Oct. 4, 1960 N. A. NELSON 2,954,801

SHUTTLE VALVE

Filed Sept. 8, 1959 2 Sheets-Sheet 1

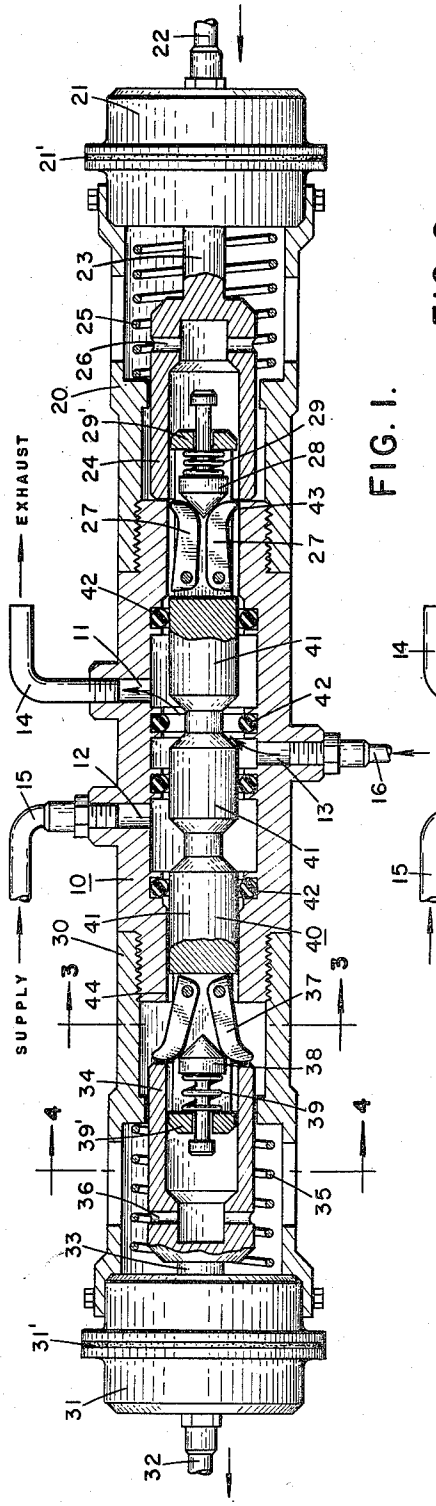


FIG. 1.

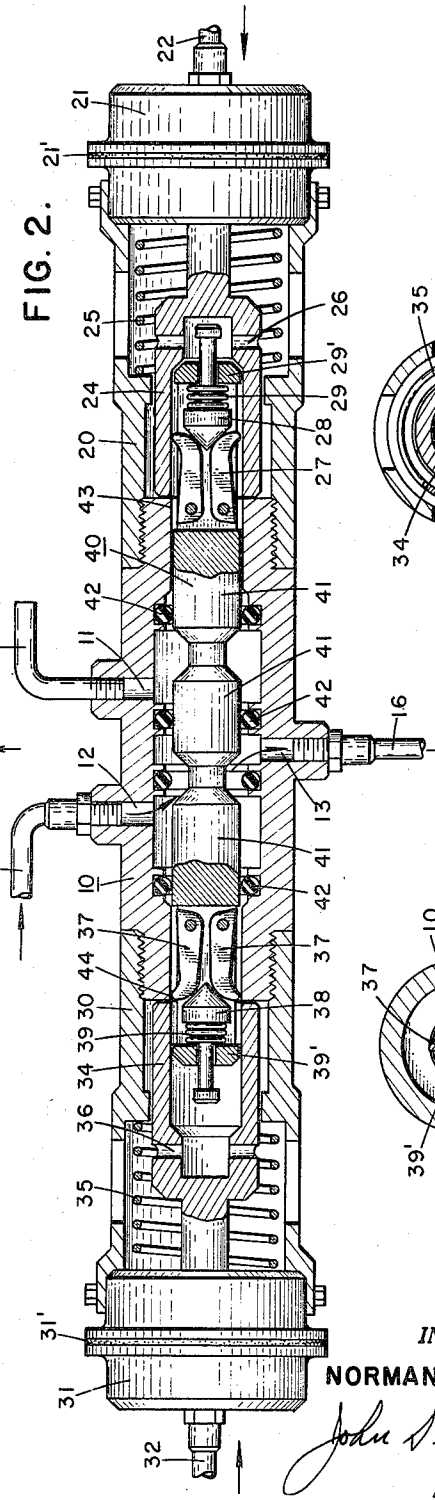


FIG. 2.

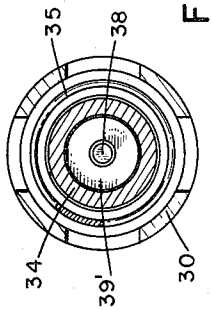


FIG. 4.

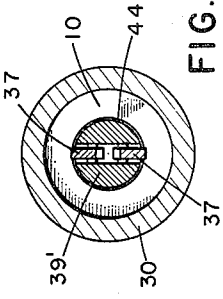


FIG. 3.

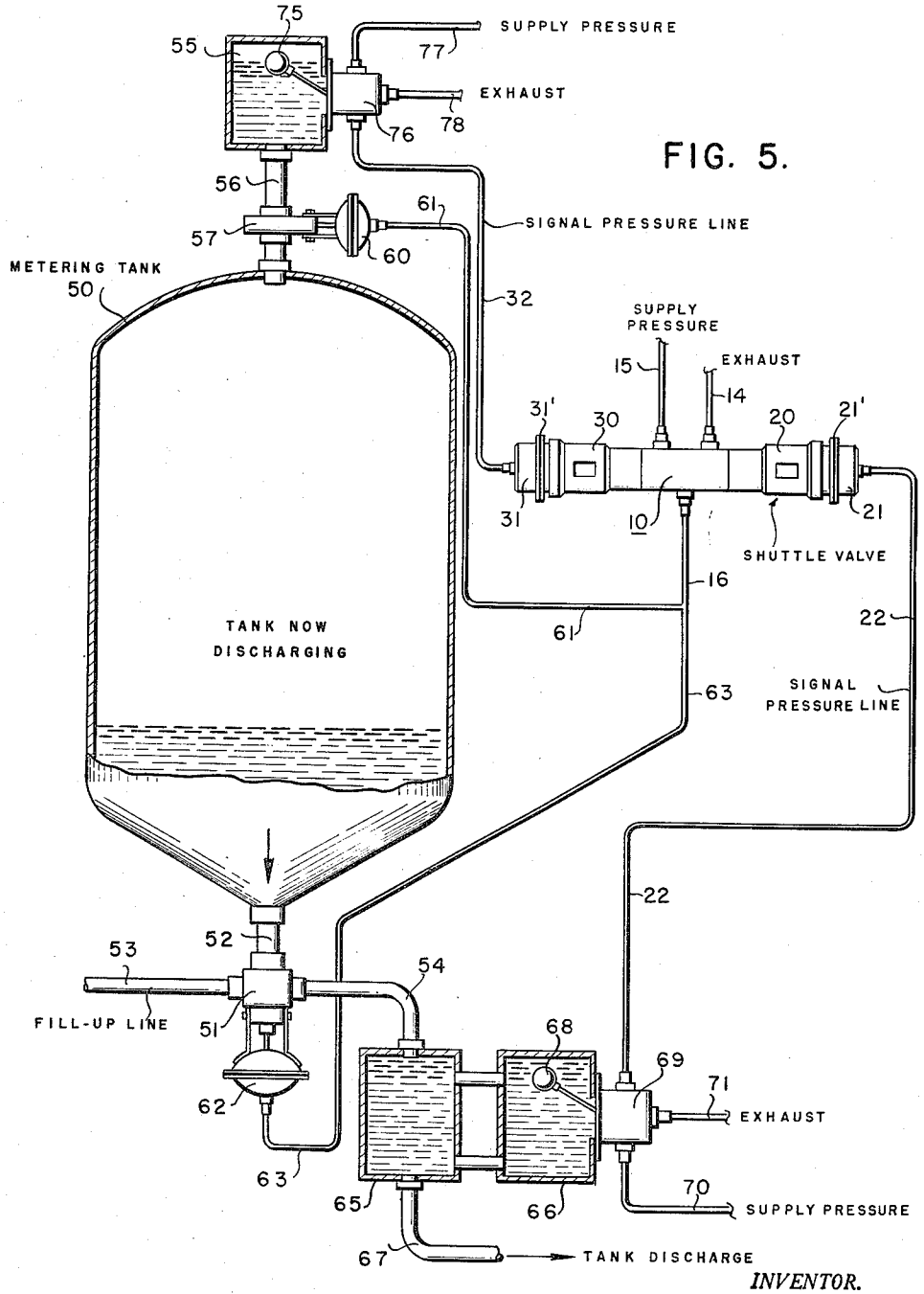
INVENTOR.
NORMAN A. NELSON,
John V. Schneider
ATTORNEY.

Oct. 4, 1960 N. A. NELSON 2,954,801

SHUTTLE VALVE

Filed Sept. 8, 1959 2 Sheets-Sheet 2

FIG. 5.



INVENTOR.

NORMAN A. NELSON

BY John D. Schneider

ATTORNEY.

United States Patent Office 2,954,801 Patented Oct. 4, 1960

2,954,801

SHUTTLE VALVE

Norman A. Nelson, South Houston, Tex., assignor, by mesne assignments, to Jersey Production Research Company, Tulsa, Okla., a corporation of Delaware

Filed Sept. 8, 1959, Ser. No. 838,781

2 Claims. (Cl. 137—620)

This invention concerns a self-returning pneumatic actuator or shuttle valve adaptable for use in fluid pressure control systems. More particularly, the invention concerns a shuttle valve of this nature which utilizes an umbrella latch type drive mechanism.

In certain pneumatic valve control systems employing pilot pressure actuated valves operated sequentially by two separate fluid pressure signals, a shuttle valve is used to direct the signals to the valves. This double signal control requires that the shuttle valve operate while an opposing signal is still in effect. It is possible to operate the shuttle valve in this manner by using special valve relays to block off the opposing signal from the source and bleed it off at one end of the shuttle valve. This permits operation of the shuttle valve by the other signal. The valve relay type control system can be eliminated by employing a special disengaging linkage between the pressure actuated valves of the control system and the shuttle valve itself. The invention to be described is of this type.

Briefly, the invention comprises a shuttle valve which includes a valve body provided with openings for transmitting fluid therethrough; a valve stem having first and second positions slidably arranged in the valve body and adapted to control fluid flow through the openings; a spring-biased sleeve movable in response to fluid pressure signals arranged on each end of the valve body; pivotal dogs having first and second positions arranged on each end of said valve stem, said dogs engaging said sleeve to prevent movement of said valve stem into said sleeve when said dogs are in said first position and permitting movement of said valve stem into said sleeve when said dogs are in said second position; and means for urging said dogs to their first positions; said valve body wall urging said dogs to their second positions at one end of said valve stem when said valve stem is in its first position and urging said dogs at the other end of said valve stem to their second positions when said valve stem is in its second position.

The objects and advantages of the invention will be more apparent from a more detailed description of the invention taken in conjunction with the drawings wherein:

Fig. 1 is a partly sectional view showing the shuttle valve in one position;

Fig. 2 is a view similar to that of Fig. 1 showing the shuttle valve in another position;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1; and

Fig. 5 is a schematic illustration showing the shuttle valve positioned in the control system of an automatic metering device.

Referring to the drawings in greater detail, Figs. 1 and 2 show a valve body 10 provided with openings 11, 12, and 13. An exhaust conduit 14 is connected to opening 11; a supply conduit 15 is connected to opening 12; and a control conduit 16 is connected to opening 13.

A housing 20 interconnects one end of valve body 10 and a diaphragm housing 21 which contains a diaphragm 21'. Fluid inlet and outlet conduit 22 connects to one side of the diaphragm in diaphragm housing 21. The other side of the diaphragm is connected to a rod 23, the free end of which forms a sleeve 24. A spring 25 is arranged in housing 20 and urges the diaphragm and connected rod 23 and sleeve 24 in the right-hand direction, as seen in the figures. Sleeve 24 is provided with openings 26 which function to release fluid from the interior of sleeve 24.

The other end of valve body 10 has connected thereto apparatus identical in all respects to the apparatus just described. Thus, housing 30, diaphragm housing 31 containing a diaphragm 31', conduit 32, rod 33, sleeve 34, spring 35, and openings 36 are similar to elements 20 to 26, respectively.

A slide valve stem 40 provided with sealing surfaces 41 is arranged in valve body 10. Various O-ring seals 42 arranged on valve body 10 engage surfaces 41 to control fluid flow through conduits 14, 15, and 16. Thus, as seen in Fig. 1, with valve stem 40 in the left-hand position, openings 11 and 13 are in fluid communication and fluid flow through openings 12 and 13 is sealed off. As viewed in Fig. 2, with valve stem 40 in the right-hand position, fluid flow through openings 11 and 13 is sealed off and openings 12 and 16 are in fluid communication. Each end of valve stem 40 is provided with outwardly and inwardly pivotal dogs, designated 27 (right-hand side) and 37 (left-hand side). Sleeves 24 and 34 have arranged therein biasing members which include conically shaped members 28, 38 biased toward the dogs by springs 29, 39, respectively, supported on piston members 29', 39' movable within sleeves 24 and 34, respectively, for urging dogs 27 and 37, respectively, outwardly. The inner surfaces 43 and 44 of valve body 10 engage dogs 27 and 37, respectively, to urge them inwardly to retracted positions when valve stem 40 is moved to the left-hand and right-hand positions, respectively. Instead of using biasing members 28, 29 and 38, 39 to expand dogs 27 and 37, respectively, outwardly spring biasing members may be attached directly to the dogs.

Although seals 42 are preferably O-ring seals, any suitable type sealing means may be employed.

The positions of valve stem 40 and sleeves 24, 34, as seen in Fig. 1, resulted from fluid pressure transmitted through conduit 22 and the exhaust of fluid pressure from conduit 32 which caused rod 23 and sleeve 24 to be moved to the left by movement of the diaphragm in housing 21 which, in turn, moved valve stem 40 through abutment with dogs 27 which were biased outwardly by members 28, 29, and 29'. Upon reaching wall 43, dogs 27 were caused to retract. As seen in the left-hand side of Fig. 1, dogs 37 expanded when movement to the left was initiated which causes dogs 27 to abut the ends of sleeve 24. As seen in Fig. 2, even though a fluid pressure signal is maintained on the diaphragm of housing

21 via conduit 22, valve stem 40 may be moved to the right in response to a fluid pressure signal through conduit 32. This signal moves the diaphragm in housing 31 which moves rod 32 and sleeve 34 to the right, which, in turn, moves dogs 37 and attached valve stem 40 to the right-hand position. In this position dogs 27 and the right-hand end of valve stem 40 enter the interior of sleeve 24.

In order to obtain a clear understanding of the invention, a description of the operation of the shuttle valve in conjunction with a metering device will now be set forth.

In Fig. 5 is shown a metering apparatus similar to the apparatus disclosed in U.S. patent application Serial No. 586,964, filed May 24, 1956, by William A. Pitts, entitled "Positive Volume Fluid Meter."

As seen in Fig. 5, a metering vessel 50 is provided with a fluid inlet and outlet valve 51 connected to a conduit 52, an inlet conduit 53, and an outlet conduit 54. Arranged above vessel 50 is a chamber 55 which fluidly communicates with vessel 50 by means of a conduit 56 in which is arranged a valve 57. Valves 51 and 57 are spring-biased diaphragm type valves in which the valve element is moved to one position under the action of a fluid pressure signal and is moved to another position under the bias of a spring upon the exhaust of the fluid pressure signal. Thus, associated with valve 57 is a diaphragm 60 to which is connected a conduit 61. Similarly, valve 51 has associated therewith a diaphragm 62 to which is connected a conduit 63. Upon application of a fluid pressure signal to diaphragm 60 via conduit 61, valve 57 closes thereby preventing fluid communication between metering vessel 50 and chamber 55 via conduit 56. Valve 51 fluidly communicates conduits 52 and 54 and closes off fluid communication between conduits 52 and 53 upon application of a fluid pressure signal to diaphragm 62 via conduit 63. Valve 57 opens to permit fluid communication between metering vessel 50 and chamber 55 when fluid pressure is exhausted from diaphragm 60 through conduit 61. Valve 51 fluidly communicates conduits 52 and 53 and closes off fluid communication between conduits 52 and 54 when fluid pressure is exhausted through conduit 63. Discharge conduit 54 connects to control chambers 65 and 66, respectively, which chambers discharge through conduit 67. Chamber 66 is provided with a float 68 which, in turn, is connected to a valve 69. Connected to valve 69 are a fluid pressure supply conduit 70, an exhaust or vent conduit 71 and conduit 22. When float 68 in response to a level of liquid in chamber 66 is in the up-position; conduit 22 exhausts through exhaust conduit 71. However, when float 68 is in the down-position, a source of fluid pressure is supplied to conduit 22 through conduit 70. Chamber 55 is provided with a float 75 which is connected to a valve 76. Connected to valve 76 are a fluid pressure supply conduit 77, an axhaust or vent conduit 78, and conduit 32. When responsive to the level of liquid in chamber 55 float 75 moves to the up-position, fluid pressure is supplied through conduit 77 to conduit 32. In the down-position of float 75, conduit 32 exhausts through vent 78.

To facilitate understanding of the operation of the shuttle valve of Figs. 1–4, the same conduit designations have been made in Fig. 5 as were made in Figs. 1–4. Thus, conduits 61 and 63 connect to conduit 16.

In the illustration of Fig. 5, it is assumed that vessel 50 is in the process of discharging. A fluid pressure signal from the supply or source is transmitted through conduit 15 to conduit 16 and thence to conduits 61 and 63 and their respective diaphragms, 60 and 62, in order to maintain valve 57 closed and valve 51 in the discharge position.

Upon complete discharge of metering vessel 50, the liquid level in chamber 66 drops and float 68 moves to the down-position. In the down-position, fluid pressure

is supplied through conduit 70 to conduit 22 and thence into the right-hand side of the actuator or shuttle valve. This fluid pressure signal through conduit 22 moves diaphragm 21′ in diaphragm housing 21 which, in turn, moves rod 23 and attached sleeve 24 to the left. Since dogs 27 abut the end of sleeve 24, valve stem 40 also moves to the left. Movement of valve stem 40 to its left-hand position, shown in Fig. 1, closes off fluid communication between supply conduit 15 and conduit 16 and exhausts conduit 16 through conduit 14. Exhaust of conduit 16 exhausts conduits 61 and 63 thereby reversing valves 57 and 51. Thus, valve 57 opens and valve 51 moves to the fill-position wherein conduits 53 and 52 are in fluid communication. The liquid in chamber 55 discharges into vessel 50 via conduit 56 and open valve 57 and float 75 moves to the down-position. In the down-position, conduit 32 exhausts through vent 78.

When vessel 50 has filled completely, liquid passes through open valve 57 and conduit 56 into chamber 55 thereby moving float 75 to the up-position. Upon movement of float 75 to the up-position, a fluid pressure signal is supplied through conduit 77 to conduit 32. Since valve stem 40 is in the position shown in Fig. 1, the fluid pressure signal passes through conduit 32 into diaphragm housing 31 thereby moving rod 32 and sleeve 34 and connected valve stem 40 to the right-hand position, as shown in Fig. 2. Movement to the right-hand position is effected even though a fluid pressure signal is being supplied simultaneously to housing 21 via conduit 22 (since float 68 is in the down-position in which position a fluid pressure signal is supplied to conduit 22 via supply conduit 70). Thus, again the valves are reversed since when valve stem 40 assumes the right-hand position of Fig. 2, supply conduit 15 fluidly communicates with conduit 16 and fluid communication between exhaust conduit 14 and conduit 16 is closed off. Application of fluid pressure to conduit 16 transmits fluid pressure to conduits 61 and 63 and then to diaphragms 60 and 62, respectively, which, in turn, closes valve 57 and at the same time fluidly communicates conduits 62 and 64 and closes off fluid communication between conduits 62 and 63. Thus, metering vessel 50 begins the discharge cycle. The entire operation is then repeated.

The valve stem of Figs. 1 and 2 is adaptable for use with various fluid pressure control or other systems and the invention is not to be construed as limited to its use in the specific metering arrangement of Fig. 5.

Having fully described the apparatus, nature, operation, and objects of my invention, I claim:

1. A shuttle valve comprising a valve body provided with openings for transmitting fluid therethrough and a valve body inner wall, a valve stem having first and second positions slidably arranged in said valve body adapted to control fluid flow through said openings, a spring-biased sleeve movable in response to fluid pressure signals arranged on each end of said valve body, pivotal dogs having first and second positions arranged on each end of said valve stem, said dogs engaging said sleeve to prevent movement of said valve stem when said dogs are in said first positions and permitting movement of said valve stem into said sleeve when said dogs are in said second positions, means for urging said dogs to their first positions, said valve body wall urging said dogs at one end of said valve stem to said second position when said valve stem is in said first position and urging said dogs at the other end of said valve stem to said second position when said valve stem is in said second position.

2. A shuttle valve comprising a valve body provided with openings for transmitting fluid therethrough and a valve body inner wall, a valve stem having first and second positions slidably arranged in said valve body adapted to control fluid flow through said openings, spring-biased means movable in response to fluid pressure signals arranged on each end of said valve body,

pivotal means having first and second positions arranged on each end of said valve stem, said pivotal means engaging said spring-biased means to prevent movement of said valve stem when said pivotal means are in said first positions and permitting movement of said valve stem into said spring-biased means when said pivotal means are in said second position, means for urging said pivotal means to their first positions, said valve body wall urging said pivotal means at one end of said valve stem to said second position when said valve stem is in said first position, and urging said pivotal means at the other end of said valve stem to said second position when said valve stem is in said second position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,369,505	Ward	Feb. 13, 1945
2,601,990	Halzer	July 1, 1952
2,614,539	Ernst	Oct. 21, 1952
2,785,699	Creson et al.	Mar. 19, 1957
2,880,755	Brown	Apr. 7, 1959