

Sept. 7, 1943.

H. C. GOLLMER

2,329,044

DUAL CYLINDER

Filed Aug. 13, 1941

2 Sheets-Sheet 1

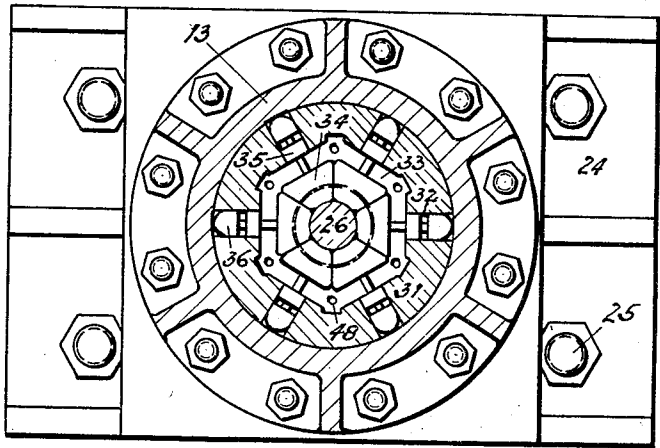


Fig. 3.

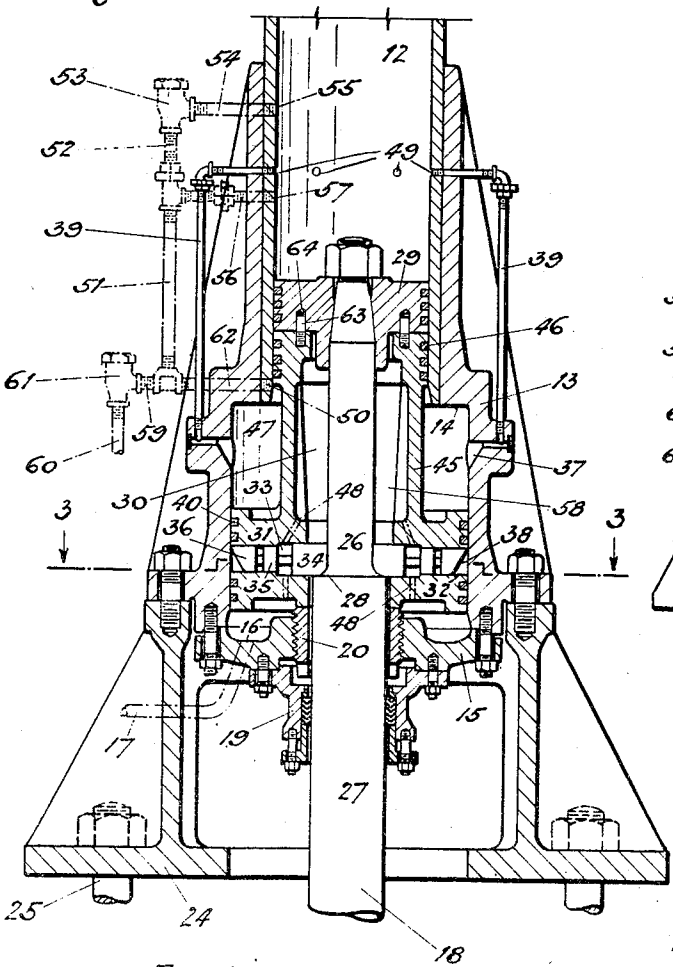


Fig. 2.

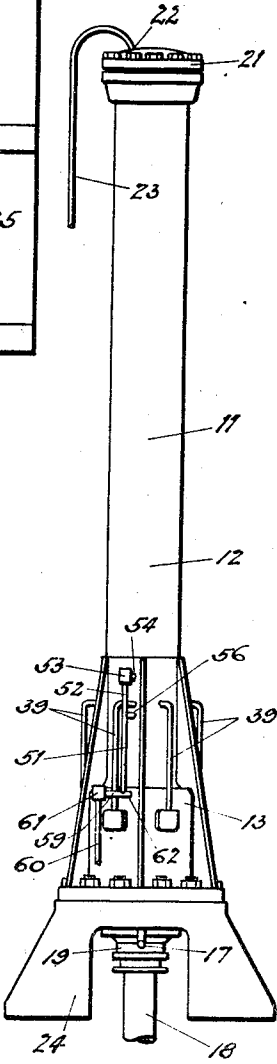


Fig. 1.

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2 Sheets-Sheet 2

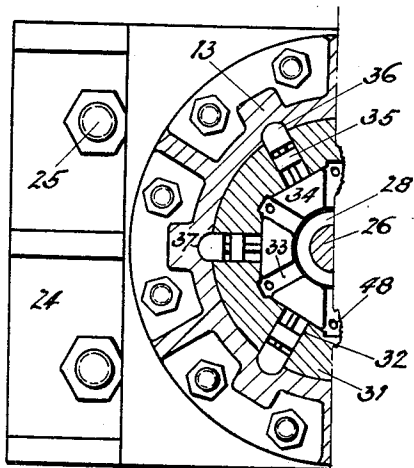


Fig. 5.

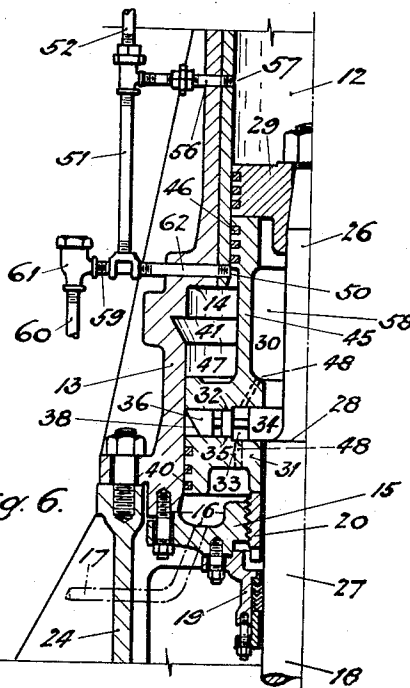


Fig. 6.

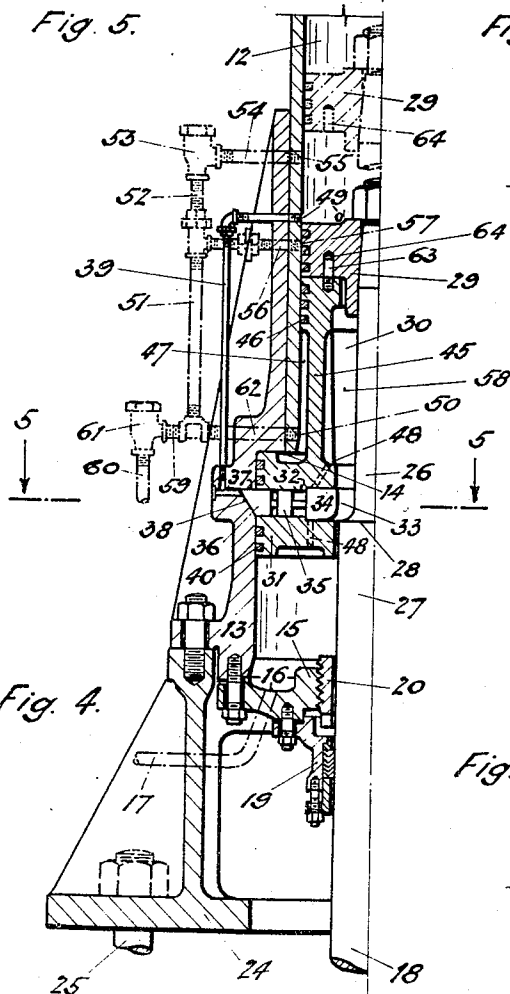


Fig. 4.

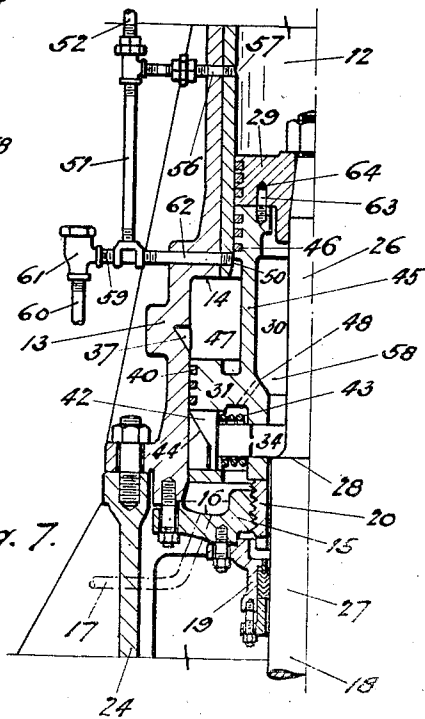


Fig. 7.

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UNITED STATES PATENT OFFICE

2,329,044

DUAL CYLINDER

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Application August 13, 1941, Serial No. 406,659

14 Claims. (Cl. 60—97)

This invention relates to a piston rod actuating mechanism designed to provide an additional force on the piston rod during a part of the movement of the rod at the beginning of the forward and at the end of the return stroke. Such a mechanism is especially useful for operating devices such as valves, sluice gates, presses, mechanisms for effecting opening and closing movement, reciprocating drive mechanisms and the like, where larger forces are required at the beginning of the forward and at the end of the return stroke, whereas, during the remaining part of the strokes, a smaller force is sufficient to operate the device.

If a device of customary design is used in cases just mentioned, piston, cylinder and the associated elements for supplying and controlling the pressure fluid must necessarily be designed for the larger force. This means that the cylinder structure and the associated supplying and control means are not economically made use of during the remaining part of the cycle of operation.

It is a broad object of the invention to attain an economic operation with actuating devices of the type described by providing means capable of producing an additional force at the beginning of the forward and at the end of the return stroke of a reciprocating mechanism.

It is a specific object of the present invention to improve a device comprising a small working piston cooperating with a relatively movable piston of larger diameter by providing means whereby the larger piston is acting at the beginning of the forward and the end of the return stroke.

In a broad aspect of the invention I contemplate a device operating on fluid pressure and comprising two pistons of different diameter, movable in fluid-tight cylinder portions of corresponding diameters, the piston of smaller diameter being secured to a piston rod with the piston of larger diameter in relatively sliding engagement thereto, fluid pressure conducting and controlling means to expose the faces of both pistons to the pressure fluid in a predetermined order, and means providing operative engagement of the larger piston with the piston rod during a part of the forward and of the return stroke of the smaller piston.

By my invention, I am enabled economically to produce larger acting forces at the beginning of the forward and at the end of the return stroke by using a device generally designed for smaller acting forces and, therefore, making more economic use of the fluid pressure medium.

For the purpose of illustrating the invention, reference will now be had to the accompanying drawings showing an exemplary physical embodiment of the invention:

Fig. 1 is an elevation of the device showing the relative longitudinal proportion of the two portions of a cylinder intended for a specific purpose, for instance the operation of presses;

Fig. 2 is a sectional view along the longitudinal axis of the cylinder and showing in enlarged scale the lower portion of the devices shown in Fig. 1;

Fig. 3 is a cross-section through the larger piston in Fig. 2 along the lines 3—3;

Fig. 4 is a sectional view similar to that of Fig. 2, but showing only the left portion of the device. It pictures the larger piston in its upper position and the smaller piston just prior to disengaging itself from the larger piston (full lines), and furthermore the smaller piston some time after disengaging itself from the larger piston (dash-dotted lines);

Fig. 5 is a sectional view transversely through the larger piston along the lines 5—5 of Fig. 4;

Fig. 6 is a sectional view similar to that of Fig. 4 but indicating the pistons in their lowest position and showing a modified larger piston; and

Fig. 7 is a sectional view similar to that of Fig. 6, showing another modification.

According to Fig. 1, the cylinder structure 11 comprises a long portion 12 of relatively smaller diameter and a short portion 13 of larger diameter. Where both cylinder portions merge, a shoulder 14, Fig. 2 is formed. The combined cylinder structure is closed at its lower end by a cover 15 having an opening 16 connected with a directional control valve (not shown) of suitable design as known in the art, through a fluid conducting pipe line 17. The portion of the cover 15 through which the piston rod 18 extends is sealed by a stuffing box 19. An adjustable shoulder ring 20 is provided which is supported by the cover 15, f. i., by means of threads. It will be noted that the stuffing box 19 forms a detachable unit permitting convenient removal when it is desired to adjust the shoulder ring 20 which limits the downward movement of the piston.

The long cylinder portion 12 is closed at its top by a cover 21 having an opening 22 which is connected by a pipe line 23 with the previously mentioned directional control valve (not shown). It will be understood that in operating the device the flow of pressure fluid is controlled in such a manner that fluid is admitted to the opening 16 while fluid is discharged through the opposite opening 22, or vice versa.

The combined cylinder structure rests upon a pedestal 24 securely held on its foundation by bolts 25.

The piston rod 18 of suitable length is composed of a relatively short end portion 26 of reduced diameter and of a longer portion 27 of

larger diameter extending through the stuffing box 19 in the bottom cover 15. At the point where the two rod portions merge, a shoulder 28 is formed, the purpose of which will be described later. A piston 29 of a diameter corresponding to the bore of the cylinder portion 12 is fastened to the free end of the reduced portion 26 of the piston rod 18. Furthermore, a piston structure 30 having a portion 31 the outer diameter of which fits the bore of the shorter cylinder portion 13 is slidably carried by the piston rod 18. The bore of the larger piston 31 has a diameter to slidably receive the piston rod portion 27 of larger diameter.

Fig. 2 shows both pistons 29 and 31 in their lowest position. From the structure so far described it will be understood that the larger piston 31 may move only a relatively short distance, while the smaller piston 29 is capable of moving an additional distance because of the sliding support of the larger piston 31 on the rod portion 27. The larger piston 31 is intended to exert an additional force on the piston rod 18 and will now be more suitably designated as auxiliary piston, whereas the smaller piston 29 may be called the main piston.

The auxiliary piston 31 is provided with borings 32, six borings being provided as shown in Fig. 3, said borings 32 extending from the outer diameter of the piston inwardly and opening into an enlarged inner housing 33 formed around the piston bore and receiving coupling blocks 34. The coupling blocks 34 are controlled in their movement by control plungers 35 connected thereto and sliding within the borings 32, said control plungers 35 carrying at their outer ends latching bolts 36.

Referring to Fig. 3, it will be seen that the coupling blocks 34 have the conformation of segments supplementing each other to a coupling ring when the coupling and latching units, each comprising a coupling block 34, a control plunger 35 and a latching bolt 36, are in their inward position. Furthermore, the overall dimension of such a coupling and latching unit is determined by the distance from the periphery of the auxiliary piston 31 to the reduced piston rod portion 26. Fig. 4 shows that at a place opposite the latching bolts 36, when the auxiliary piston 31 is in its highest position, latch recesses 37 are provided in the surrounding cylinder wall, to receive the latching bolts 36.

These coupling and latching units each comprising a coupling block 34, a control plunger 35 and a latching bolt 36 form an important feature of the present invention as they are also intended to support the auxiliary piston 31 in its upper position, thereby holding same in its initial operating position for the later part of the return stroke. While this is a preferred embodiment, it should be understood that other suitable means, *i. e.*, spring support or the like may serve the same purpose. In the structure shown in the drawings, the aforementioned coupling and latching units also control the operation of the coupling blocks 34, the action of which will now be described.

The coupling blocks 34 are arranged within the housing 33. They have a radial extension that allows them to move out of an engaging position with the piston rod portion 26 in front of the shoulder 28 into an inactive position wherein the piston rod portion 27 may move past them. Furthermore, the control plungers 35 are able to retract the coupling blocks only if the

outwardly disposed latching bolts 36 are permitted to project beyond the periphery of the piston 31 into the latch recesses 37, as shown in Fig. 4. It will be understood that the height of the inner housing 33 is sufficient to permit sliding movement of the coupling blocks 34 therein and, as result of their dimensioning, by-pass of pressure fluid around them. It will now be understood that the auxiliary piston 31 when in the position shown in Fig. 2 will act through the main piston on the piston rod 18 upon admission of fluid pressure through the opening 16 in the bottom cover 15. Similarly, coupling to the piston rod 18 will be effected upon further downward movement of the auxiliary piston 31 out of its latching position shown in Fig. 4.

Disengagement of the latching bolts 36 out of the position shown in Fig. 4 is effected during the beginning of the downward movement of the auxiliary piston 31 as a result of the outwardly and upwardly tapered peripheral faces 38 of the latching bolts 36. In addition to the inclined bolt faces 38, pressure fluid ducts 39 leading to the bottom of the latch recesses 37 may be provided. By controlling the admission of fluid pressure, as later described in detail, the latching bolts 36 may be aided in their retracting movement. It will be obvious that both latch-releasing means may be provided or any one of them alone to effect release of the latching bolts 36 at the proper time.

According to Figures 2 to 5, the inner housing 33 is provided approximately in the transverse center of the piston 31. This position is immaterial and the coupling and latching units may be placed nearer to the top or bottom face of the auxiliary piston 31 as Figures 6 and 7, respectively, show. The latch recesses 37 may be of a circumferential extension just sufficient to receive the latching bolts 36, as more clearly shown in Figures 2, 4, 5 and 7 and in such a case piston rings 40 on the circumferential face of the auxiliary piston 31 may be provided above and below the latching bolts 36. According to Fig. 6 the individual latch recesses 37 of the other figures are replaced by a circumferential groove 41 preventing the passage of expansible piston rings which therefore are arranged only below the coupling and latching units.

Fig. 7 shows a modified structure of the coupling and latching units, each of which consists of a latching bolt 42 carrying the coupling block 34 urged outwardly by a spring 43. It may be noted that the tapered engaging portion 44 of the bolt extends only partly over the peripheral face from the top of the bolt, thereby substantially reducing the size of the latch recesses 37. The piston rings on the auxiliary piston 31 are disposed above the latching bolts 42 and slide over the latch recesses 37 during the upward movement of the piston, this being permitted by the relatively small size of the latch recesses 37.

Of the piston structure 30 shown in Fig. 2, only the auxiliary piston 31 has been mentioned. It will be noted that a hollow hub-like portion 45 projects from the side of the auxiliary piston facing the main piston 29. The hub portion 45 is of a diameter substantially that of the main piston 29 and carries on its end portion sealing rings 46. The height of the hub portion 45 is so chosen, that the sealing rings 46 are still disposed within the cylinder portion 12 when the auxiliary piston is in its lowest position whereby a fluid-tight chamber 47 is formed. The purpose of this chamber 47 will be described later.

In order to effect movement of the pistons 29 and 31 in the manner previously mentioned, the admission and discharge of fluid must be controlled in a predetermined order. Reference will now be made to Fig. 2 for a better understanding of the fluid control means.

Pressure fluid is admitted or fluid discharged in accordance with the operation of the device to or from the bottom of the auxiliary piston 31 through the pipe line 17 connecting with the opening 16. Holes 48 which traverse the top and bottom walls of the inner housing 33 provide a communicating passage from the bottom side of the auxiliary piston 31 to the bottom side of the main piston 29 and to the inward faces of the control plungers 35. It will be noted that, when pressure fluid is admitted through opening 16, a force is exerted on the control plungers 35 which tends to move them outwardly.

The cylinder chamber 12 in front of the main piston 29 has its cover 21 the opening 22 forming the outlet of the pipe 23 in which the flow of liquid is controlled by the previously mentioned directional control valve (not shown).

The latch recesses 37 are connected by pipe lines 39 with the cylinder 12 through ports 49 at a point just above the main piston 29 when the same is at the beginning or at the end of its lone travel as shown in Fig. 4.

The chamber 47 is connected through port 50—arranged at a place so that it will never be covered during operation—pipes 62, 51 and 52, check valve 53 and pipe 54 with the cylinder 12 through port 55. The position of the port 55 is not critical as the port serves solely as outlet for fluid during the upward movement of the auxiliary piston 31, it being only necessary that the port 55 be located in front of the main piston 29 when the same is in a position according to the position shown in full lines in Fig. 4. The check valve 53 permits fluid to flow only into the cylinder 12.

Between the pipe portions 51 and 52, a pipe 56 is branched off to lead into the cylinder 12 at port 57. This port 57 is preferably spaced from the ports 49 so that the main piston, on the return stroke, first uncovers ports 49 and admits pressure fluid through pipes 39 to the outer side of the control plungers 35 to effect release of the latching bolts 36 and coupling of the coupling blocks 34 to the auxiliary piston 31, before pressure fluid is fed through port 57 and pipes 56, 51 and 62 and port 50 into chamber 47 to act on the auxiliary piston 31.

The operation of the device will now be described: When the pistons 29 and 31 are in the position shown in Fig. 2, fluid pressure is fed through opening 16 and the pipe line 17 connected thereto. The holes 48 crossing the inner housing 33 within the auxiliary piston 31 convey pressure fluid also into the inner hub chamber 58 to act on the main piston 29. Pressure fluid within the inner housing 33 urges the control plungers 35 outwardly. As a result of the pressure of the pressure fluid the auxiliary piston 31 is forced against the main piston 29 fixed to the piston rod 18 and both pistons move in unison upwardly until the auxiliary piston 31 is arrested by the shoulder 14, Fig. 4, whereupon the main piston 29 continues its travel (see dash-dotted outline of the main piston 29). During the initial upward movement the coupling blocks 34 do not actually serve as a coupling as the auxiliary piston 31 acts on the main piston. However, as soon as the latching bolts 36 project into the latch

recesses 37 moved radially outward by the fluid pressure within the housing 33, the coupling blocks 34 move out of their coupling position and permit the main piston 29 to continue its movement alone.

During the upward movement discharge of fluid is permitted from the opposite sides of both pistons through the top cover 21 by means of the opening 22, the side of the auxiliary piston 31 facing the chamber 47 being considered the opposite side thereof. It will be noted that fluid in the chamber 47 escapes partly through pipes 39, partly through the port 50, pipes 62, 51, 56, 52, 54 and outlet ports 57 and 55 into the upper cylinder portion 12 and thence through opening 22. When the ports 49 and 57 are covered, port 57 having been covered before the auxiliary piston reaches its uppermost position, the additional pipe line 52 and 54 still provides an avenue of escape through the check valve 53 to port 55. Although the pipe lines 39 and 56 permit the discharge of fluid aside of pipe line 52 and 54, they are rather intended for controlling the flow of fluid for the return movement of the auxiliary piston 31.

In order to effect return movement of the piston rod 18, the flow of fluid is reversed, pressure fluid entering through the opening 22 in the top cover 21 and discharge of fluid being permitted through the holes 48 and the opening 16 in the bottom cover 15. The first part of the return stroke will be performed by the main piston 29 alone. During its further travel the main piston 29 will uncover first port 55, but a flow of pressure fluid is prevented by check valve 53. Subsequently the ports 49 of pipe lines 39 will be uncovered permitting the pressure fluid to act on the latching bolts 36, forcing them out of the latch recesses 37 as soon as this movement is allowed by the reduced diameter of the short portion 26 of the piston rod 18.

The released auxiliary piston 31 will then start moving downwards. The vacuum created thereby effects a sucking of fluid through pipe 59 and 60 over a check valve 61 and through the port 50, the check valve preventing flow of fluid in the reverse direction. The provision of said additional means is not considered essential. Pipe 60 is connected to a (pressureless) oil storage tank (not shown) known in the art.

Shortly after uncovering the ports 49 the main piston 29 will pass the ports 57 permitting a flow of pressure fluid into the chamber 47 to act on the auxiliary piston 31. Inasmuch as the disengaging movement of the latching bolts 36 and the concomitant movement of the control plungers 35 and the coupling blocks 34 has brought the latter into coupling position, the auxiliary piston 31 will engage the piston rod 18 at the shoulder 28 by means of said coupling blocks 34 during its continued downward movement, acting again in unison with the main piston 29.

It will be seen that during common movement of both pistons 29 and 31 the angular position of the auxiliary piston 31 must be preserved to ensure engagement of the latching bolts 36 in the latch recesses 37. To preserve alignment of the latching means, the terminal face of the hub portion 45 is provided with guiding pins 63 engaging in corresponding recesses 64 within the abutting faces of the main piston 29. It will be understood that the angular position of the main piston 29 relative to the auxiliary piston does not change during the independent move-

ment of the main piston as result of the usual connection between the piston rod 27 and the mechanism to be operated thereby. The aligning means may be omitted when the latching recesses are formed by a circumferential groove 41 as shown in Fig. 6.

I have made reference generally to fluid as the driving medium, as the device may be operated by gaseous as well as liquid media. Anyone skilled in the art will understand that the longitudinal dimensions of the cylinder portion and the proportional sizes of the pistons serve only as exemplary illustrations, and may be changed to suit the intended purpose. I am also aware that various changes may be made in the means controlling the flow of fluid and in the means coupling the auxiliary piston to the piston rod at the beginning of one stroke and at the end of the other stroke to produce a greater acting force by the piston rod, without departing from the spirit of my invention, and I desire therefore to claim the invention broadly, limited only by the scope of the appended claims.

What I claim is:

1. A device adapted to actuate valves, sluice gates, presses, opening and closing apparatus, forward and backward motion mechanisms and the like, said device including a combination of two pistons of different size arranged in corresponding cylinder portions and of which the larger piston is capable of relative movement with respect to a piston rod carrying the smaller piston in fixed relation, the arrangement being such that the larger piston transmits an additional actuating force to the piston rod at the initial part of the forward stroke of the smaller piston, latching bolts slidably carried by said larger piston and driven into coupling engagement with the piston rod near the end of the return stroke of said smaller piston, and fluid conducting and controlling means feeding pressure fluid first to one side of both pistons while permitting the fluid to be discharged from the opposite side of the smaller piston to effect forward movement of both pistons and then feeding pressure fluid to the opposite side of the smaller piston and subsequently to that of the larger piston while permitting the fluid to be discharged at the other side of the larger piston, said latching bolts engaging with the cylinder wall and being adapted to hold the larger piston in the end position of its forward movement and to release the same upon feeding of pressure fluid to effect return movement thereof.

2. In a device of the type adapted to produce a larger force at the beginning of the movement of two pistons of different size enclosed in corresponding cylinder portions, the larger of said pistons being floatingly mounted on a piston rod having the smaller piston fixedly secured thereto and being adapted to transmit an additional force to the piston rod during the initial part of the movement of the smaller piston, latching means carried by said larger piston and forced into engagement with the surrounding cylinder wall, and fluid conducting and controlling means permitting of feeding and of discharging pressure fluid in a predetermined order to effect movement of both pistons in both longitudinal directions, said latching means having a releasable latching engagement with the adjacent cylinder wall at the end of the forward movement of said larger piston and including means providing positive engagement with the piston rod when

the latching means are out of latching engagement with the cylinder wall.

3. In a device of the type adapted to produce a larger force at the beginning of the movement of two pistons of different size enclosed in corresponding cylinder portions, the larger of said pistons being floatingly mounted on a piston rod having the smaller piston fixedly secured thereto and being adapted to transmit an additional force to the piston rod during the initial part of the movement of the smaller piston, latching means carried by said larger piston and forced into engagement with the surrounding cylinder wall, and fluid conducting and controlling means permitting of feeding and of discharging pressure fluid in a predetermined order to effect movement of both pistons in both longitudinal directions, said latching means having a releasable latching engagement with the adjacent cylinder wall at the end of the forward movement of said larger piston and including means providing positive engagement with the piston rod when the latching means are out of latching engagement with the cylinder wall, and guiding means carried by the smaller piston and co-operating with companion means carried by the larger piston being provided to align the larger piston by engagement with the non-rotatable smaller piston for proper engagement of the latching means with recesses in the cylinder wall.

4. A device as claimed in claim 2 wherein the latching means comprise plungers slidably arranged within the said larger piston, said plungers having their ends adjacent to the cylinder wall cut off at an angle such that a gradual engagement and disengagement with recesses in the cylinder wall is effected, and said plungers carrying coupling blocks at their opposite ends engaging a shoulder of the piston rod when said plungers are out of engagement with said recesses.

5. A device as claimed in claim 2, wherein the latching means comprise plungers cooperating with recesses in the cylinder wall to hold the said larger piston in position at the end of its forward movement and having, at their ends adjacent to the piston rod, blocks coupling said larger piston to the piston rod for the return movement of said larger piston, said plungers being forced into latching position by pressure liquid driving the smaller piston and being released upon discharge of said pressure liquid to couple the larger piston to the piston rod.

6. A device as claimed in claim 2 wherein the latching means comprise plungers slidably arranged within the said larger piston, said plungers having their ends adjacent to the cylinder wall cut off at an angle such that a gradual engagement with the said hub member, and engagement and disengagement with recesses in the cylinder wall is effected, and said plungers carrying coupling blocks at their opposite ends engaging a shoulder of the piston rod when said plungers are out of engagement with said recesses, and wherein spring means are provided to force said plungers into latching engagement with the cylinder wall, said plungers being forced out of latching engagement by the initial return movement of the larger piston.

7. A device comprising in combination a larger and a smaller piston moving in cylinder portions of corresponding diameters, said smaller piston being fixed to a piston rod carrying the larger piston in sliding engagement, the movement of said larger piston being limited in its cylinder

portion to a part of that of the smaller piston, means for coupling the larger piston to the piston rod for the return movement of said larger piston, means for alternately feeding and discharging pressure fluid to and from opposite sides of the pistons, respectively, said means including external pipe lines connecting a chamber on the side of the larger piston adjacent to the smaller piston with the cylinder portion in front of the smaller piston.

8. A device comprising a larger and a smaller piston in cylinder portions of suitable diameters, a piston rod having the smaller piston secured thereto and carrying the larger piston in sliding engagement therewith, said larger piston having limited movement in respect to the smaller piston and cooperating with means coupling said larger piston to the piston rod during a part of the return movement of the larger piston, a hollow cylindrical hub member of the larger piston extending into the cylinder portion of the smaller piston and defining an outer chamber and an inner chamber separated by said hub, fluid feeding and discharging means determining the flow of fluid to and from opposite sides of the piston assembly, means passing pressure fluid into the inner chamber to effect first combined forward movement of both pistons and subsequently of the smaller piston alone, means connecting the outer chamber with the cylinder portion in front of the smaller piston to permit of discharging fluid during the forward movement of said larger piston, and of introducing pressure fluid to effect return movement of said larger piston.

9. A device as claimed in claim 8, wherein the means connecting the outer chamber with the cylinder portion in front of the smaller piston include a pipe line communicating with the said outer chamber in either position of the larger piston and having an inlet port in the cylinder wall surrounding the smaller piston approximately at the leading edge thereof when said smaller piston is in its intermediate position and in engagement with the said hub member, said pipe line being connected to a fluid supply source through a check valve permitting flow of fluid only from that source.

10. A device as claimed in claim 8, wherein the means connecting the outer chamber with the cylinder portion in front of the smaller piston include a pipe line communicating with the said outer chamber in either position of the larger piston and having an inlet port in the cylinder wall surrounding the smaller piston approximately at the leading edge thereof when said smaller piston is in its intermediate position and in engagement with the said hub member, and a second port spaced from said first inlet port and positioned to be covered later during the forward movement of the smaller piston, said second port being connected with said pipe line through a check valve permitting only discharge of fluid from the outer chamber during the forward movement of the larger piston into the cylinder portion in front of the smaller piston.

11. In a device having cylinder portions of fitting diameters and predetermined lengths, a main piston and a piston of larger diameter on a common piston rod, the larger piston being floatingly mounted on said piston rod, the arrangement being such that the larger piston moves in unison with the main piston only at the beginning of the forward and at the end of the return movement of the smaller piston for

a predetermined distance, fluid conducting means to force movement of both pistons in both directions, plungers mounted in bores of the larger piston and having inner faces exposed to pressure fluid to force said plungers into latching engagement with the cylinder wall when the larger piston reaches the end of the forward movement, said plungers carrying coupling blocks at their inner ends for engagement with the piston rod and being of such longitudinal extension that the blocks are in coupling engagement when the plungers are out of latching engagement.

12. A device as claimed in claim 11, wherein the plungers when in latching position project into recesses in the adjacent cylinder wall, the bottom of said recesses being connected by pipe means with a port leading into the space in front of the main piston, said port being positioned to be uncovered by the main piston upon its engagement with the larger piston during the return movement of said main piston whereby pressure fluid enters back of the plungers and forces them out of latching engagement.

13. A device of the type described, comprising a cylinder structure including a cylinder chamber of relatively large diameter communicating with a cylinder chamber of smaller diameter and forming an inner terminal shoulder at the circumferential meeting line therewith, a piston of relatively large diameter operating in said first chamber, a smaller piston operating in said second chamber, a common piston rod fixedly connected to the smaller piston and slidably supporting the larger piston, means providing operative engagement of the larger piston with the piston rod during the travel of the larger piston toward the terminal shoulder, means coupling said larger piston to the piston rod during the return movement of said larger piston, said larger piston and the terminal shoulder defining a pressure chamber during the return movement of the larger piston, and means controlling the flow of pressure fluid to move the larger piston while operatively engaging the piston rod and subsequently the smaller piston independently of said larger piston and to effect the corresponding return movement by acting first on the smaller piston and subsequently on the larger piston while coupled to the piston rod.

14. A device of the type described, comprising in combination a piston secured to a piston rod, a relatively large piston slidably mounted on said piston rod, a cylinder structure having two corresponding chambers to receive said pistons for operation therein, the longitudinal extension of the chamber housing the large piston determining the travel of said piston, a hub connected with the large piston to provide an engaging member with the small piston whereby pressure acting on the opposite side of the large piston will move both pistons in unison until the large piston reaches the end of its chamber, means for applying pressure fluid to the small piston to effect continued independent movement and corresponding return movement thereof, means effecting coupling the large piston to the piston rod upon said return movement of the small piston, means for applying fluid pressure to the large piston from the end of its chamber to continue return movement of both pistons in unison, and means controlling the flow of fluid in predetermined order.

HUGO C. GOLLMER.

CERTIFICATE OF CORRECTION.

Patent No. 2,329,044.

September 7, 1943.

HUGO C. GOLLMER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 27, for "thier" read --their--; page 3, first column, line 21, after "has" insert --in--; page 4, second column, line 59, claim 6, strike out "in engagement with the said hub member, and"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of January, A. D. 1944.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.