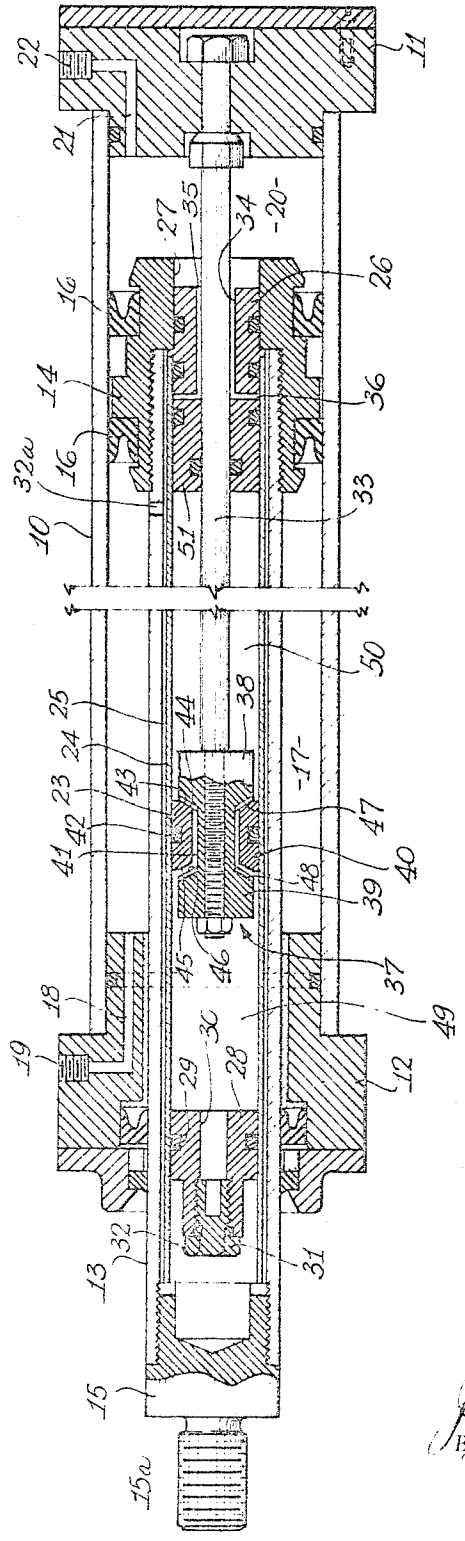
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AIR CYLINDER WITH HYDRAULIC CONTROL

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AIR CYLINDER WITH HYDRAULIC CONTROL

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This invention relates to fluid power actuators and more particularly to hydraulically controlled air legs and cylinders.

Various types of hydraulically controlled air legs and cylinders are disclosed in our prior Patents Numbers 3,146,680, issued September 1, 1964 and 3,149,541, issued September 22, 1964, and the present invention is directed to a cylinder assembly of generally similar type but considerably modified form.

The present invention contemplates the provision of a low cost, double-acting, air-powered cylinder having an internal, self-contained, pre-set hydraulic control means. Such a cylinder is useful in many applications including the operational control of doors, loading chutes, jigs and fixtures, drill feeds, and the like.

The air cylinder in accordance with the invention comprises a main cylinder, a hollow push rod extending axially into the main cylinder and an air piston fixed to the push rod in the cylinder and providing a rear air chamber on one side thereof and a forward air chamber on the other side thereof. A hydraulic controlled cartridge is removably mounted in the push rod and comprises a tube having an external diameter less than the internal diameter of the push rod to provide an annular air passage between the tube and the push rod. A hydraulic piston rod is fixed to the main cylinder and extends through the air piston into the tube. A hydraulic piston assembly is mounted on the hydraulic piston rod in the tube and provides a rear oil chamber on one side thereof and a forward oil chamber on the other side thereof. The piston assembly has an oil flow passage from one of the oil chambers to the other and means are provided for controlling oil flow through such passage. A cover is slidably mounted in the tube adjacent each end thereof and closes a respective one of the oil chambers, one of the covers being exposed to air in the forward air chamber and the other of the covers being exposed to air in the rear air chamber. The air piston rod has a port communicating with the forward air chamber and the annular air passage and each of the forward and rear air chambers has an air inlet and outlet port.

The invention will be described with reference to the accompanying drawing, in which the single figure is a sectional side elevation of a cylinder assembly in accordance with the invention.

In the drawing, 10 is the main tube or cylinder which is provided at one end with a blind end cap 11 and at the other end with a gland cap 12. A hollow push rod or air piston rod 13 extends through the gland cap into the cylinder and has fixed to its inner end an air piston 14. A closure cap 15 with suitable coupling means 15*a* is mounted on the outer end of the rod 13. As shown, the piston is provided with packer rings 16. The piston forms in the cylinder a forward air chamber 17, having a passage 18 in gland cap 12 and a port 19, and a rearward air chamber 20 having a passage 21 in cap 11 and port 22.

Located within the piston rod 13 is a removable hydraulic cartridge 23 comprising a tube 24 each end of which terminates inwardly of the adjoining end of rod 13. The external diameter of the tube 24 is less than the internal diameter of rod 13 to provide a space 25 between the opposed wall surfaces of rod 13 and tube 24. As shown, the radial extent of space 25 may be relatively small.

The inner end of tube 24 is provided with a cap 26 having a portion extending into the tube and a portion extending into an axial bore 27 in the piston.

The outer end of tube 24 is closed by a floating cover 28 which is slidably mounted in the tube. Sealing engagement with the tube wall is provided by an O-ring 29. As shown, the cover 28 has an axial air bleed bore 30 closed by a cap 31. The space 32 in the piston rod between caps 15 and 31 communicates with the air chamber 17 through the annular space 25 and port 32*a*.

A hydraulic piston rod 33 has one end removably fixed to blind end cap 11 and extends axially into piston rod 13 and tube 24. The rod 33 extends through an axial bore 34 in cap 26, the wall of the bore being slightly spaced from the rod to form an annular space 35 therebetween which communicates with an inner space 36 within the tube 24 and providing communication between space 36 and air chamber 20.

Mounted on the free end of piston rod 33 is a piston or metering valve assembly 37 incorporating valve means operable during the extension and retraction strokes of the piston rod 13. The assembly 37 comprises a retraction valve member 38 and an extension valve member 39, each in the form of a collar or annulus fixed to rod 33, and a tubular valve seat member 40 freely reciprocal between members 38 and 39. Seat member 40 has an axial fluid flow passage 41 therein and has sealing engagement, as by O-ring 42, with tube 24. Seat member 40 has, as shown, a bevelled seat 43 at one end for engagement with a complementary seat 44 on retraction member 38 and a bevelled seat 45 at its other end for engagement with a complementary seat 46 on member 39. Member 38 has a pair of slots or passages 47 in the seat thereof which provides throttled fluid flow therethrough during the extension stroke, i.e., when member 40 is seated on member 38. Member 39 has a pair of slots or passages 48 in the seat thereof for fluid flow therethrough during the retraction stroke, i.e., when member 50 is seated on member 39.

Assembly 37 provides within tube 24 a low pressure oil reservoir 49 between assembly 37 and floating cover 28 and a high pressure oil reservoir 50 between assembly 37 and a second floating cover 51 having sealing engagement with the inner wall of tube 24 and with piston rod 33.

In operation, the free space between floating covers 28 and 51 in tube 24 is provided with a body of oil.

To perform an extension stroke, air under pressure is supplied to chamber 20 through port 22 and the push rod 13 extends. Oil under pressure in reservoir 50 is metered through orifice 48 into reservoir 49, the forward speed of the push rod 13 being controlled or limited by the size of orifice 48.

When the extension stroke is completed, residual air pressure through spaces 35, 36 continues to act on floating cover 51 to transfer oil to low pressure reservoir 49 and to move floating cover 28 ahead until it stops against the closure cap 15. The space between assembly 37 and cover 28 is now full of oil preparatory to a retraction stroke.

To perform a retraction stroke, air under pressure is supplied to chamber 17 through port 19 and the push rod retracts. Oil under pressure from reservoir 49 is metered through orifice 47 into reservoir 50, the rearward speed of the push rod being controlled or limited by the size of orifice 47. When the retraction stroke is complete, transfer of oil from reservoir 49 to reservoir 50 will continue until the floating cover 51 engages cap 26. An extension stroke may then be started.

The hydraulic control cartridge 23 is readily insertable in and removable from the assembly. The cartridge is a self-contained unit which is pre-set to accomplish its desired control function. Thus, the size of the orifices 47 and 48 may be chosen to perform the desired degree of control for any particular operation.

Since the cartridge is a self-contained unit, its replacement as required is a simple operation.

We claim:

1. A hydraulically controlled air cylinder comprising a main cylinder, a hollow push rod extending axially into said cylinder, an air piston fixed to said push rod in said cylinder and providing a rear air chamber on one side of said air piston and a forward air chamber on the other side of said air piston, a hydraulic control cartridge in said push rod comprising a tube having an external diameter less than the internal diameter of said push rod to provide an annular air passage between said tube and push rod, a hydraulic piston rod fixed to and axially arranged in said cylinder, said hydraulic piston rod extending through said air piston, a hydraulic piston assembly mounted on said hydraulic piston rod in said tube and providing a rear oil chamber on one side of said piston assembly and a forward oil chamber on the other side of said piston assembly, means providing an oil flow passage through said piston assembly from one of said oil chambers to the other, means controlling oil flow through said oil flow passage, and a cover slidably mounted in said tube adjacent each end thereof and closing a respective one of said oil chambers, a first one of said covers being exposed to air in said forward air chamber and a second one of said covers being exposed to air in said rear air chamber, said covers having floating movement in said tube in response to differential fluid pressures thereon, said air piston rod having a port communicating with said forward air chamber and said annular air passage, means providing an air inlet and outlet port communicating with said forward air chamber, and means providing an air inlet and outlet port communicating with said rear air chamber.

2. A hydraulically controlled air cylinder as defined in claim 1, said main cylinder having a blind end cap closing one end thereof and a gland cap closing the other end thereof and through which said air piston rod extends, each of said caps having one of said air inlet and outlet ports therein.

3. A hydraulically controlled air cylinder as defined in claim 2, said hydraulic piston rod being removably fixed to said blind end cap.

4. A hydraulically controlled air cylinder as defined in claim 1, said hydraulic piston assembly comprising a pair of spaced annular members fixed to said hydraulic piston rod, each said annular member having a valve seat, said valve seats being in confronting relation, each said valve seat having an oil metering passage therein, and a tubular valve seat member between said valve seats and freely reciprocal into engagement with each one of said valve seats.

5. A hydraulically controlled air cylinder as defined in claim 1, said tube having an annular closure member fixed to an end thereof adjacent said second cover, said closure member having an axial bore permitting passage therethrough of said hydraulic piston rod and exposing said second cover to air in said rear air chamber.

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