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3,149,537

FLUID CONTROL MECHANISM

Filed Jan. 19, 1961

2 Sheets-Sheet 1

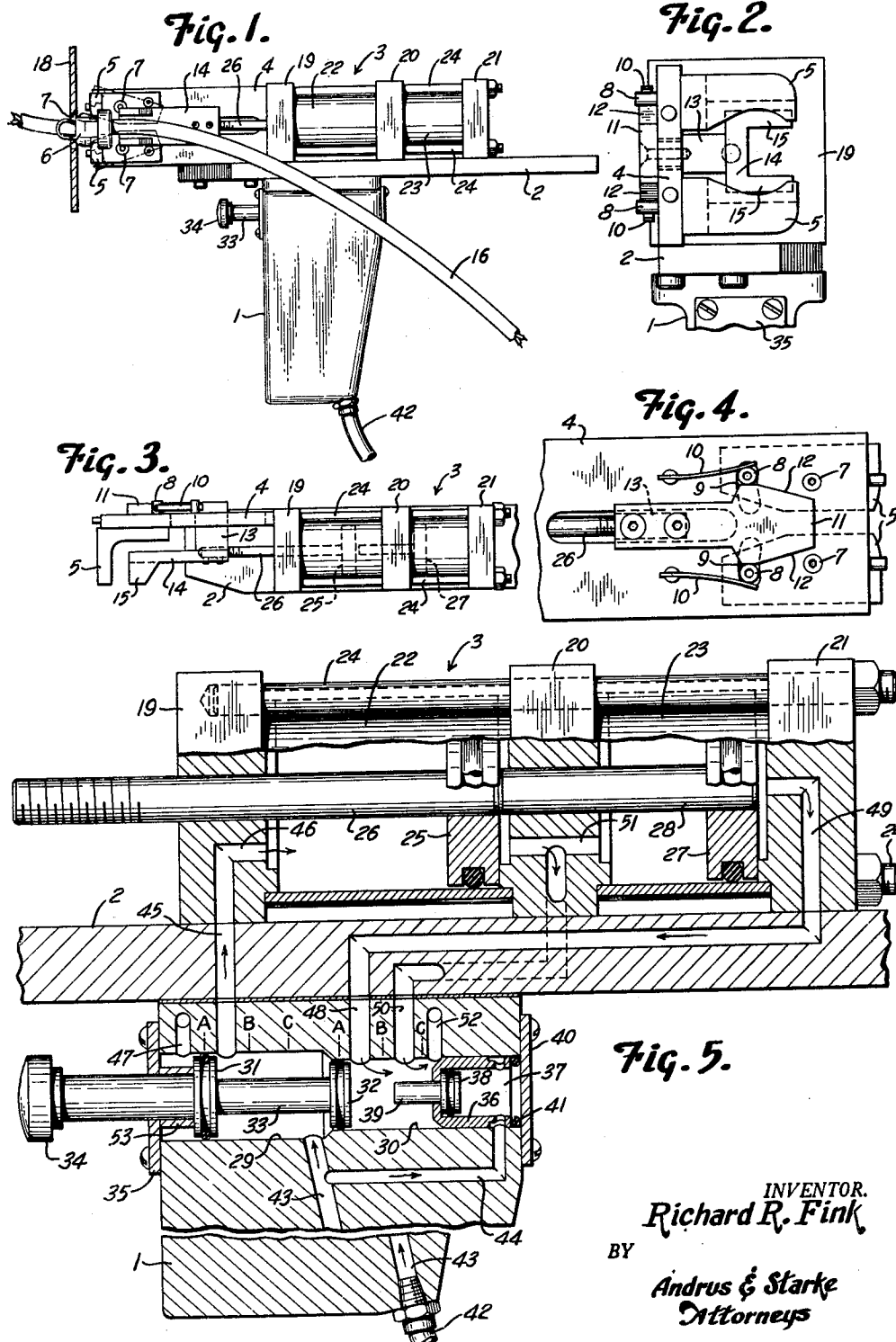


Fig. 5.

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2 Sheets-Sheet 2

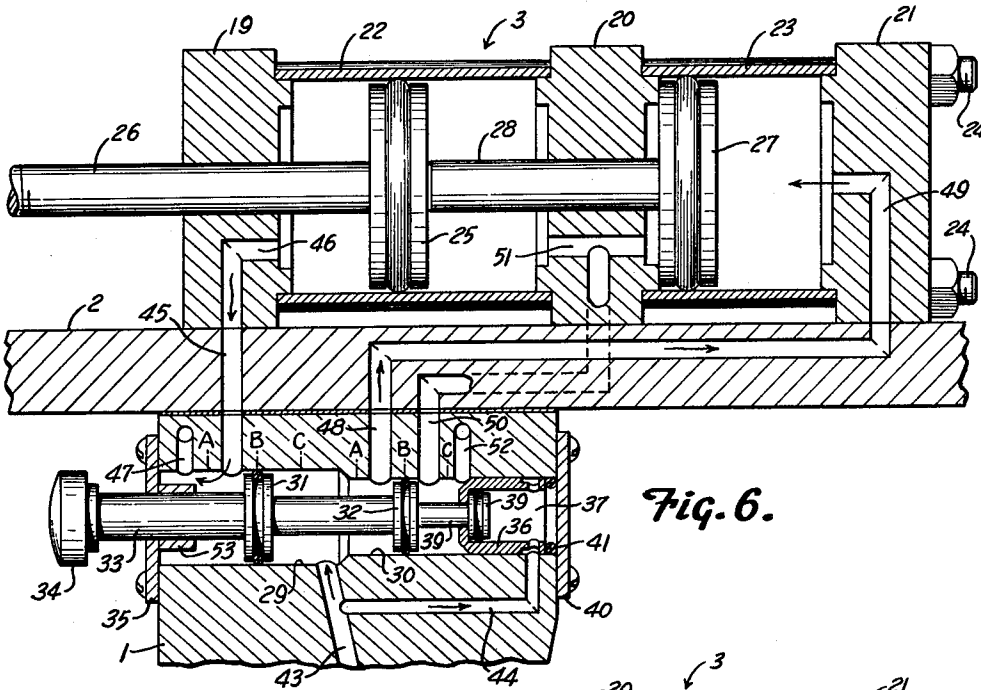


Fig. 6.

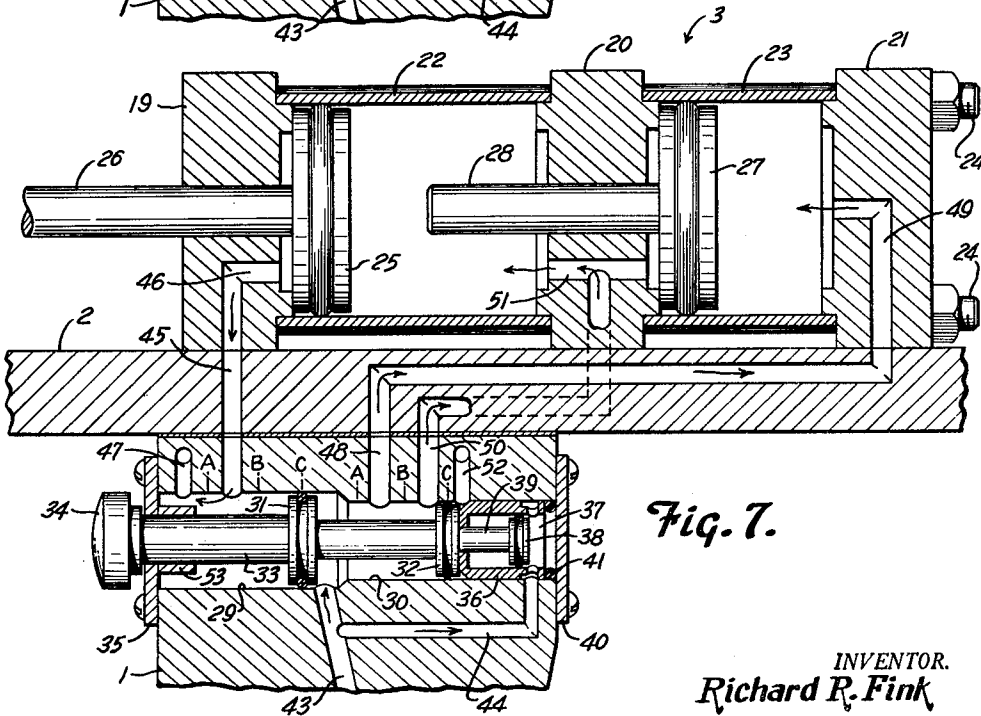


Fig. 7.

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1

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FLUID CONTROL MECHANISM

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8 Claims. (Cl. 91-178)

This invention relates to a fluid control mechanism and more particularly to a valve for use with a fluid-actuated tandem cylinder.

Tandem cylinders, in which two cylinders are axially aligned, are employed to obtain a two-stage movement of a working member. For example, in the copending patent application Serial No. 40,003, filed June 30, 1960, now Patent No. 3,044,157, entitled Apparatus for Installing Bushings, a tandem cylinder structure is employed to obtain a two-stage movement to clamp and install a strain-relieving bushing within an opening in a wall. In this prior application, air or other hydraulic fluid is introduced into the rear cylinder of the tandem unit to move the working member in a first increment of movement to close the jaws and compress the strain-relieving bushing. Fluid pressure is then introduced into the forward cylinder to move the working member ahead in a second stroke to drive the bushing into the opening in the wall. In this prior application, the air or hydraulic fluid introduced to the cylinders is controlled by means of solenoid valves.

The present invention is directed to a manually-actuated valve employed to control the flow of fluid to a tandem cylinder unit and which eliminates the electrical connections required with solenoid valves. More specifically, the handle which supports the tandem cylinder unit defines a chamber or cylinder and a valve member is slidably disposed within the cylinder and is adapted to be moved manually from a starting position to a first and a second operable position. In the first operable position the valve member serves to direct air or other fluid from the chamber to one of the cylinders in the tandem unit, while in the second position the valve member serves to direct fluid from the chamber to the second of the cylinders. According to the invention, fluid pressure acts against the valve member and opposes movement of the valve member from the first to second operable position. This fluid pressure increases the force required by the operator to move the valve member from the first to the second position and therefore provides an indication to the operator as to the location of the first position. With this construction the operator can freely move the valve member within the chamber from the starting to the first operable position and when the resistance of the fluid pressure is encountered, the operator will know that the first position has been reached. Increased force exerted by the operator can then move the valve member to the second operable position.

The valve construction of the invention results in a more compact, maneuverable unit because the electrical connections have been eliminated and a single air line is the only connection required to the apparatus.

In addition, a single button control is employed which eliminates the possibility of human error which is frequently encountered when using a two-button system.

The use of the fluid pressure as resistance to the movement of the valve member from the first to second positions provides substantial advantages over the use of springs or other resilient members because the air pressure for both the operation of the mechanism and the back pressure are from the same source and the pressure will be constant, which is an advantage over the use of springs which tend to lose their resiliency after long periods of service.

2

Other objects and advantages will appear in the course of the following description.

The drawings illustrate the best mode presently contemplated for carrying out the invention.

In the drawings:

FIGURE 1 is a side elevation of an apparatus for installing strain-relieving bushings and employing the valve construction of the invention;

FIG. 2 is an end view of the apparatus shown in FIG. 1;

FIG. 3 is a top view of the apparatus shown in FIG. 1;

FIG. 4 is a fragmentary rear elevation showing the cam structure employed to operate the jaws;

FIG. 5 is a vertical section taken through the cylinder unit and handle construction of the invention;

FIG. 6 is a view similar to FIG. 5 showing the valve member in the first operable position; and

FIG. 7 is a view similar to FIG. 5 showing the valve member in the second operable position.

The drawings illustrate a valve construction as used with an apparatus for installing strain-relieving bushings as described in the copending patent application Serial No. 40,003, filed June 30, 1960.

As shown in FIGURE 1, the apparatus includes a handle 1 to be grasped by the operator and which supports a base plate 2. The base plate 2 carries a cylinder unit 3 and a vertical plate 4 which projects forwardly beyond the end of the base plate 2.

A pair of cooperating jaws 5 are pivotally connected to the plate 2 and each jaw is provided with a laterally extending edge which is adapted to engage a groove in a strain relief bushing 6. The bushing 6 forms no part of the invention and may be any conventional type of electrically insulating bushing, such as that sold under the trade name of Heyco.

The jaws 5 are pivotally connected to support plate 2 by pins 7 and a cam follower pin 8 is connected to each jaw and extends through an arcuate slot 9 in the base plate 2. The outer end of each cam follower 8 is engaged by a leaf spring 10 which urges the cam follower pin toward the longitudinal center of the plate 2. The springs 10 serve to urge the cam follower pins toward each other and thereby bias the jaws 5 to the open position.

The follower pins 8 are moved outwardly within the slots 9 by a cam 11. As shown in FIG. 4, the cam 11 is provided with a pair of rearwardly diverging cam surfaces 12 which engage the respective pins 8 and move the pins outwardly within the slots 9 as the cam is moved forwardly.

To move the cam 11 and thereby actuate the jaws 5, the rear portion of the cam is connected to a transverse bar 13 which extends through a slot in plate 2 and is connected to a ram 14. The ram 14 is provided with a generally U-shaped forward end having a pair of spaced flanges 15 which straddle the cord 16 and are adapted to engage the rear end of the bushing 6 to drive the bushing into the opening 17 in the wall 18 after the jaws 5 are opened.

The cam 11 and ram 14 are adapted to be moved in two stages or increments by the cylinder unit 3. To begin operation the cam and ram are in the rearmost position, and in the first stage of movement the cam and ram are moved forwardly to a position where the cam follower pins 8 ride up on the high portion of the cam surface 12, thereby closing the jaws 5 and clamping the bushing to compress the same in cross sectional area. In the second stage of movement the ram 14 and cam 11 are moved further forward, thereby riding the cam followers down the inner portion of the cam surfaces to open the jaws and thereafter move the ram forwardly in engagement with the bushing 6 to drive the bushing within the opening 17 in the wall 18.

3

The cylinder unit 3 includes a forward head 19, a central head 20 and a rear head 21 which are secured to the base plate 2. The heads 19 and 20 enclose the opposite ends of a forward cylinder 22 while the central head 20 and the rear head 21 enclose the opposite ends of a rear cylinder 23 which has a shorter length than the forward cylinder 22. The heads are connected together by a series of tie rods 24.

A piston 25 is slidably disposed within the forward cylinder 22 and the piston rod 26 which is connected to piston 25 extends through the forward head 19 and is connected to the ram 14. In addition, a rear piston 27 is slidably disposed in rear cylinder 23 and the piston rod 28, connected to the rear piston, extends through the central head 20 and is adapted to bear against the forward piston 25.

According to the invention, a manually operated valve construction is employed for controlling the flow of fluid to the cylinders 22 and 23. As best shown in FIG. 5, the handle 1 is provided with a pair of axially aligned chambers 29 and 30 which extend through the handle. The forward chamber 29 has a slightly larger diameter than the rear chamber 30.

Valve members 31 and 32 are slidably disposed within the respective chambers 29 and 30 and the valve members are carried by a common stem 33 which extends outwardly of the handle. The outer end of the stem 33 carries a button 34 which is adapted to be pushed or depressed by the operator. The forward end of the chamber 29 is enclosed by a keeper plate 35 having an opening through which the stem 33 extends.

A cup-like insert 36 is secured by a press fit within the rear end of chamber 30 and the insert defines a chamber or cylinder 37. A piston 38 is slidably disposed within the chamber 37 and a piston rod 39, connected to the piston, extends through the inner end of the insert into the chamber 30.

The rear end of the chamber 37 is enclosed by a keeper plate 40 and an annular seal 41 seals the joint to prevent leakage of fluid from the chamber.

Air or other hydraulic fluid is introduced to the handle 1 through a conduit 42 which is connected to a suitable source of air pressure. The conduit 42 is threadedly connected within a passage 43 which communicates with the inner or rear end of the chamber 29. In addition, a by-pass passage 44 provides communication between the inlet passage 43 and the rear end of the chamber 37. With this construction, air is introduced simultaneously into the chamber 29 and also the chamber 37 to normally urge the valve member 31 and piston 38 forwardly in the respective chambers.

An outlet passage 45 provides communication between the chamber 29 and an inlet port 46 formed in the forward head to thereby enable fluid to pass from the chamber 29 to the forward end of the cylinder 22. In addition, exhaust passage 47 provides communication between the forward end of the chamber 29 and the exterior.

Fluid is introduced into the rear cylinder 23 from the chamber 30 through a passage 48 formed in the handle and an inlet passage 49 which is provided in the rear head 21. Similarly, fluid is introduced into the rear end of the forward cylinder through a passage 50 formed in the handle 1 and a connecting passage 51 formed in the central head 20.

An exhaust passage 52 provides communication between chamber 30 and the exterior.

Air pressure acting within passages 43 and 44 normally urges the valve member 31 and the piston 38 forwardly within the respective chambers. A spacer sleeve 53 is disposed around the stem 33 and serves to position the valve member 31 at the desired location within the chamber 29. With the valve members 31 and 32 in the positions indicated by A in FIG. 5, the air pressure will act through passages 45 and 46 to hold the piston 25 against the central head 20 and to correspondingly move the

4

piston 27 to the rear of the rear cylinder 23 due to engagement of the piston 25 with the piston rod 28. At this time, the air behind the piston 25 is discharged through passages 51 and 50 to chamber 30 and is exhausted to the exterior through passage 52. Similarly, the air behind the piston 27 is discharged through passages 49 and 48 and is exhausted to the atmosphere through passage 52.

The operator then depresses the button 34 to move the valve members 31 and 32 to a position indicated by B in the drawings. In this position, the valve member 32 contacts the inner end of the piston rod 39. With the valve members in this position, the passages 46 and 45, which communicate with the forward end of the forward cylinder 22, are in communication with the exhaust passage 47 to thereby permit discharge of the air from cylinder 22. Similarly, the passage 48 is brought into communication with the inlet passage 43 so that air is supplied through passages 48 and 49 to the rear cylinder to push the pistons 27 and 25 forwardly in the respective cylinders. Moving the piston 25 within the cylinder causes the cam 11 and ram 14 to move forwardly, resulting in the jaws being closed or clamped around the bushing. During this time, the pressure is maintained behind the piston 38 in the chamber 37.

To provide the second increment of movement the operator must then further depress the button 34 and this second stage of movement is made against the air pressure in chamber 37 due to the engagement of valve member 32 with piston rod 39. By exerting a greater force, the operator can then move the valve members 31 and 32 to the position indicated by C in the drawings. At this location, the passages 46 and 45 are still in communication with the exhaust passage 47, and the inlet passage 43 is then brought into communication with the passage 50 to admit air to the rear end of the forward cylinder 22 to thereby move the piston 25 forwardly in a second increment of movement. Moving the piston 25 forwardly will cause the jaws to open and the ram 14 will engage the rear end of the bushing 6 to drive the bushing into the opening in the wall.

After the bushing has been installed in the wall, the operator releases the button 34 and the pressure within lines 43 and 44 will move the valve members 31 and 32 and the piston 38 forwardly in the respective chambers to bring the members back to their original starting position.

With the present valve construction, the first increment of movement is achieved by manually depressing the button 34 until the valve member 32 engages the piston rod 39 of the piston 38. When this position is reached, an increased force is necessary in order to further depress the button due to the pressure of the air within the cylinder 37. The resistance of the air within this line can be readily felt by the operator so that he can readily determine the end point of the first increment or stroke of movement. By increasing the force applied to the button 34, the valve members can be moved in the second stroke of movement against the air pressure in chamber 37 to complete the operation. Thus, the fluid pressure exerted against the valve member indicates to the operator that the first position has been reached.

The valve construction of the invention eliminates the electrical leads which are necessary when using solenoid valves to control the flow of fluid to the cylinders. With the present system, a single air line is the only connection to the handle which makes the unit more maneuverable and compact.

Furthermore, a single button control is employed which facilitates the operation and prevents any mistake in operation as might occur if a two-button system were employed.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. A valve construction for controlling the flow of fluid, comprising a casing defining a chamber, a valve member slidably within the chamber and adapted to be moved from a normal starting position to a first operable position and to a second operable position with said valve member directing the flow of fluid to a first location when at said first operable position and directing the flow of fluid to a second location when at said second operable position, an operating member disposed externally of the casing and connected to the valve member, and compressible fluid pressure means disposed to act against the valve member for opposing movement of the valve member from said first operable position to the second operable position, said fluid being compressed as the valve member is moved from said first position to said second position to thereby increase the force required to be applied to the operating member to move the valve member from said first operable position to the second operable position.

2. In a valve construction for controlling the flow of fluid to a tandem cylinder structure, a casing defining a pair of chambers, a valve member disposed in the first of the chambers and adapted to be moved from a normal starting position to a first operable position and to a second operable position with said valve member directing the flow of fluid to a first location when at said first operable position and directing the flow of fluid to a second location when at said second operable position, an operating member disposed externally of the casing and connected to said valve member for actuating the same, a piston member slidably disposed in the second chamber, a projection connected to one of said members and extending between said chambers and disposed to engage the other of said members when the valve member is moved from the starting position to the first operable position, and conduit means for introducing a compressible fluid into said second chamber with said fluid being introduced into the end of said second chamber opposite from the first chamber whereby the pressure of the fluid within the second chamber acts against said piston member to oppose movement of the valve member from said first operable position to the second operable position, said fluid being compressed by the piston member as said valve member moves from the first to second position thereby increasing the force required to be applied to the operating member and indicating to an operator the location of the first position.

3. In a valve construction for controlling the flow of fluid, a casing defining a pair of axially aligned closed cylinders, a valve member slidably disposed within a first of the cylinders and adapted to be moved from a starting position to a first operable position and to a second operable position with said valve member directing the flow of fluid to a first location when at said first operable position and directing the flow of fluid to a second location when at said second operable position, an operating member disposed externally of the casing and connected to said first valve member for actuating the same, a piston member slidably disposed in the second cylinder, a piston rod connected to the piston member and extending into said first cylinder and adapted to be engaged by said valve member when the valve member is moved from the starting position to the first operable position, and conduit means for introducing a compressible fluid into the second cylinder with the fluid being introduced into the end of the second cylinder opposite from the first cylinder whereby the pressure of the fluid within the second cylinder acts against the piston member to oppose movement of the valve member from said first position to the second position, said fluid being compressed by the piston member as said valve member moves from the first to second position, thereby increasing the force to be applied to the operating member and indicating to an operator the location of the first position.

4. In a valve construction for controlling the flow of fluid, a casing defining a pair of separate chambers, a valve member slidably disposed within a first of the chambers, inlet conduit means for introducing fluid into said first chamber, first outlet conduit means connected to the first chamber and disposed to communicate with said inlet conduit means when the valve member is in a first operable position to direct the flow of fluid through said first chamber to said first outlet conduit means and to a first location of use, second outlet conduit means connected to said first chamber and disposed to be in communication with said inlet conduit means when said valve member is in a second operable position to direct the flow of fluid through said first chamber to said second outlet conduit and to a second location of use, an operating member disposed externally of the casing and connected to the valve member to actuate the same and move the valve member from a starting position to the first operable position and to the second operable position, a piston member slidably disposed within the second chamber, means connected to one of said members and extending between the chambers and adapted to engage the other of said members when the valve member is moved to the first operable position, and fluid conduit means connected to said inlet conduit means for introducing a compressible fluid into the second chamber whereby said fluid pressure means acts against said piston member to oppose movement of the valve member from the first position to the second position, said fluid being compressed by the piston member as the valve member moves from the first to second position, thereby increasing the force required to be applied to the operating member.

5. In a valve construction for controlling the flow of fluid, a casing defining a first cylinder and a second cylinder with the first cylinder having a first section and a second section, a valve member slidably disposed in each section of said first cylinder, a connecting member connecting the valve members together as an integral unit, an operating member disposed externally of the casing and connected to the valve members to move the valve members from a starting position to a first operable position and to a second operable position, a piston member slidably disposed in the second cylinder, means connected to one of said members and extending between said cylinders and adapted to be engaged by the valve members when the valve members are moved from the starting position to the first operable position, conduit means for introducing a compressible fluid into the first cylinder, first outlet conduit means connected to the first section of the first cylinder and adapted to conduct fluid from the first section to a first location when the valve members are in said first operable position, second outlet conduit means communicating with the second section of said first cylinder and adapted to conduct fluid from said second section to a second location when the valve members are in the second operable position, and by-pass conduit means connected to said inlet conduit means for introducing the compressible fluid into said second cylinder whereby the pressure of the fluid within the second cylinder acts against the piston member to oppose movement of the valve member from the first operable position to the second operable position, said fluid being compressed by the piston member as said valve member moves from said first position to said second position, thereby increasing the force required to be applied to the operating member and indicating to an operator the location of said first position.

6. An apparatus of the class described, comprising a supporting structure, a tandem cylinder unit carried by the supporting structure and including a forward cylinder and a rear cylinder, said cylinder unit including a forward piston disposed within the forward cylinder and having a forward piston rod connected to an element to be controlled and said cylinder unit including a rear piston slidably disposed within the rear cylinder and having a rear piston rod extending into said forward cylinder and

adapted to engage said forward piston, a handle connected to the supporting structure and defining a chamber, a valve member slidable within the chamber and adapted to be moved from a normal starting position to a first operable position and to a second operable position with said valve member directing the flow of fluid to the rear end of the rear cylinder when at said first operable position to thereby move said pistons forwardly in the respective cylinders and said valve member directing the flow of fluid into the rear end of the forward cylinder when at the second operable position to move the forward piston forward in a second increment of movement, an operating member disposed externally of the handle and connected to the valve member, and fluid pressure means disposed to act against the valve member for opposing movement of the valve member from the first operable position to the second operable position to thereby increase the force required to be applied to the operating member to move the valve member from said first operable position to the second operable position.

7. An apparatus of the class described, comprising a supporting structure, a tandem cylinder unit carried by the supporting structure and including a forward cylinder and a rear cylinder, said cylinder unit including a forward piston disposed within the forward cylinder and having a forward piston rod connected to an element to be controlled and said cylinder unit including a rear piston slidably disposed within the rear cylinder and having a rear piston rod extending into said forward cylinder and adapted to engage said forward piston, a handle defining a pair of axially aligned chambers, valve means slidably disposed in the first of the chambers and adapted to be moved from a starting position to a first operable position and to a second operable position with said valve means directing the flow of fluid to the rear of the rear cylinder when at said first operable position to thereby move both pistons forwardly in the respective cylinders to actuate said element and said valve means directing the flow of fluid to the rear of the forward cylinder when at said second operable position to thereby move the forward piston forwardly in a second increment of movement to further actuate said element, an operating member disposed externally of the casing and connected to the valve means for actuating the same, a piston member slidably disposed in the second chamber, means extending between the chambers for providing engagement between the valve means and the piston member when the valve means is moved from the starting position to the first operable position, conduit means for introducing fluid into said first chamber, first outlet conduit means providing communication between the first chamber and the rear of the rear cylinder, second outlet conduit means providing communication between the first chamber and the rear portion

of the forward cylinder, and means for introducing a compressible fluid into the second chamber whereby the pressure of the fluid within the second chamber acts against the piston member to oppose movement of the valve means from the first operable position to the second operable position, said fluid being compressed by the piston member as said valve means moves from the first position to the second position to thereby increase the force required to be applied to the operating member to move the valve means from said first position to the second position.

8. An apparatus of the class described, comprising a handle defining an internal chamber, valve means movably disposed within the chamber and adapted to be moved from a normal starting position to a first operable position and to a second operable position, operating means disposed externally of the handle and connected to said valve means for moving said valve means in said chamber, a working element mounted on the handle and adapted to perform a series of working operations, inlet conduit means for introducing fluid into said chamber, first outlet conduit means connected to the chamber and disposed to communicate with the inlet conduit means when said valve means is in said first operable position to direct the flow of fluid to said working element, second outlet conduit means connected to said chamber and disposed to be in communication with said inlet conduit means when said valve means is in the second operable position to direct the flow of fluid through said second outlet conduit to said working member, and compressible fluid pressure means disposed to act against the valve means for opposing movement of the valve means from said first operable position to said second operable position, said fluid being compressed as said valve means is moved to said second operable position to thereby increase the force required to be applied to the operating means to move the valve means from said first position to the second position.

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