SELF-RECYCLING TIME DELAY VALVE
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This invention relates broadly to fluid operated recycling valves and more particularly to an air powered self-recycling valve which alternately supplies air pressure to a pair of outlet ports after a predetermined time delay.

One of the objects of the invention is to provide a construction of self-recycling air supply slide valve, having a novel structure providing a predetermined recycling period.

Another object of the invention is to provide a construction of continuously recycling powered air pressure time delay valve for alternatingly supplying air pressure to one of two outlet ports having a novel time delay chamber structure which is more compact than similar structures heretofore known in the art.

A further object of the invention is to provide a construction of self-recycling valve for alternatingly delivering fluid under pressure to a pair of outlet ports after a predetermined time delay or recycling period which is relatively simple and compact in construction, and easy to assemble so as to lend itself to mass production techniques.

Other and further objects of the invention reside in the novel construction of the time delay chamber and the mechanisms controlled thereby, and will become apparent to one skilled in the art as the specification hereinafter following progresses, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of the self-recycling time delay valve of the invention, with connecting conduits shown in schematic form;

FIG. 2 is an enlarged longitudinal sectional view thereof, taken in the vertical plane;

FIG. 3 is a horizontal sectional view taken substantially along line 3—3 of FIG. 2; and

FIG. 4 is a fragmentary longitudinal sectional view similar to FIG. 2, but showing the valve members disposed in different operating positions.

The fluid of air powered valve of the invention is designed to alternately supply fluid or air pressure to one and then the other of a pair of outlet ports on a continuous basis, thus enabling the device to alternately supply air pressure to a pair of loads, connected to the outlet ports, which are adapted to be actuated by air pressure. The device of the invention has a novel time delay mechanism constructed therein, such that there is a consistent predetermined time delay between the continuous alternate energization of the outlet ports.

Referring to the drawings in greater detail—reference numeral 1 represents a main body portion having an axial bore 2 therethrough, a pair of outlet ports 3 and 4 transversely disposed in communication therewith through one side of the main body portion, and a centrally disposed axial inlet port 5 disposed intermediate a pair of exhaust ports 6 and 7, all disposed transversely through the opposite side of main body portion 1 in communication with axial bore 2.

Ports 3, 4, 5, 6 and 7 are threaded as shown in FIG. 3 to receive the respective conduits 8, 9, 10, 11 and 12. Air inlet conduit 9 is adapted for connection to a first load (LOAD I) to be powered by air pressure supplied therethrough, while air outlet conduit 8 is adapted for connection to a second load (LOAD II) to be powered by air pressure supplied therethrough, as schematically illustrated in FIGS. 1 and 3.

While the device of the invention has been designed mainly for operation by air under pressure for supplying air under pressure to a pair of load members, it is also to be understood that the device may operate with other type fluids, and air pressure is used throughout the specification only for purposes of illustration.

A hollow valve sleeve 13 is secured in axial bore 2 by means of O-rings 14 and is provided with annular recesses 15, 16, 17, 18 and 19 about the outer periphery thereof in communication with the hollow portion of valve sleeve 13 and with ports 3, 4, 5, 6, and 7, respectively. A slide valve member 20, having annular recessed portions 21, 22 and 23 on its outer periphery separated by lands 24, is longitudinally slidably disposed within hollow valve sleeve 13 such that lands 24 and the sealing O-rings carried thereby are in sliding engagement with the hollow bore of valve sleeve 13.

Slide valve member 20 is provided with a pair of axially aligned bores 25 and 26 in opposite ends thereof, the bottoms of which terminate in spaced relation with each other, centrally of valve member 20, and which are connected in communication with annular recessed portion 21 by means of transverse passages 27 and 28, respectively. A pair of slide valve head portions 29 and 30 are connected in axial bores 25 and 26, respectively, by means of sealing O-ring members, as indicated, and are provided with portions carrying O-rings 31 and 32, respectively, in sliding engagement with axial bore 2 of main body portion 1. Slide valve head portions 29 and 30 are provided with axial passages 33 and 34, respectively, placing axially aligned bores 25 and 26 in communication with opposite ends of bore 2. Slide valve head portions 29 and 30 are thus connected to slide valve member 20 in such a manner that members 29, 30 and 20 are adapted for longitudinal reciprocation as a unit within axial bore 2 and the hollow portion of valve sleeve 13. This combination forms a pressure drop operated slide valve.

Main body portion 1 is connected between the lower portions of a pair of end body portions 34 and 35 by means of bolts 36. Apertured gaskets 37 are connected between the members to insure an air tight connection when bolts 36 are tightened.

Referring to FIG. 2, end body portions or end members 34 and 35 carry the progressively smaller recessed bores 38, 39, 40 and 41, 42, 43, respectively, on the inwardly turned faces thereof, with bores 40 and 43 forming pressure chambers connected in communication with respectively opposite ends of axial bore 2 through passages 44 and 45.

The time delay chamber, indicated generally at 46, and which determines the preset time interval between the switching of air pressure supply from LOAD I through outlet port 4 to LOAD II through outlet port 3, consists of a tubular body portion 47, sealed at opposite ends by plug members 48 and 49 secured therein by lock wire members 50 screwed in through registered grooves in members 47, 48 and 49. O-rings 51 are provided about plug members 48 and 49 and extend into abutment with tubular body portion 47 to provide an air tight seal between the members at opposite ends of the chamber. Opposite ends of tubular body portion 47 extend into recessed bores 38 and 41 of end body portions 34 and 35, respectively, and the outwardly extending reduced diameter portions 52 and 53 of plug members 48 and 49 extend through recessed bores 39 and 42 which form exhaust chambers, and into a slip-fit connection with recessed bores 40 and 43, respectively, of end body portions 34 and 35, and are sealed therein by O-rings, as indicated in FIG. 2, to seal the outer ends of the pressure chambers formed by bores 40 and 43.

Plug members 48 and 49 provide stop surfaces 54 and 55 on the inner ends thereof, with the inner ends having recesses 56 and 57 which are respectively disposed in communication with: outlet port 4 through conduits 9, 59, air regulating valve 60, and conduit connector 61 thread-
ably connected through members 47 and 48; and outlet port 3 through conduits 8, 62, air regulating valve 63 and conduit connector 64 connected through the wall of plug member 49. The outwardly extending reduced diameter portions 52 and 53 of the plug members carry axial bores 65 and 66 adapted to connect the interior of bores 39 and 42 in communication with pressure chambers 48 and 43. A bleeder valve is connected in each axial bore 65 and 66 at opposite ends of the time delay chamber with each valve consisting of a piston member 67 disposed in sliding engagement with bores 65 and 66 and urged inwardly by the springs 68 to normally seal bleeder valve heads 69 and thus seal opposite ends of the chamber. Transverse passages 76 are provided through the outwardly extending portions 52 and 53, placing axial bores 65 and 66 in communication with exhaust chambers 39 and 42, which in turn are vented to the atmosphere through passages 71.

A guide shaft 72, extending axially through tubular body portion 47, is slidably supported on the inner ends of axial bores 65 and 66, with the terminating ends of the shaft disposed in spaced relation with the bleeder valve piston members 67.

Stop members 73 and 74 are connected adjacent opposite ends of the shaft and are adapted to engage opposite ends of piston member 75 which is slidably connected on shaft 72. O-ring 76 is connected to provide an air tight sliding seal between piston 75 and shaft 72, while O-ring 77 is connected about the outer perimeter of the piston to provide an air tight sliding connection between the piston and tubular body portion 47. Piston member 75 is provided with opposite end faces 78 and 79 adapted to abut stop surfaces 54 and 55 respectively. Piston member 75 is generally + shaped in cross section, with the end surfaces 80 and 81 of the outwardly extending end portions of the piston member, as previously indicated, adapted to abut stop members 73 and 74. Piston member 75 is preferably constructed of brass, or the like, with friction engagement between piston member 75 and guide shaft 72, maintained at a minimum by the finish on the outer surface of shaft 72 and the inner bore of the aperture through the piston, the position of O-rings 76 and 77, relative to each other, and lubrication on the shaft surface.

In FIG. 2, the air powered time delay valve of the invention is shown in a state whereby piston member 75 is beginning to slide on shaft 72 from left to right and air pressure from air inlet port 5 is being supplied to LOAD I, while LOAD II is deenergized. Starting with this position of the valve the operation is as follows: Air pressure from inlet port 5 is supplied through annular recess 17, annular recessed portion 21 and annular recess 16, to outlet port 4, and from there to LOAD I through conduit 9. Air pressure is also supplied through transverse passage 27, axial bore 25, axial passage 32, and passage 44 to pressure chamber 40 which is sealed by valve 69. At this time, pressure supplied to chamber 40 has no effect, since it is counterbalanced by air pressure supplied to chamber 43 through annular recessed portion 21, transverse passage 28, axial bore 26, axial passage 33, and end of axial bore 2, and passage 45. At this time pressure chamber 43 is also sealed by a bleeder valve head 69 which is urged onto its seat by spring 68. At the same time air pressure is supplied from conduit 9 through conduit 59, air regulating valve 60 and conduit connector 61 to recess 56 within time delay chamber. This air pressure behind piston member 75 causes the piston to slide along guide shaft 72 from left to right, as shown in phantom lines. Guide shaft 72, during the travel of piston 75, may laterally shift slightly from left to right so that its end is in abutment with piston member 75, but spring 68 is of such strength to overcome the force caused by the normal friction between piston 75, and shaft 72, to maintain bleeder valve head 69, on the right side of FIG. 2, in its seat. Piston 75 moves across time delay chamber 46 is a predetermined time interval. The range of the time cycle or the time delay is controlled by the air pressure supplied to the piston, and the volume of the time delay chamber. At constant air pressure different time delays may be obtained between the opening and closing of the various ports by inserting time delay chambers 46 of different volume in the valve device.

When piston member 75 reaches the opposite or right end of cylinder 40, piston and head 69 is in contact with stop member 74 on shaft 72, as indicated in phantom lines in FIG. 2. Continued air pressure on piston member 75 causes it to move further to the right, longitudinally shifting guide shaft 72 into abutment with piston member 67 until end face 79 of the piston abuts stop surface 55. While piston member 75 moves longitudinally to the right the air in chamber 46 on the right side of the piston is exhausted through conduit connector 64, air regulating valve 63, conduits 62 and 8, outlet port 3, annular recess 15, annular recessed portion 22, and annular recess 18 to exhaust port 6. Shaft 72 moves bleeder valve piston 67 longitudinally to the right, compressing spring 68 to move bleeder valve head 69 from its seat, as shown in FIG. 4. The opening of valve 69 releases air pressure from chamber 43 through bore 66, transverse passage 70, exhaust chamber 42, and passage 71, to the atmosphere. This immediate movement of the bleeder valve member 20, 29 and 30 to shift longitudinally to the right as shown in FIG. 4, due to the air pressure in chamber 46 and bore 25, and lack of air pressure on the right end of the slide valve member. As slide member 20 and its associated heads 29 and 30 shift to the position shown in FIG. 4, recessed portion 21 moves out of registration with annular recess 16, thus removing air pressure from outlet port 4 and to the left end of chamber 46 through conduit connector 61. LOAD I is also deenergized at this time. Air pressure is now applied from inlet port 5 through annular recess 17, annular recessed portion 21, and annular recess 16 to actuated LOAD II through outlet port 3 and conduit 8. Air pressure is also supplied through conduits 8 and 62, air regulating valve 63, and conduit connector 64 to the right side of piston member 75, causing guide shaft 72 to shift axially from right to left, clearing bleeder valve head 69 in pressure chamber 43, and causing the piston member to begin its sliding travel from right to left, along shaft 72, in the chamber in the predetermined time interval. When piston member 75 reaches the opposite end of the chamber, end surface 89 contacts stop member 73 shifting guide shaft 72 to the left, thus unseating valve head 69 to vent the pressure in chamber 49 to the atmosphere through 65, 70, 39 and 71. Release of pressure from chamber 49 immediately causes slide valve 20, 29 and 30 to shift from right to left cutting off air pressure to LOAD II, and to the right end of time delay chamber 46. The valve now assumes the position shown in FIGS. 2 and 3 with air pressure again supplied to LOAD I through outlet port 4, and the valve proceeds to again cycle itself. It can thus be appreciated that the valve continuously recycles itself in a predetermined interval as long as air pressure is applied to inlet port 5.

While piston member 75 is moving from right to left, air in the left side of chamber 46 is exhausted through connector 61, regulating valve 60, conduits 59 and 9, annular recess 16, annular recessed portion 23, and annular recessed portion 19 to exhaust port 7.

The device of the invention thus opens one outlet port for a predetermined period of time while closing the other outlet port, and then opens the other outlet port for the same predetermined period of time, while closing the first outlet port for the same period. By providing the floating or sliding connection of piston member 75 on guide shaft 72, for producing the predetermined time interval, applicant has been able to shorten the length of the shaft, which would be required if the members were rigidly connected, by two-thirds.
While the invention has been described in a preferred embodiment, it is realized that modifications can be made without departing from the spirit of the invention, and it is to be understood that no limitations upon the invention are intended other than those imposed by the scope of the appended claims.

What is claimed is:

1. In combination with a slide valve means of the type adapted to alternately connect and supply fluid pressure to a pair of outlet ports from an inlet port adapted for connection to a source of fluid pressure when fluid pressure is alternately released from opposite ends of the slide valve, means connecting opposite ends of said slide valve means to said inlet port, a pair of bleeder valve means connected to opposite ends of the slide valve means, longitudinally shiftable means connected between said pair of bleeder valve means to open one bleeder valve of said pair when longitudinally shifted, a pair of stop surfaces connected in spaced relation on said longitudinally shiftable means, piston means connected for sliding movement on said longitudinally shiftable means between said pair of stop surfaces, and means connected to the pair of outlet ports for alternately supplying fluid pressure to opposite sides of said piston means for sliding said piston means along said longitudinally shiftable means into contact with corresponding stop surfaces to thereby shift said longitudinally shiftable means to alternately open opposite bleeder valve means of said pair to release pressure from one end of the slide valve means and move it to the opposite state.

2. The combination as set forth in claim 1 including a pair of pressure chamber means connected between said pair of bleeder valve means and opposite ends of the slide valve.

3. The combination as set forth in claim 1 in which said pair of stop surfaces are connected adjacent opposite ends of said longitudinally shiftable means.

4. The combination as set forth in claim 1 in which said longitudinally shiftable means is axially movable in opposite directions to open opposite bleeder valve means.

5. The combination as set forth in claim 1 in which said stop surfaces are spaced apart a substantial distance on said longitudinally shiftable means, and said piston means is slideable in opposite directions on said longitudinally shiftable means from one stop surface to the opposite stop surface.

6. The combination as set forth in claim 5 in which said piston means slides in opposite directions between opposite stop surfaces in the same predetermined period of time.

7. The combination as set forth in claim 1 in which said longitudinally shiftable means and said piston means move in the same longitudinal direction.

8. The combination as set forth in claim 1 in which said pair of bleeder valve means are normally closed.

9. The combination as set forth in claim 1 including spring means connected to said bleeder valve means urging the same normally closed against the axial opening force of said piston means sliding on said axially shiftable means in its movement across said chamber.

10. In combination with a pressure drop operated slide valve mechanism of the type adapted to supply fluid pressure from an inlet port adapted for connection to a source of fluid pressure alternately to a pair of outlet ports while removing pressure from the opposite outlet port when fluid pressure is alternately released from opposite ends of the pressure drop slide valve mechanism, the improvement comprising means connecting opposite ends of said slide valve means to said inlet port, a pair of valve means connected to release pressure from opposite ends of the slide valve mechanism when opened, first longitudinally movable means connected to open opposite valve means of said pair when oppositely moved, second longitudinally movable means connected for longitudinal movement on said first longitudinally movable means for a predetermined distance and connected to move said first longitudinally movable means to open one of said valve means after traveling the predetermined distance, and means connected to the pair of outlet ports for alternately supplying fluid pressure to move said second longitudinally movable means in opposite directions to continuously recycle the slide valve mechanism.

11. The combination as set forth in claim 1 in which the slide valve also includes a pair of exhaust ports, and the side of the piston means opposite the side to which fluid pressure is applied is connected to a corresponding one of the exhaust ports through said means, one of the outlet ports and the slide valve.

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