June 6, 1961 D. H. YOUNG 2,987,047

FLUID-PRESSURE ACTUATED CONTROL APPARATUS

Filed Aug. 18, 1959 2 Sheets-Sheet 1

FIG. 1.

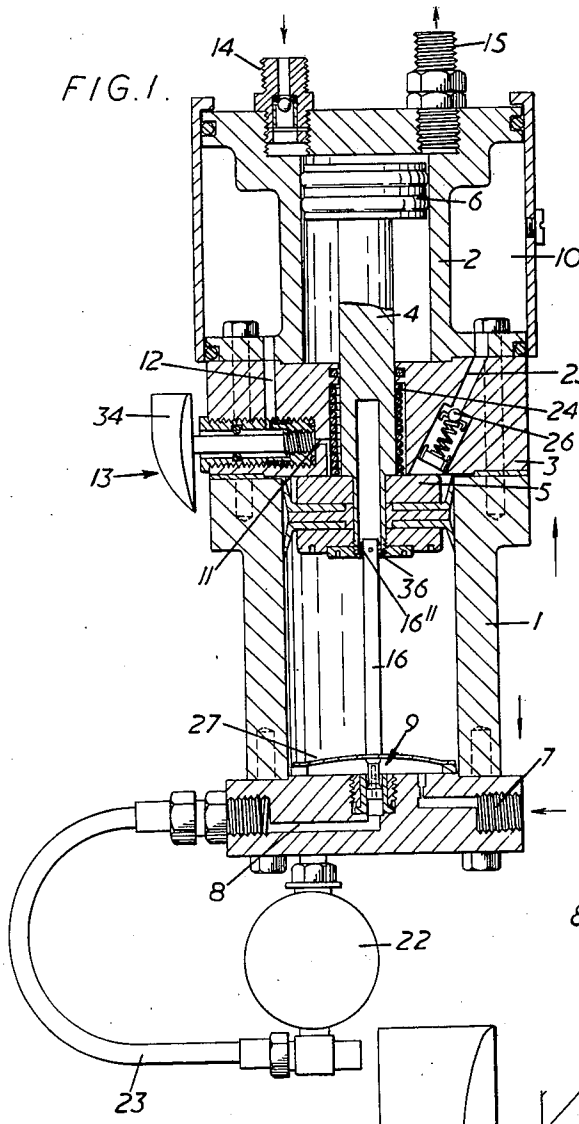


FIG. 5.

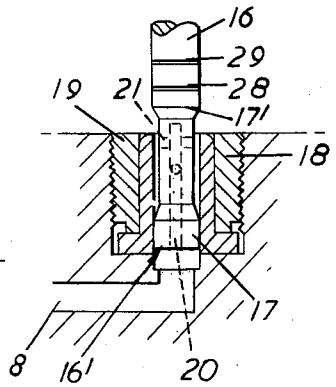
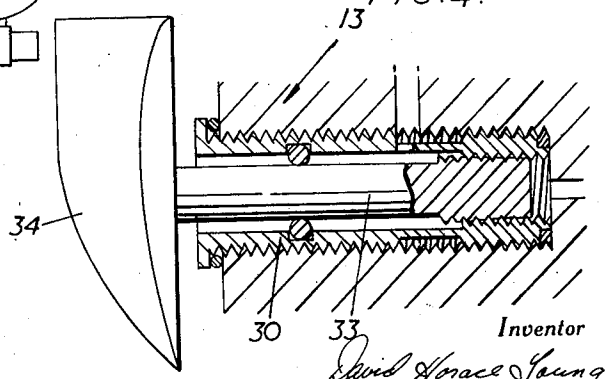


FIG. 4.



Inventor
David Horace Young
By
Watson, Cole, Grindle & Watson
Attorneys

June 6, 1961 D. H. YOUNG 2,987,047

FLUID-PRESSURE ACTUATED CONTROL APPARATUS

Filed Aug. 18, 1959 2 Sheets-Sheet 2

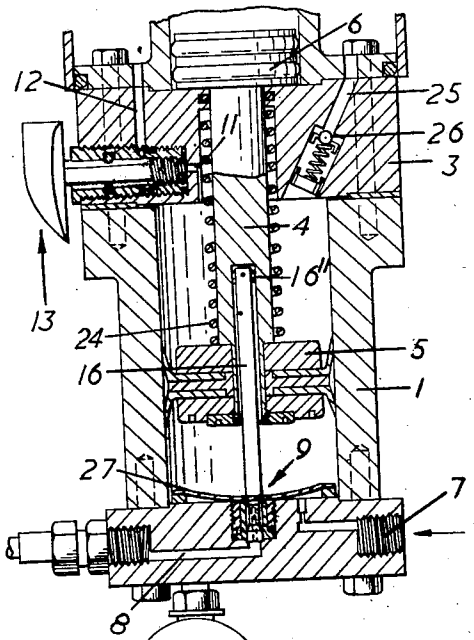


FIG. 2.

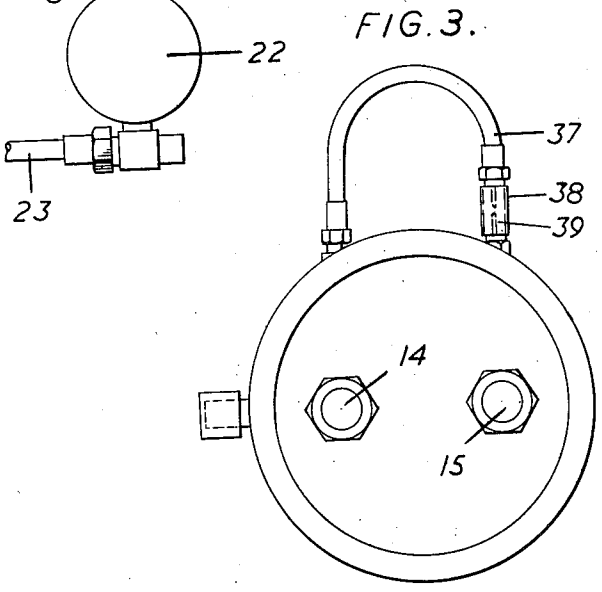


FIG. 3.

Inventor
David Horace Young
By
Watson, Cole, Grindle & Watson
Attorneys

United States Patent Office

2,987,047

Patented June 6, 1961

2,987,047

FLUID-PRESSURE ACTUATED CONTROL APPARATUS

David Horace Young, 54 St. James' Ave., Hampton Hill, Middlesex, England

Filed Aug. 18, 1959, Ser. No. 834,458
Claims priority, application Great Britain Sept. 9, 1958
9 Claims. (Cl. 121—38)

This invention relates to fluid-pressure actuated control apparatus. In its more important aspect the apparatus is adapted to dispense a lubricant or other substance at any desired controlled rate within limits. The apparatus of this invention is however not limited to this application but has numerous other applications: for example it may be utilized to actuate the blow-off valve of a steam boiler at predetermined time intervals.

The fluid-pressure actuated control apparatus according to my invention comprises a chamber having a wall movable in one direction to decrease the volume of the chamber by fluid pressure acting directly or indirectly on the wall, means for moving the wall in the opposite direction, a control member connected at one end to the wall, a reservoir for hydraulic fluid, a passageway connecting the reservoir with the interior of the chamber, means for regulating flow of hydraulic fluid from the chamber to the reservoir when the wall is moved in said one direction whereby to regulate movement of the control member, a fluid-pressure release means automatically actuated when the wall has moved in said one direction to a predetermined position whereby the fluid pressure on the wall is released and the wall is moved in said opposite direction, means for the passage of hydraulic fluid from the reservoir to the interior of the chamber when said wall moves in said opposite direction, and means automatically actuated when the wall has moved in said opposite direction to a predetermined position to restore the fluid pressure acting on the wall.

A preferred form of fluid-pressure actuated control apparatus will now be described with reference to the accompanying drawings, in which:

FIGURE 1 is a central vertical sectional view of the apparatus;

FIGURE 2 is a partial view, similar to that of FIGURE 1, showing the pistons and other parts in a different working position;

FIGURE 3 is a top plan view of the apparatus;

FIGURE 4 is an enlarged sectional view of the valve means for regulating the flow of hydraulic fluid to the reservoir, and

FIGURE 5 is a view to an enlarged scale of the valve means controlling the escape of pressure fluid from the lower cylinder.

The apparatus shown in the drawings comprises two axially aligned cylinders **1**, **2** separated by a transverse wall **3** provided with a through-hole which is axially aligned with the cylinders and through which extends a piston rod **4** having at its ends pistons **5**, **6** which work in the cylinders **1**, **2** respectively. The cylinder **1** beneath the piston **5** receives pressure fluid, e.g. steam, from an inlet **7** and the steam passes from the cylinder through a passageway **8** controlled by valve means which are indicated generally by the reference numeral **9**.

The space in cylinder **1** above piston **5** contains hydraulic fluid and this space is adapted to be placed in communication with a reservoir **10** surrounding the cylinder **2** by passageways **11** and **12**: flow through such passageways is controlled by valve means indicated generally by the reference numeral **13**. The space in cylinder **2** above piston **6** has an inlet **14** controlled by a non-return valve and an outlet **15** also controlled by a non-return valve.

The piston rod **4** has an axial bore extending upwardly from the lower end thereof and movable in this bore is a valve stem **16** having a collar **16''** pinned to the upper end thereof. The lower end portion of the valve stem **16** has an integral, axially aligned valve **16'** (FIGURE 5) comprising an intermediate reduced portion providing a head **17** and an annular shoulder **17'** which is adapted to seal with the upper end of a flanged sleeve **18** which is made for example of polytetrafluoroethylene and which is retained in the base of cylinder **1** by means of a screwed retainer ring **19**. In all positions of the valve stem the valve head **17** seals with the inner wall of sleeve **18**. The valve **16'** has extending from the lower end thereof an axial bore **20** communicating with a plurality of radial passageways **21** and it will be seen from FIGURES 1 and 5 that, with the valve **16'** in the raised position thereof shown in those figures pressure fluid entering the cylinder **1** will pass directly into outlet passageway **8** and thence to the steam trap **22** via pipe **23**.

A helical spring **24** surrounding piston rod **4** urges piston **5** to its lowermost position and a passageway **25** containing a spring-pressed ball **26** in a part thereof of enlarged diameter extends between reservoir **10** and the space in cylinder **1** above piston **5**. A substantially rectangular spring plate **27** secured at its ends to the base of cylinder **1** has two intermediately disposed longitudinally extending tongues having recessed ends which engage in an annular groove **28** in the valve stem **16** (see FIGURE 5) and this spring plate is adapted to snap the valve **16'** from the lowered position shown in Figure 2 to the raised position shown in FIGURES 1 and 5 and vice versa. The spring **27** may advantageously be backed by a rectangular spring plate (not shown) secured at its ends to the base of cylinder **1** and engaging in the annular groove **29** on the valve stem **16** (see FIGURE 5).

The action of the apparatus so far described is as follows. With the pistons **5**, **6** in the uppermost position thereof shown in FIGURE 1 pressure fluid entering cylinder **1** via inlet **7** passes freely to exhaust through radial passageways **21**, bore **20**, passageway **8** and pipe **23** and the piston **5** and piston **6** are moved downwardly under the action of spring **24**. On downward movement of the pistons the lubricant or other substance to be dispensed is drawn into cylinder **2** via inlet **14** from a suitable source (not shown) and the hydraulic fluid is drawn from reservoir **10** through conduit **25** into the space in cylinder **1** above piston **5**. Downward movement of the pistons continues until the end wall of the axial bore in the piston rod **4** engages the upper end of valve stem **16**. Further downward movement of the pistons causes spring **27** to snap past its dead centre position to the position shown in FIGURE 2 thereby causing valve shoulder **17'** to move into engagement with its seat thus preventing escape of pressure fluid from cylinder **1**. Pistons **5** and **6** then commence to move upwardly under the action of the pressure fluid, piston **5** forcing the hydraulic fluid through passageways **11** and **12** into reservoir **10**, flow through passageway **25** being prevented by ball **26**, and piston **6** forcing the substance to be dispensed through the outlet **15**.

The rate at which the hydraulic fluid is forced into the reservoir **10** and thus the rate at which the substance is dispensed preferably comprises an elongated passage of gradually decreasing cross-section through which the hydraulic fluid is caused to flow whereby its pressure is reduced, and means for varying the cross-section of the outlet of the passage. In the construction illustrated the rate at which the hydraulic fluid is forced into the reservoir **10** and thus the rate at which the substance is dispensed is controlled by the valve means **13** which comprises a sleeve **30** (see FIGURE 4) which is screwed into a socket in the wall **3** and which is internally threaded at its inner end. The valve means **13** also comprises

a stem 33 having a taper thread at its inner end which is screwed into the internally threaded portion at the inner end of the sleeve 30. The stem 30 is provided at its outer end with a handle 34 whereby the stem can be rotated and the axial position thereof varied.

The taper thread on the inner end of the stem 33 provides an elongated helical passage of gradually decreasing cross-section through which the hydraulic fluid is caused to flow in its passage from passageway 11 to passageway 12: the cross-section of the outlet of the passage may be varied by rotation of the handle 34. It will be appreciated that the hydraulic fluid in flowing between the threads of the sleeve 30 and the stem 33 has its pressure greatly reduced and this together with the fine control provided by the co-operating threads enable the rate at which the hydraulic fluid flows to the reservoir 10 to be very much more finely controlled than when a ball valve is used. The taper thread instead of being provided on the stem could be provided on the sleeve.

The thread may be of 8 mm. diameter and 0.75 mm. pitch and the taper on the thread may be from 0.315" to 0.303". The pistons in their ascent finally reach a position in which the annular lip 36 on piston 5 engages collar 16" on the valve stem 16 and the valve stem is then raised so that the spring 27 snaps to the position thereof in which valve 16' is in its open position. The above cycle of operations is then repeated.

A pipe 37 (FIGURE 3) connecting passageway 12 with reservoir 10 contains a sight glass 38 containing two spaced and axially aligned rods 39. In operative position of the apparatus the tube 37 extends vertically and the hydraulic fluid drips from the upper rod to the lower rod, thus enabling the rate at which the hydraulic fluid is forced into the reservoir 10, and thus the rate at which the substance is dispensed, to be readily judged.

The valve means 9 enable the direction of movement of the pistons to be very rapidly changed and it will be appreciated that the apparatus disclosed affords a simple means for closely regulating the rate at which a lubricant, a boiler water additive or other substance may be dispensed. Movement of the piston rod 4 may be utilized to control a wide variety of other operations, for example piston rod 4 may be so adapted that when it reaches predetermined positions in the cylinder 2 it opens and closes the blow-off valve of a steam boiler or effects numerous other controlling operations in a manner which will be clear to those skilled in the art.

In the apparatus illustrated the pressure fluid acts directly on the piston 5 forming the movable wall.

In the apparatus illustrated the spring 24 moves downwards piston 5 forming the movable wall but other means for moving the piston downwards may be employed and the pressure fluid used to move the piston upwards may be utilized to move the piston downwards. In one advantageous construction utilizing the pressure fluid to move the piston downwards a shunt passageway connects inlet 7 with the upper part of cylinder 1 and flow of pressure fluid through this passageway is controlled by a valve which, when the piston is ascending, is urged to the closed position thereof against the pressure of the pressure fluid by the pressure of the liquid being dispensed which is caused to act on the valve by means of a further passageway in communication with the outlet from cylinder 2. When the pressure of the pressure fluid on the lower face of piston 5 is released, such fluid opens the valve in the shunt passageway so that the fluid then acts on the upper face of piston 5 to move it downwards until the pressure on the lower face of the piston is restored when the valve is again closed and the piston moves upwards, the wall of cylinder 1 being provided with a bleed hole to permit the escape of pressure fluid from the space in the cylinder above the piston.

I claim:

1. A fluid-pressure actuated control apparatus comprising a chamber having a wall movable in one direction to decrease the volume of the chamber by fluid pressure acting on the wall, means for moving the wall in the opposite direction, a control member connected at one end to the wall, a reservoir for hydraulic fluid, a passageway connecting the reservoir with the interior of the chamber, means for regulating flow of hydraulic fluid from the chamber to the reservoir when the wall is moved in said one direction whereby to regulate movement of the control member, said flow regulating means comprising an elongated passage of gradually decreasing cross section through which a hydraulic fluid is caused to flow whereby its pressure is reduced and means for varying the cross section of the outlet of the passage, a fluid-pressure release means automatically actuated when the wall has moved in said one direction to a predetermined position whereby the fluid pressure on the wall is released and the wall is moved in said opposite direction, means for the passage of hydraulic fluid from the reservoir to the interior of the chamber when said wall moves in said opposite direction, and means automatically actuated when the wall has moved in said opposite direction to a predetermined position to restore the fluid pressure acting on the wall.

2. A control apparatus as claimed in claim 1, wherein the elongated passage is helical and is provided by a taper thread on one of two co-operating threaded members.

3. A fluid-pressure actuated control apparatus comprising a cylinder having a piston forming a chamber and movable in one direction to decrease the volume of the chamber by fluid pressure acting on the piston, means for moving the piston in the opposite direction, a piston rod forming a control member and connected at one end to the piston, a reservoir for hydraulic fluid, a passageway connecting the reservoir with the interior of the chamber, means for regulating flow of hydraulic fluid from the chamber to the reservoir when the piston is moved in said one direction whereby to regulate movement of the control member, said flow regulating means comprising an elongated passage of gradually decreasing cross section through which a hydraulic fluid is caused to flow whereby its pressure is reduced and means for varying the cross section of the outlet of the passage, a fluid-pressure release means automatically actuated when the piston has moved in said one direction to a predetermined position whereby the fluid pressure on the piston is released and the piston is moved in said opposite direction, means for the passage of hydraulic fluid from the reservoir to the interior of the chamber when said piston moves in said opposite direction, and means automatically actuated when the piston has moved in said opposite direction to a predetermined position to restore the fluid pressure acting on the wall.

4. A control apparatus as claimed in claim 3, wherein the cylinder has an inlet for pressure fluid and an outlet therefor, a valve controls flow of pressure fluid through the outlet, and spring means are provided for snapping the valve to its open and closed positions when the piston in such cylinder reaches the predetermined positions thereof.

5. A control apparatus as claimed in claim 4, wherein the valve is carried by a stem and the reciprocable piston and rod assembly and the stem have co-operating abutments such that, when the piston in the cylinder forming the chamber moves in said one direction to said predetermined position, the valve stem is moved to cause the valve to snap to its open position, and, when such piston has moved in said opposite direction to said predetermined position, the valve stem is moved to cause the valve to snap to its closed position.

6. A control apparatus as claimed in claim 3, wherein the elongated passage is helical and is provided by a taper thread on one of two co-operating threaded members.

7. A valve for accurately controlling the rate of flow of fluids comprising means defining a cylindrical passage

having a length of internal thread therein, a valve body having an external thread therearound partially rotatably disposed in said internal thread, means for conducting fluid under pressure into one end of said passage on one side of said valve body, means connected to said body for effecting rotary adjustment thereof with consequent adjustment of the relative axial positions of said threads, one of said threads being tapered, whereby the interengaging portions of the respective threads define between them an elongated helical flow passage, the minimum cross-sectional area of which is varied incident to said adjustment.

8. A valve as defined in claim 7, wherein one of said

threads is of uniform cross section to cooperate with said tapered thread in defining tapered flow passage.

9. A valve as defined in claim 7, wherein said valve body includes a stem projecting from the other end of said cylindrical passage and having a control handle thereon.

References Cited in the file of this patent

UNITED STATES PATENTS

1,920,285	Wilkins et al.	Aug. 1, 1933
1,998,873	Kingsbury	Apr. 23, 1935
2,252,939	McCoy	Aug. 19, 1941
2,371,085	Waters	Mar. 6, 1945