressure in the cylinders 12 and 31 is exhausted they are moved to the left under the influence of biasing means, not shown, until the flat surface of the arms 50 clear the studs 52 whereupon the toggle element 46 buckles downward by its own weight and the piston assembly of the unit 11 returns to its starting position. It is to be here noted that the above movement prevents further exhausting of the large cylinder 12 through the three way valve 56. Thus residual pressure in the large cylinder is utilized to cushion the return movement of the parts and is then slowly bled from the large cylinder through the perforations 44 and vent port 40 as the large piston assumes its starting position.

*Modification*

Where it is so desired the improved apparatus of this invention may be modified to eliminate the toggle element by substituting suitable locking means therefor. An illustrative embodiment of such a modification is shown in Figures 5 to 8 inclusive.

In this embodiment a large pressure responsive unit 65 is associated in tandem with a small pressure responsive unit 66 for operation with a pressure circuit similar to the one shown in Figure 1.

The large unit 65 comprises a cylinder 67 with suitable heads 68 and 69 and a piston 70 which carries a piston rod 71. The head 69 is apertured and provided with a boss 72 which functions as a guide for the piston rod 71 projecting therethrough, as is clearly shown in Figures 5 and 6. The unit 65 is provided with an operating pressure port 73 in which a nipple 74 may be positioned and a vent port 75.

Formed in the center of the piston rod 71 and extending longitudinally thereof is a bore 76 in which a plunger 77 is operably positioned. One end of the bore 76 is preferably threaded, as at 78, to receive a threaded nipple 80 which, in conjunction with a nut 81, properly secures a suitable expansion cup 82 to the piston 70. The end of the plunger 77 adjacent the nipple 78 is also provided with an expansion cup 83 of leather or other like material. An intermediate portion of the plunger 77 is restricted to form a conical portion 84 and the head thereof is provided with a vent recess 85. A helical spring 86 interposed between the leading end of the plunger 77 and the bottom of the bore 76 functions to bias the plunger toward the left as viewed in the drawings.

Formed in the plunger 77 intermediate the ends thereof is a plurality of radially disposed apertures in which hardened bushings 87 are positioned. The bushings 87 are in alignment with the restricted portion 84 of the plunger 77 when that member is in its normal position as shown in Figures 6 and 7. Each bushing 87 carries a hardened ball 88 which upon operable movement of the plunger 77 moves between retracted and extended position, see Figures 5, 6, 7 and 8.

The pressure responsive unit 66 comprises an open end cylinder 90 operably positioned on the protruding portion of the piston rod 71. The interior wall of the cylinder 90 is preferably not in air tight association with the peripheral surface of the piston rod 71 so that residual pressure may escape from the large cylinder 67 when the device returns to normal position. The extreme end of the piston rod 71 carries an expansion cup 91 which may be secured in position by a screw 92 or other suitable attaching means. The closed end 93 of the cylinder 90 carries a threaded attaching stud 94 to which a load 102 to be moved may be adjustably connected. This load may be a weight to be lifted or a spring to be opposed and causes biasing of the unit to the left when pressure therein is released. The closed end 93 is provided with an operating pressure port 95 in operable association with a threaded nipple 96.

Formed intermediate the ends of the cylinder 90 and penetrating the wall thereof is a plurality of small apertures 97 which connect with an outwardly extending threaded nipple 98. The apertures 97 are disposed to operate in conjunction with the cup 91 to provide a control means for controlling the flow of operating pressure to and from the pressure responsive unit 65 in the manner previously explained in regard to the embodiment shown in Figures 1 to 4, inclusive.

The open end of the cylinder 90 is provided with an enlarged portion 99 to add rigidity and strength to the member and also to permit the interior wall of the cylinder to be recessed to form a ball race 101. It is to be noted that the ball race 101 in conjunction with the balls 88 function, upon operation of the unit 66 and plunger 77 to the position shown in Figure 5, to lock the cylinder 90 against movement in either direction.

*Operation of modified embodiment*

The operation of the modified embodiment above described is in effect similar to the operation of the first described apparatus. In other words, the small pressure responsive unit 66 is operated to a predetermined position where it is locked against return movement and then the large pressure responsive unit 65 is operated to thereby deliver an increased working pressure or force through the locked up unit 66.

It is to be noted that the nipples 74, 96 and 98 are in substantially the same locations as their counterparts on the first described embodiment. Consequently, the pressure circuit there shown may be employed without alteration for operating either embodiment. Assume now that the conduit 60 is connected to the nipple 96 and that the conduit 61 connects nipple 98 with nipple 74. Under such a condition and with the apparatus in normal position, as shown in Figure 6, operation of the valve 56 to open position closes the exahust 58 and directs a flow of operating pressure through the port 95 and into the right end of the cylinder 90. In response to the introduction of operating pressure into the cylinder 90 the cup 91 is expanded into air tight relation with the inner wall of the cylinder 90 and that member is moved from the position in which it is shown in Figure 6 toward the right. Upon the arrival of the cylinder 90 at a predetermined destination, as shown in Figure 5, the ports 97 are uncovered as also are the ball containing bushings 87. Coincidently with the uncovering of the ports 97 operating pressure is directed through the conduit 61, nipple 74, port 73 and into the left end of cylinder 67 and thence through the nipple 80 and into the bore 76. This pressure moves the plunger 77 to the right, overpowering the biasing spring 86 and by engagement with the inclined surface of the conical portion 84 forces the balls 88 into the ball race 101 thereby locking the cylinder 90 in its extended position. The continued

flow of operating pressure into the cylinder 67 now functions to drive the piston 70 toward the right which movement carries the locked unit 66 in a like direction thereby imposing increased force on the load connected to the stud 94.

When the unit has been under the increased pressure for a sufficient length of time the operating handle 57 is elevated to operate the valve 56 to thereby terminate the supply of operating pressure and to open the exhaust 58. The flow of operating pressure is now reversed, that is from the cylinder 67, through the port 73, nipple 74, conduit 61, nipple 98, ports 97 and into the cylinder 90 from whence it passes through the port 95, nipple 96, conduit 60, valve 56 to be discharged through the exhaust 58. As this discharging operation takes place the piston 70 together with the piston rod 71 and unit 66 locked thereto are moved toward the left in unison due to the biasing action of the load 102. As the pressure within the cylinder 67 and bore 76 is exhausted, the biasing spring 86 forces the plunger 77 to the left and as the conical portion 84 of the plunger 77 moves into alignment with the balls 88 pressure exerted thereon by the segmental surface of the ball race 101 under the urge of the returning cylinder 90 moves the balls 88 radially inwardly to the position in which they are shown in Figure 6. The parts are thus returned to their starting positions and any residual pressure in the cylinder 67 is bled off through the ports 97 and the space between the wall of cylinder 90 and the piston rod 71 and the now contracted cup 91.

It will be apparent from the foregoing that herein is provided a highly efficient and sturdy device with which a two step or stage power stroke may be delivered. Moreover the apparatus contains a safety feature wherein the automatically controlled second stage of increased pressure cannot be started until the limited pressure initial stage portion of the power stroke has been completed and locked.

As it will be apparent to those skilled in the art to which the improved apparatus appertains that numerous changes and widely different designs may be made without departing from the spirit and scope of the invention, it is intended that the embodiments herein disclosed shall be interpreted as illustrative only and not in a limiting sense. Reference is therefore to be had to the appended claim for a definition of the limits of the invention.



I claim:

Fluid driving mechanism, comprising a cylinder of large diameter adapted for mounting in a device to be fluid driven, a piston movable in this cylinder, a hollow piston rod attached thereto also serving as the piston for a smaller diameter movable cylinder, the closed end of which is also provided with means for attaching to said device to be fluid driven, a spring restrained piston movable in said hollow piston rod, means whereby said hollow piston rod may be lockerd immovably to said smaller movable cylinder after said smaller cylinder reaches a predetermined position, control means for supplying fluid to said smaller cylinder and further control means for bypassing said fluid to said larger cylinder after said predetermined position has been reached by said smaller cylinder, means normally tending to bias the movable elements of the device to a starting position and means for exhausting all fluid from said device to permit said movable elements to return to said starting position under the urging of said biasing means.

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