United States Patent

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[54] **FLUID PRESSURE DEVICE**
12 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **92/110,** 92/113, 116/70
[51] **Int. Cl.** **F01b 3/00**
[50] **Field of Search** 92/5, 9, 8, 52, 51, 110, 111, 117, 130, 66, 78; 91/176; 116/70

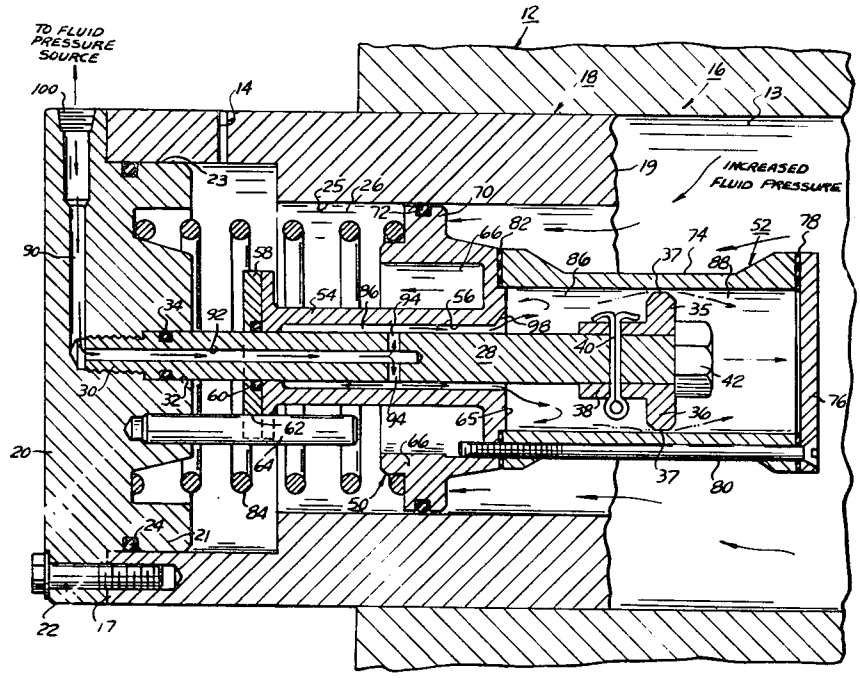
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ABSTRACT: A fluid cylinder and piston assembly for use in a fluid filter assembly or the like, which includes a housing and a cover; a spring-biased compound piston and cylinder assembly is reciprocable within the housing on a stationary guide rod attached to the cover of the housing. The compound piston and cylinder assembly defines a pressure chamber having a plunger attached to the end of the guide rod disposed therein and the chamber is in communication in front of the plunger with a fluid inlet in the cover by means of restricted passages to move the compound piston and the cylinder assembly in one direction and the plunger is constructed such as to permit metered amounts of fluid to the plunger within the cylinder at a predetermined fluid pressure to move the compound piston and cylinder assembly in the other direction.



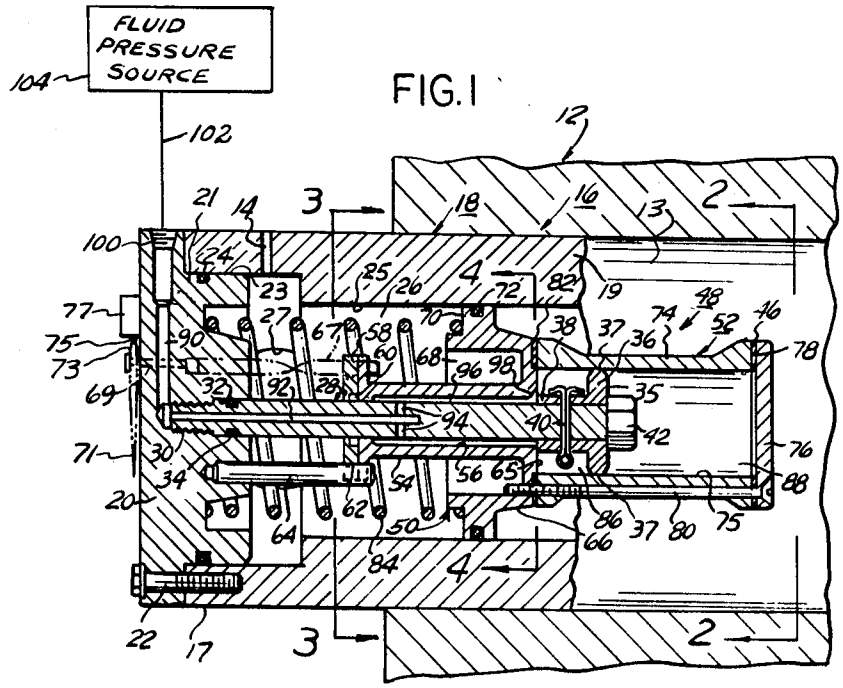


FIG.1

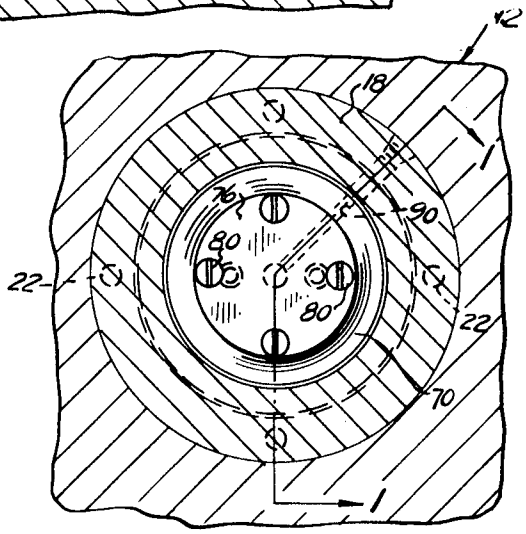
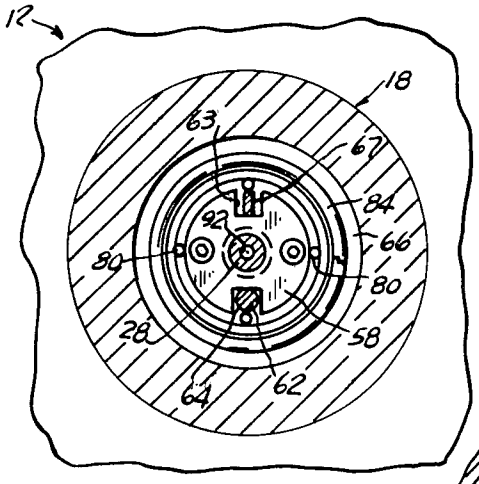


FIG.2

FIG.3



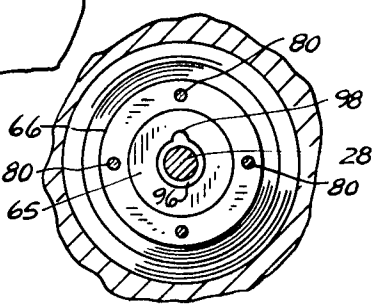
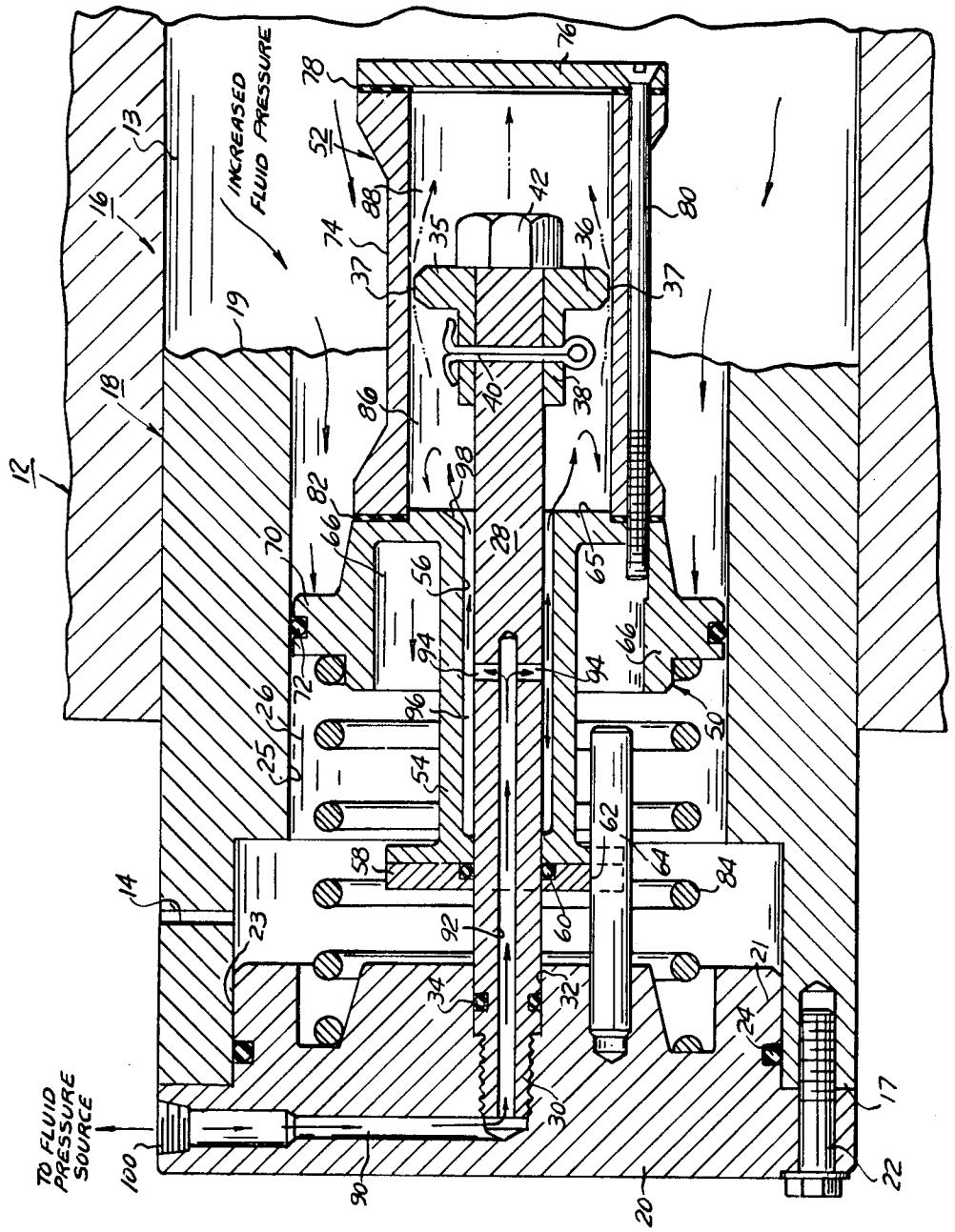


FIG.4

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FIG. 5



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FLUID PRESSURE DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention refers to fluid pressure devices, and more in particular to a compound piston and cylinder assembly in which the cylinder is utilized to assure complete return of the piston.

2. Description of the Prior Art

Fluid cylinders are generally provided with a piston member movable within the cylinder in response to fluid being directed and exhausted from opposite sides of the piston member. Movement of the piston member is transmitted by a rod connected to the piston to produce the desired mechanical work or increase in pressure.

It is believed that the invention can best be understood by reference to a particular application for which the fluid pressure device of the present invention is particularly suited.

In applicant's prior U.S. Pat. Nos. 3,425,557 and 3,425,558; both issued Feb. 4, 1969 to N. O. Rosaen, for "Backwash Means for Dual Filter Elements," a fluid filter arrangement is disclosed provided with backwashing means actuated by fluid pressure, which is energized upon a signal to introduce a pressure surge in the filter chamber to dislodge particles from the filter element which are then carried into a sump or dirt collector.

These known devices employ a pressure-sensitive combined indicator and switch actuating means in the form of an auxiliary housing defining a pressure chamber which is open to the fluid flow chamber of the filter and which contains a piston normally biased into inactive position by a spring means. The piston carries at its end an actuator which is rotatable upon reciprocation of the piston. The actuator is connected to a pointer outside of the auxiliary housing which cooperates with a dial having markings indicating the respective condition of the filter element through a range from "clean" to "filter bypassing." The actuator also carries a cam integral with the pointer which cooperates with the button of a switch to actuate a pump or other fluid pressure device upon rotation of the actuator when the filter element becomes clogged. Energization of the switch then causes operation of the pump to direct fluid diverted from the filter chamber through a nozzle against the dirty filter element to dislodge particles therefrom. Conversely, the switch is utilized in the particular dual filter assemblies disclosed in the aforementioned patents to actuate a motor to rotate the dirty filter element out of the fluid stream and position a clean filter element in the filter chamber.

Under normal flow conditions of the filter, the pressure-sensitive device remains inactive. However, as the filter element becomes clogged, the pressure at the inlet side is increased causing the piston in the auxiliary chamber to be moved and thus rotate the pointer and actuate the switch. As normal fluid flow through the filter element is reestablished, the piston is permitted to return to its inactive position by the expanding spring means.

Difficulties have been encountered in the past in accomplishing complete return of the piston. Incomplete return produces a false indication of the condition of the filter element and can result in malfunction of the backwash means. This difficulty is caused by increased resistance due to material buildup on the walls of the cylinder and the ineffectiveness of the spring return means, which gradually becomes fatigued and thus becomes ineffective to overcome the normal fluid pressure at the other side of the piston to completely return the piston.

SUMMARY OF THE INVENTION

The present invention is disclosed and described herein as a pressure-sensitive indicator and switch actuator device combined with a pressure accumulator to produce and store sufficient return pressure for complete return of the indicator piston to thereby maintain a full power stroke which is necessary to obtain a true indication of the condition of the filter element.

The present novel device may be utilized in various different fluid filter assemblies and is herein described as being embodied in a self-cleaning dual filter assembly of the type disclosed in the aforementioned U.S. patents to which reference should be had if necessary.

Generally, the dual filter assembly of the aforementioned patents comprises a filter housing having an inlet and an outlet. The housing contains dual filter elements mounted on a carrier for rotation within the housing. The carrier divides the housing into a fluid flow chamber in which one filter element is disposed in active filtering position and in a flushing chamber containing the other filter element in a nonfiltering position. When the active filter element becomes clogged, a motor is energized to rotate the element carrier to move the active filter element out of the filtering position and into the flushing chamber and to move the former inactive clean filter element from the flushing chamber into the filtering position. The present novel pressure-sensitive device is attached to the filter housing at the inlet side in communication with the filter chamber and as the filter element becomes clogged is actuated to rotate the indicator pointer and the switch cam. Upon reestablishing of normal fluid flow, the piston is positively returned by means of stored fluid pressure.

Generally, the present invention comprises a housing attached to the filter housing having a housing cover which has a pressurized fluid inlet. The housing cover supports a stationary guide rod having a plunger at its other end which extends into the cylinder chamber of the combined piston and cylinder assembly which has an extended portion of reduced diameter adapted for sliding movement on the stationary guide rod. A minimal radial clearance is provided between the radial surface of the guide rod and the internal surface of the piston extension which has an orifice for communication with the cylinder chamber. The stationary guide rod is axially and longitudinally bored to provide a passage which is in communication with the pressurized fluid inlet in the cover of the housing and with the radial clearance around the stationary guide rod. Normally, the combined piston and cylinder assembly is biased away from the cover by means of a compression spring. However, as pressurized fluid is forced through the inlet into the axial passage of the guide rod and into the radial clearance around the guide rod, it enters the cylinder chamber in front of the stationary plunger at the end of the guide rod as the piston and cylinder assembly is moved towards the cover against the force of the compression spring because of a pressure differential created in the filter chamber. As the piston and cylinder assembly moves toward the housing cover, the actuator rod is rotated to rotate the pointer and cam for energization of the switch. Continuous fluid pressure within the cylinder of the piston and cylinder assembly causes the fluid to be metered around the plunger surfaces to enter the rear of the cylinder chamber. As the pressure in the cylinder chamber in the rear of the plunger increases, it combines with the spring force at the reestablishment of normal fluid flow through the inlet, to move the piston and cylinder assembly back away from the cover to its initial starting position.

The invention will be best understood by reference to the following detailed description taken in connection with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate a preferred embodiment in which:

FIG. 1 is a longitudinal cross section of the present novel device shown in active position and illustrating schematically its installation in a representative fluid filter assembly;

FIG. 2 is a front view of the present novel device shown in FIG. 1;

FIG. 3 is a cross section through the present novel device shown in FIG. 1 as seen along line 3—3 thereof;

FIG. 4 is another cross section through the present novel device shown in FIG. 1 as seen along line 4—4 thereof; and

FIG. 5 is an enlarged longitudinal cross section through the present novel device similar to FIG. 1 showing the device in an operating position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the drawings, FIG. 1 schematically illustrates a fluid filter system including a dual filter assembly 12 which may be of the type disclosed in the aforementioned U.S. Pat. Nos. 3,425,557 and 3,425,558.

The pressure-sensitive device 16 comprises a cylindrical housing 18 which is open towards the fluid chamber 13 of the filter assembly 12. The front end 17 of the housing 18 is closed by a cover 20, which is secured to the housing by means of screws 22. A seal 24 is provided between the radial surface 23 of the cover extension 21 extending into the housing and the internal surface of the housing to provide a fluidtight assembly.

The housing 18 defines a chamber 26 which is in communication with the atmosphere through an appropriate vent 14. A guide rod 28 extends axially through the chamber 26 and has a threaded end 30 for fixed threading attachment to the housing cover 22 through a central aperture 32, which is sealed as at 34. The other end of the guide rod is provided with a plunger 36 which has a hub portion 38 by which the plunger 36 is attached to the guide rod by means of a cotter pin 40 or the like extending through the plunger hub and through the guide rod. The end of the guide rod is formed with a nut head 42 to facilitate screwing of the guide rod into the cover 20 and, in assembly, the face 35 of the plunger 36 abuts against the nut head 42.

The rear end 19 of the housing 18 has a central opening 44 for extension therethrough of the rear end 46 of a compound piston and cylinder assembly 48, which is disposed for reciprocation within chamber 26 along the guide rod 28. The compound piston and cylinder assembly 48 comprises a piston portion 50 contained within the chamber 26 and a cylinder portion 52 coaxially secured to the piston 50 for simultaneous movement with the piston portion. The piston portion 50 of the compound piston and cylinder assembly is made up of a cylindrical sleeve 54 adapted for sliding movement along the guide rod 28 by means of its central bore 56. The front end of the sleeve 54 extends into a radial flange 58 which is sealed off against the guide rod by an O-ring 60. The radial flange 58 is provided with opposite radial cutouts or slots 62 and 63 (FIG. 3). A dowel 64 extends into one slot 62 and is secured to the cover 20 for axial extension into the chamber 26. The dowel 64 is provided to prevent rotation of the compound piston and cylinder assembly during actuation.

A rotatable crankpin 67 (indicated in dot and dash lines in FIG. 1) extends into the other slot 63. The crankpin 67 is provided with a regular twist around its axis and extends for rotation into the cover 20. The shaft end 69 of the crankpin extends out of the cover for attachment to a pointer 71 which has an integral cam face 73 adapted upon rotation of the pointer to actuate the button 75 of a switch 77. It will be understood that the pointer 71 is adapted to cooperate with a dial face to indicate changed condition of a filter element and the switch 77 is provided to actuate a pump or a motor for filter rotation, as explained previously with reference to the aforementioned U.S. Pat. Nos. 3,425,557 and 3,425,558.

Rearwardly, the sleeve 54 expands into an enlarged head portion 66 which defines a circumferential recess 68 extending around the sleeve 54, which is adapted to provide clearance for the dowel 64 and crankpin 67 upon advance of the piston assembly towards the cover 20. The head portion 66 is provided with a radial flange 70 which receives an external sealing member 72 for sliding engagement with the internal surface 25 of the pressure chamber 26.

The cylinder portion 52 comprises an open-ended cylindrical housing 74 the outer end of which is closed by a cover 76 provided with suitable shims or gaskets 78 for sealing against the housing 74. The cylindrical housing 74 is coaxially attached to the outer surface 65 of the piston head portion 66 by means of long bolts 80 which simultaneously secure the cover 76 to the housing and whereby upon actuation of the compound piston and cylinder assembly the piston portion 50 and the cylindrical portion 52 will be moved as a unit, as will be described. Suitable gaskets 82 are provided to be clamped between the housing and the piston head portion 66 to seal the abutting interfaces.

The end of the guide rod with the plunger 36 extends into the cylindrical housing 74 and, as shown in FIG. 1, in the inactive position of the device the rear surface 65 of the head portion 66 of the piston abuts against the end of the hub 38 of the plunger 36, which thereby limits the rearward extension of the piston 50 since the guide rod is fixed to the cover 20. The piston and cylinder assembly is normally held in this position by means of a compression spring 84 positioned around the guide rod 28 within the chamber 26, and which is biased between the cover 20 and the front of the piston flange 70.

The plunger 36 within the cylindrical housing 74 divides the housing into a front pressure chamber 86 in front of the plunger 36 and a rear pressure chamber 88 in rear of the plunger 36. The radial surface of the plunger 36 is chamfered relative to the body of the plunger to provide a radial edge 37, which slidingly engages the internal surface 75 of the cylindrical housing 74. It will be noted that the plunger 36 is not sealed against the internal surface 75 of the cylindrical housing for a purpose to appear.

The cover 20 is provided with a passage 90 extending from the radial surface of the cover to the axial center thereof to be in communication with an axial bore 92 extending through the guide rod 28. The axial bore communicates with transverse passages 94 behind the radial flange 58 of the piston portion 50, which extend through to the surface of the guide rod to open into a radial channel 96 provided by a clearance between the radial surface of the guide rod and the inner surface of the central bore 56 through the cylindrical sleeve 54 of the piston 50. Normally, the radial channel 96 is closed off rearwardly by the abutment of the piston head 66 against the hub portion 38 of the guide rod plunger 36, as seen in FIG. 1, except for a relatively small bypass orifice 98 (see also FIG. 4) which bypasses the hub portion 38 to establish communication of the radial channel 96 with the front pressure chamber 86 in the cylindrical housing 74.

The opening of the passage 90 in the cover 20 comprises a fluid inlet 100 which is connected to a conduit 102 leading to a source of pressurized fluid 104.

With additional reference to FIG. 1, the device operates as follows: By way of reference to the aforementioned U.S. patents, as one of the filter elements (not shown) in the dual filter assembly 12 becomes gradually clogged and thus tends to reduce the fluid flow through the filter element, the pressure in the fluid flow chamber 13 of the filter assembly increases in accordance with the clogged condition of the filter element and thereby exerts increased pressure on the piston 50 to overcome the force of the spring 84.

Due to the open communication with the fluid pressure source 104, pressure in the front pressure chamber 86 increases accordingly at a rate in correspondence with the advance of the piston 50 towards the cover 20.

Advancement of the piston 50 towards the cover 20 due to increased pressure in the fluid flow chamber 13 causes the twisted crankpin 67 to be rotated to thus rotate the pointer 71 for visual indication of the respective filter condition outside on the cover 20 in the manner known from the aforementioned U.S. patents.

As the piston 50 continues to move toward abutment of the flange 58 against the cover 20 (which occurs upon a predetermined degree of clogging of the filter element fluid under pressure continues to fill the expanding front pressure chamber 86. As the device comes to the abutting position the pressure will equalize in the chambers 86 and 88 as the fluid meters around the radial edges 37 of the plunger 36.

The switch 77 in the meantime has been energized by rotation of the pointer 71 to initiate rotation of the dirty filter ele-

ment out of the fluid flow chamber for replacement with a clean filter element (not shown). The clogged filter element, as described in the reference patents, is then disposed in a flushing chamber (not shown) of the dual filter assembly **12**, where it is cleaned by fluid from the normal fluid flow chamber (preferably by utilizing a pump as described in the reference patents). Upon completion of the exchange of the filter elements in the dual filter assembly **12**, normal fluid flow through the fluid flow chamber **13** will be reestablished, that is, pressure will be reduced to the designated value permitting the spring **84** to return the piston **50** to the right (FIG. **1**) and toward the chamber **13**. The reduction in pressure in chamber **13** produces a pressure differential across the cover **76** causing an expansion of chamber **88** and thus a movement of cylinder **52** to the right as seen in FIG. **1**. The conjoined effort of the expansion of chamber **88** with the stored energy of the spring **84** positively returns the combined piston and cylinder assembly **48** to its initial starting position and thereby assures complete return of the pointer **71** to zero and deenergization of the switch **77**. Thus, the present fluid pressure device assures at all times full active and return stroke when used as an indicator device to always produce a true indication of the filter element. Thus, the present novel fluid pressure device eliminates the requirement for having to maintain a continued watch on the condition of the filter element and provides at all times a positive return of the indicating device to always produce a true reading.

The device can be used, for instance, to perform desired mechanical work by appropriate design of the pressure chamber volumes and piston areas and in correspondence with the power of the bias spring any desired piston movement can be accomplished; that is, the piston can be permitted to move faster in one direction than in the other, or, conversely, exert more pressure in one direction of movement than in the other. Moreover, the present improved fluid pressured can be used as a mechanical movement or power transmitting device in the sense of the disclosure of a "cylinder construction" in U.S. Pat. No. 3,335,642, to B. O. Rosaen, according to the teaching therein. The present fluid pressure device can be used to replace a two-way piston cylinder assembly in these devices. These fluid cylinders are generally provided with a piston member movable within the cylinder in response to fluid pressure directed to opposite sides of the piston. The movement of the piston or cylinder is then transmitted through a connection to produce the desired mechanical work. The problem connected with these types of power cylinders is that the connecting rod attached to one side of the piston reduces the effective piston area, which means that an equal rate of fluid flow causes the piston member to move in the two directions at different rates of speed. Further, this difference in effective area on opposite sides of the piston also results that, if different external forces are applied in opposite directions to the piston and to the cylinder, a relative movement between these members will be produced.

By means of the present disclosure, an improved double-acting piston and cylinder structure has been provided which effectively avoids the drawbacks of conventional double-acting piston and cylinder structures by appropriate determination of the volumes of the several pressure chambers, piston areas and size of the bypass orifices.

Having described my invention, I claim:

1. A fluid pressure device comprising a cylindrical housing having a chamber, a guide rod extending into said chamber, a combined piston and cylinder assembly reciprocably disposed on said guide rod within said chamber, said guide rod having a plunger at its end slidably disposed within the cylinder of said combined piston and cylinder assembly and dividing said cylinder into a first pressure chamber on one side of said plunger and a second pressure chamber on the other side of said plunger, spring means normally biasing said combined piston and cylinder assembly in a first direction, means connecting said first pressure chamber with a source of fluid pressure to thereby produce movement of said combined piston and cylinder assembly in a second direction and against said spring means, means associated with said plunger to establish fluid communication between said first pressure chamber and said second pressure chamber to permit fluid from said first pressure chamber to pass into said second pressure chamber at a predetermined rate to thereby produce movement of said combined cylinder and piston assembly in said first direction, said guide rod being secured to an end wall of said cylindrical housing, said means connecting said first pressure chamber with said source of fluid pressure comprising a first channel extending through said end wall and a second channel extending through said guide rod, said second channel being connected to a passage within said piston which is open towards said first pressure chamber.

2. A fluid pressure device as defined in claim **1**, in which said passage within said piston comprises a cylindrical bore through which said guide rod extends, having a diameter larger than the diameter of said guide rod.

3. A fluid pressure device as defined in claim **2**, in which said plunger is provided with means to normally substantially close said passage when the piston is in inactive position.

4. A fluid pressure device as defined in claim **3**, in which said piston is provided with an orifice connecting said passage to said first pressure chamber bypassing said connecting means to normally close said passage to permit fluid to enter said first pressure chamber to move said piston away from said plunger and said means normally closing said passage to thereby fully open said passage to said first pressure chamber.

5. A fluid pressure device as defined in claim **1**, in which said spring means is retained around said guide rod between said piston and said end wall of said housing.

6. A fluid pressure device comprising a cylindrical housing having a chamber, a guide rod extending into said chamber, a combined piston and cylinder assembly reciprocably disposed on said guide rod within said chamber, said guide rod having a plunger at its end slidably disposed within the cylinder of said combined piston and cylinder assembly and dividing said cylinder into a first pressure chamber on one side of said plunger and a second pressure chamber on the other side of said plunger, spring means normally biasing said combined piston and cylinder assembly in a first direction, means connecting said first pressure chamber with a source of fluid pressure to thereby produce movement of said combined piston and cylinder assembly in a second direction and against said spring means, means associated with said plunger to establish fluid communication between said first pressure chamber and said second pressure chamber to permit fluid from said first pressure chamber to pass into said second pressure chamber at a predetermined rate to thereby produce movement of said combined cylinder and piston assembly in said first direction, said means associated with said plunger comprising a radial contact surface on said plunger normally sealing said first pressure chamber from said second pressure chamber and being pressure responsive to bypass fluid in metered amounts from said first pressure chamber to said second pressure chamber.

7. A fluid pressure device comprising a cylindrical housing having a chamber, a guide rod extending into said chamber, a combined piston and cylinder assembly reciprocably disposed on said guide rod within said chamber, said guide rod having a plunger at its end slidably disposed within the cylinder of said combined piston and cylinder assembly and dividing said cylinder into a first pressure chamber on one side of said plunger and a second pressure chamber on the other side of said plunger, spring means normally biasing said combined piston and cylinder assembly in a first direction, means connecting said first pressure chamber with a source of fluid pressure to thereby produce movement of said combined piston and cylinder assembly in a second direction and against said spring means, means associated with said plunger to establish fluid communication between said first pressure chamber and said second pressure chamber to permit fluid from said first pressure chamber to pass into said second pressure chamber

at a predetermined rate of pressure in said first pressure chamber to thereby produce movement of said combined cylinder and piston assembly in said first direction, and means to restrain said piston and cylinder assembly from rotation around said guide rod.

8. In combination, means forming a chamber with a source of pressurized fluid connected with said chamber, a piston member reciprocably movable within said chamber between a first and a second position, said piston member being normally biased toward a first position and provided with a cylindrical portion extending therefrom, a guide rod disposed within said chamber and extending through said piston member and into said cylindrical portion, said guide rod being provided with a plunger slidably disposed within said cylindrical portion and dividing said cylindrical portion into a first pressure chamber in the front of said plunger and a second pressure chamber in the rear of said plunger, first means to establish fluid communication between said first pressure chamber and a source of fluid pressure upon movement of said piston member toward said first position, second means associated with said plunger to meter fluid around said plunger and into said second pressure chamber at a predetermined rate to positively return said piston member to said second position, said first means establishing fluid communication comprising a first channel in communication with said source of fluid pressure extending through a wall portion of said chamber, a second channel connected to said first channel and disposed in transverse direction thereto and axially through said guide rod, a third channel transversely disposed and intersecting said second channel for extension through the surface of said guide rod, and a passage within said piston and in communication with said third channel and opening into said first pressure chamber through an orifice provided in said piston.

9. In combination, means forming a chamber with a source of pressurized fluid connected with said chamber, a piston member reciprocably movable within said chamber between a first and a second position, said piston member being normally biased toward the first position and provided with a cylindrical portion extending therefrom, a guide rod disposed within said chamber and extending through said piston member and into said cylindrical portion, said guide rod being provided with a plunger slidably disposed within said cylindrical portion and dividing said cylindrical portion into a first pressure chamber in the front of said plunger and a second pressure chamber in the rear of said plunger, first means to establish fluid communication between said first pressure chamber and a source of fluid pressure upon movement of said piston member toward said first position, second means associated with said plunger to meter fluid around said plunger and into said second pressure chamber at a predetermined rate to positively return said piston member to said second position, said second means associated with said plunger to meter fluid into said second chamber comprising a pressure-responsive radial contact surface on said plunger normally sealing said first pressure chamber from said second pressure chamber but yielding to meter fluid therepast upon an increase in pressure in said first pressure chamber beyond a predetermined value.

10. In combination, means forming a chamber with a source of pressurized fluid connected with said chamber, a piston member reciprocably movable within said chamber between a first and a second position, said piston member being normally biased toward the first position and provided with a cylindrical portion extending therefrom, a guide rod disposed within said chamber and extending through said piston member and into said cylindrical portion, said guide rod being provided with a plunger slidably disposed within said cylindrical portion and dividing said cylindrical portion into a first pressure chamber in the front of said plunger and a second pressure chamber in the rear of said plunger, first means to establish fluid communication between said first pressure chamber and a source of fluid pressure upon movement of said piston member toward said first position, second means associated with said plunger to meter fluid around said plunger and into said second pressure chamber at a predetermined rate to positively return said piston member to said second position, indicating means for indicating movement of said piston and comprising a pointer having a rotatable crank end connected to said piston member for rotatable actuation thereby upon movement of said piston within said chamber.

11. A fluid pressure device comprising a housing having a chamber open at one end, means connecting the open end of said chamber with a first source of fluid pressure, a piston axially slidably disposed in said chamber with one side exposed to said first source of fluid pressure and movable in said chamber in response to changes in the pressure differential across said piston, a cylinder joined to said piston and movable therewith, said cylinder having a cylinder chamber and a wall having one surface exposed to said cylinder chamber and an opposite surface of said wall exposed to said first source of fluid pressure so that said wall moves with said piston in response to changes in the pressure differential across said wall, means for pressurizing said cylinder chamber to aid in moving said piston in one direction.

12. A fluid pressure device comprising a housing having a chamber open at one end, means connecting the open end of said chamber with a first source of fluid pressure, a piston axially slidably disposed in said chamber with one side exposed to said first source of fluid pressure and movable in said chamber in response to the changes in the pressure differential across said piston, a cylinder joined to said piston and movable therewith, said cylinder having a cylinder chamber and a wall having one surface exposed to said cylinder chamber and an opposite surface of said wall exposed to said first source of fluid pressure so that said wall moves with said piston in response to the changes in the pressure differential across said wall, said cylinder having a second cylinder chamber, a second source of fluid pressure connected with said second cylinder chamber, metering means connecting said first-mentioned cylinder chamber with said second cylinder chamber to meter pressurized fluid to said first cylinder chamber upon expansion of said first cylinder chamber to thereby aid in movement of said piston in one direction.