

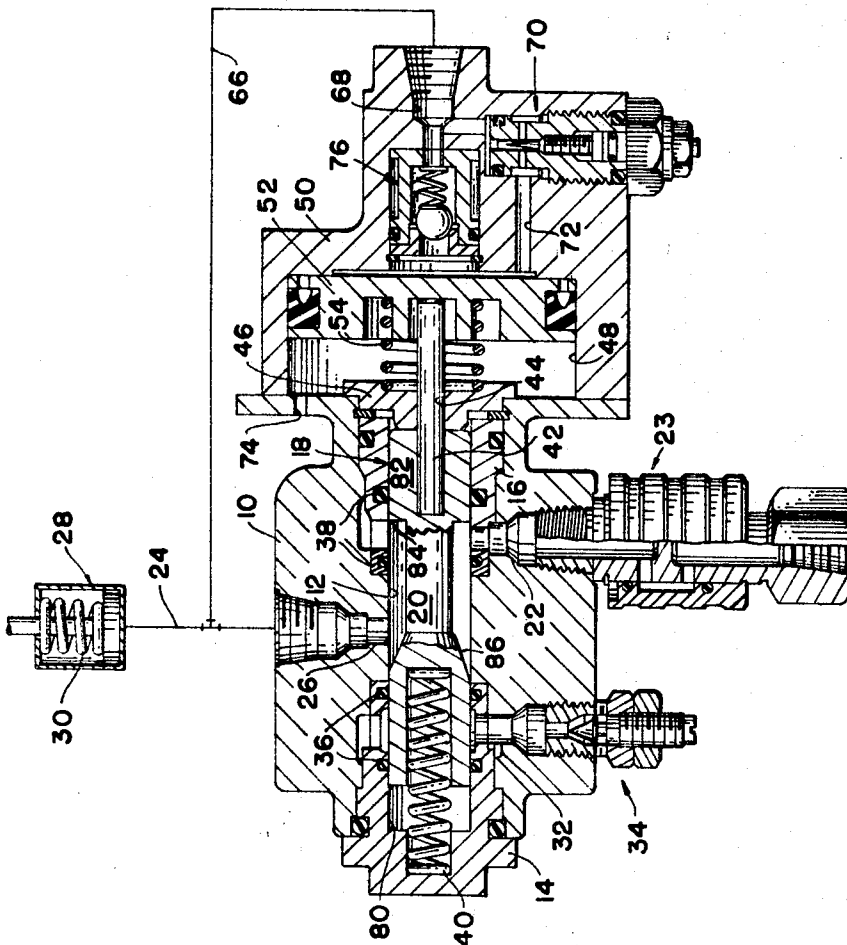
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PNEUMATIC RECIPROCATING VALVE

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PNEUMATIC RECIPROCATING VALVE

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This invention relates to a pneumatic control valve and has particular reference to a pneumatic control valve for automatically effecting timed reciprocation of a single acting power cylinder or positive displacement pump or the like. Devices such as measuring pumps or single acting power cylinders have been operated automatically at a desired number of cycles per minute by means of an electrical control including an electrically operated timer, and pneumatic control valves have also been utilized to achieve the desired automatic cycling. The invention represents a marked improvement over conventional cycling systems for driving single acting power cylinders and the like by providing a single pneumatic control valve which eliminates all electrical controls and obtains completely pneumatic cycling in a compact valve arrangement which is infinitely variable to produce any number of cycles per minute.

Accordingly the principal object of the invention is to provide a new and improved pneumatic control valve for automatic reciprocation of a work cylinder.

Another object of the invention is to provide a pneumatic control valve for a single acting power cylinder or pump in which the cycle of operation of the control valve is infinitely variable.

A further object of the invention is to provide a stall-free control valve for a single acting power cylinder.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating a preferred embodiment of the invention, wherein:

The drawing is a sectional view through a pneumatic control valve according to the invention.

A valve according to the invention includes a valve body 10 having a cylindrical bore 12 therein with end guides 14 and 16 mounted at opposite ends of the bore. A spool valve member 18 is reciprocally confined within bore 12 and is provided with a reduced portion 20 at the middle thereof. Inlet port 22 communicates with the bore 12 at one end thereof and is connected to a source of pneumatic fluid maintained under pressure through sleeve valve 23. Pressure line 24 connects work port 26 to a one-way pump or power cylinder illustrated schematically at 28. The power cylinder 28 is provided with a return spring 30. The work port 26 is located approximately midway between the ends of bore 12 and is in continuous communication with the reduced portion 20 of spool 18.

Exhaust port 32 communicates with bore 12 at the end thereof opposite inlet port 22 and is vented to atmosphere through adjustable needle or bleed valve 34. O-rings 36, 38 carried by end guides 14 and 16 respectively are provided to either side of the inlet and exhaust ports 22 and 32 so as to engage with the ends 80 and 82 of spool 18 and prevent undesired fluid flow through such ports. Return spring 40 is confined between the guide 14 and the adjacent end 80 of spool 18 so as to bias the spool away from the guide 14 to the position illustrated where the other end 82 of the spool is seated on spacer 46.

Spool 18 carries pin 42 which extends through opening 44 in spacer 46 into the cylindrical piston chamber 48 formed in valve cap 50 and abuts piston 52. The piston 52 is urged to the right hand end of the piston chamber 48 by a spring 54. Pressure line 66 communicates line 24 with an inlet 68 in cap 50 which is in communication with the right hand end of piston chamber 48 through

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adjustable time delay valve 70 and passage 72. The left hand end of piston chamber 48 is vented to atmosphere through opening 74 and a one-way check valve 76 is provided to vent the right hand end of chamber 48 to inlet 68.

With spool 18 positioned as illustrated and sleeve valve 23 in the "on" position, pressure fluid flows through inlet port 22, around the reduced portion 20 of spool 18, and through the work port 26 and pressure line 24 to the one-way power cylinder 28 so as to extend the same along its work stroke and compress return spring 30. At this time the left hand end 80 of spool 18 closes the exhaust port 32. Pressure fluid from work port 26 also flows through pressure line 66 to inlet 68 and is metered through bleed valve 70 into the right hand end of piston chamber 48. As the pressure in the right hand end of the piston chamber builds up, the piston 52, pin 42 and spool 18 are all shifted to the left against the resistance of springs 40 and 54. The rate at which the spool is moved to the left is determined by the setting of the bleed valve 70 and may be adjusted over a wide range of speeds ranging from a practically instantaneous shift to a very slow shift.

As the spool 18 moves to the left the shoulder 84 is swept over the inlet port opening in bore 12 so as to sharply cut off the inlet port 22 from the interior of bore 12. When this occurs the tapered portion 86 of spool end 80 has already been moved to the left sufficiently to uncover the outlet 32 so that the pressure fluid in power cylinder 28 is exhausted to atmosphere through pressure line 24, work port 26, exhaust port 32 and exhaust valve 34. The speed at which the power cylinder 28 is retracted is controlled by the setting of exhaust valve 34 and may be adjusted to permit a rapid return of the power cylinder or a very slow return thereof. At this time the pressure fluid in the right hand end of piston chamber 48 is also exhausted through the check valve 76 and pressure line 66 so that the spool 18 and piston 54 are shifted back to the position shown in the drawing by springs 40 and 54 to close the exhaust port 32 and open the inlet port 22. Thus the cycle of operation is automatic with the timing thereof being infinitely variable through adjustment of the two bleed valves 34 and 70. It is also important to note that the speed of operation of the control valve may be varied under load so that it is possible to adjust the cycle of the power cylinder 28 during operation thereof.

The spacing between shoulder 84 and portion 86 of the spool 18, and the spacing of ports 22 and 32, are such that as spool 18 is moved to the left, portion 86 must uncover the exhaust port 32 just prior to the time at which the shoulder 84 closes the inlet port 22. Thus immediately prior to the time when the inlet port 22 is closed, the inlet port 22, exhaust port 32 and work port 26 are all in communication with each other and there may be a slight pressure fluid cross flow from the inlet port 22 to the exhaust port 32. Further shifting of the spool to the left closes the inlet port 22 so that the pressure fluid in the power cylinder 28 and piston chamber 48 is free to be exhausted through the exhaust port 32 and valve 34. If the valve did not allow intercommunication between the inlet, work and exhaust ports at the neutral position of spool 18, the inlet port would be closed prior to the opening of the exhaust port and the valve could become stalled with the work port isolated from both the inlet and exhaust ports. The shoulder 84 provides a sharp cut-off of the inlet port as the spool 18 is moved to the left to prevent unnecessary or prolonged cross flow from the inlet port to the exhaust port.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to

be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

What I claim as my invention is:

1. A pneumatic valve for effecting continuous timed reciprocation of a work piston or the like, comprising a valve body having a valve bore therein, an inlet port, an exhaust port and a work port opening into said bore, means supplying pressure fluid to said inlet port and means communicating said work port with one side of said work piston, a valve spool reciprocable in said bore and operable upon reciprocation thereof alternately to communicate said work port with said inlet and exhaust ports while closing the other of said two last-mentioned ports, spring means urging said spool in one direction to connect said inlet and work ports, a cylinder in said valve body, a piston reciprocable in said cylinder and connected to said spool, passage means communicating one end of said cylinder with said work port to shift said piston and valve spool in the opposite direction against the force of said spring means to connect said work and exhaust ports, an adjustable valve means in said passage means for metering the flow of pressure fluid to said one end of said cylinder to provide a time delay between the establishment of communication between said inlet and work ports and shifting of said spool in said opposite direction, said spool being adapted to open said exhaust

port just prior to closing said inlet port and to open said inlet port just prior to closing said exhaust port so as to permit automatic reciprocation of said spool and work piston.

2. A valve as in claim 1 including a by-pass around said adjustable valve means for exhausting pressure fluid from said one end of said cylinder to exhaust, and a check valve in said by-pass.

3. A valve as in claim 1 including an adjustable valve means in said exhaust port for regulating the exhaust of pressure fluid from said work port to said exhaust port to provide a time delay between opening of said exhaust port and shifting of said spool in said one direction.

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