

[54] **AIR CYLINDER WITH SELF-CONTAINED PNEUMATIC PISTON RETURN**

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 [58] Field of Search. **91/416, 399, 357, 394, 402**

[56] **References Cited**

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[57] **ABSTRACT**

An air cylinder having an annular chamber disposed around the piston chamber, a portion of the pressure fluid causing the working stroke of the piston is passed to and accumulated in the annular chamber during the working stroke of the piston. The annular chamber thereafter supplies the accumulated pressure fluid to one end of the piston chamber to actuate the return stroke of the piston.

1 Claims, 3 Drawing Figures

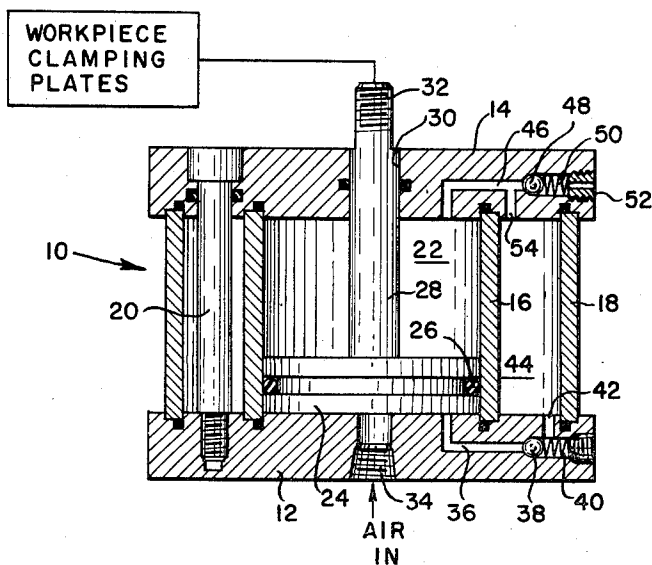
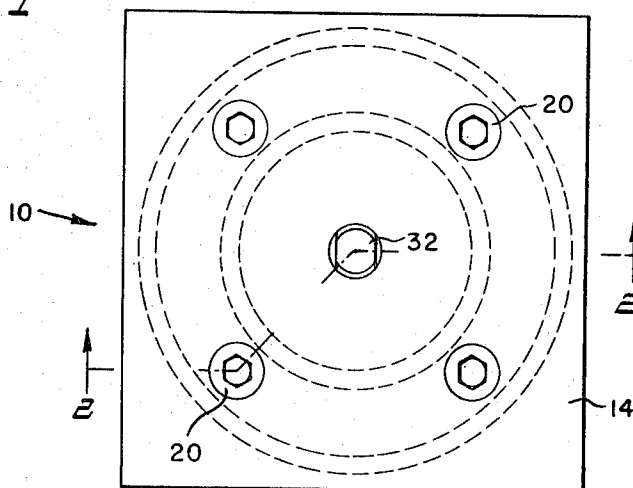


Fig. 1



WORKPIECE
CLAMPING
PLATES

Fig. 2

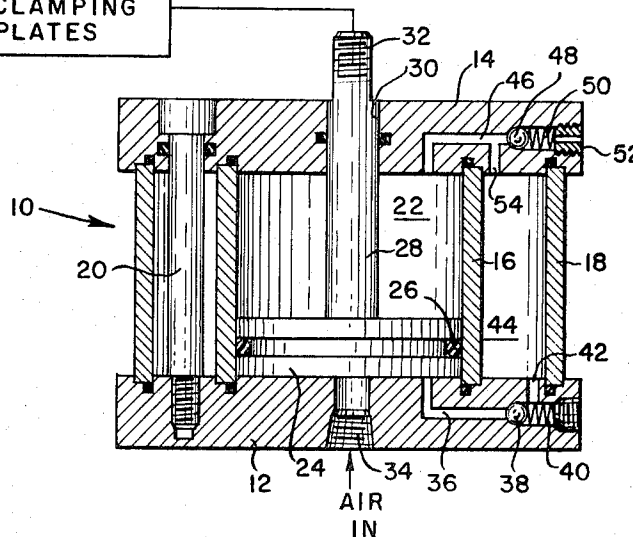
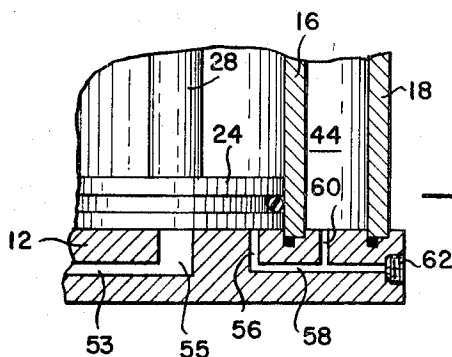


Fig. 3



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AIR CYLINDER WITH SELF-CONTAINED PNEUMATIC PISTON RETURN

The present invention relates to an air cylinder, and, in particular, to a compact air cylinder with self-contained pneumatic piston return means.

A principal object of the present invention is to provide a novel compact reliable air cylinder or fluid pressure motor having novel self-contained pneumatic piston return means. The apparatus of the present invention is particularly useful in installations in which space is at a premium.

For the most part, use has been made heretofore of either double acting reciprocatory fluid pressure motors or a spring arrangement to actuate the return stroke of the piston.

In double acting reciprocatory fluid pressure motors which are used in various installations in machines for moving a part to and fro in opposite directions, a pressure fluid usually air is alternately supplied to the opposite sides of the piston from external sources to effect reciprocation of the piston. The pressure fluid supply is usually controlled by means of a four-way valve and relatively space consuming and complex piping systems. In many installations, the necessity for utilizing pipes to supply and exhaust air to and from the opposite ends of the cylinder is a serious disadvantage.

The use of a spring to actuate the return stroke of the piston is disadvantageous since the spring tends to retard the movement to the piston on its forward or working stroke and since the spring complicates the structure and introduces another working part which is subject to failure.

In accordance with the present invention, the air cylinder is provided with an additional chamber which acts as a reservoir for accumulating a portion of the pressure fluid during the working stroke of the piston. When the flow of primary pressure fluid to the air cylinder stops and the primary pressure fluid is evacuated from the piston chamber, thereafter, the pressure fluid in the reservoir effects the return stroke of the piston by acting upon the forward face of the piston to drive the piston in the other direction.

One presently preferred embodiment of the invention comprises an air cylinder having a pair of first and second end walls, a cylindrical member extending between said end walls and defining therein a piston chamber, a piston head reciprocable in said piston chamber and having a piston rod passing through a bore provided in one of said end walls, a pressure fluid inlet port provided in the other end wall to supply pressure fluid to said chamber, an annular second chamber disposed outside of said cylindrical member around said piston chamber, means including passage means in said other end wall to supply a predetermined amount of pressure fluid to be accumulated in said outer chamber, means to vent air from the upper portion of the piston chamber upon movement of said piston head towards said one end wall, and means to supply pressure fluid from said second chamber to the upper end of the piston chamber to actuate return movement of said piston head upon stopping the supply of pressure fluid through said inlet port.

It is another feature of the invention that the self-contained pneumatic piston return means enables the air cylinder to be mounted in any desired position, even inverted, without gravity significantly adhering with the operating characteristics of the air cylinder.

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken in connection with the accompanying drawings wherein:

FIG. 1 is a plan view of one embodiment of an air cylinder in accordance with the present invention.

FIG. 2 is a cross-sectional view taken on the line 2—2 of FIG. 1.

FIG. 3 is a partial longitudinal cross-sectional view of another embodiment of an air cylinder in accordance with the invention.

Referring now to the drawings, and more particularly to FIG. 2, the air cylinder of the invention generally designated

by reference numeral 10 has first and second end walls 12 and 14 which for the purpose of illustration will be referred to as the lower and upper end walls respectively. Inner and outer concentric cylindrical members 16 and 18 are hermetically sealed between the end walls 12 and 14 with the ends of the cylindrical members received in suitable recesses in the facing surfaces of the end walls. A plurality of bolts 20 fasten the end walls together and are positioned in the annulus between the cylindrical members 16 and 18.

The inner cylindrical member 16 defines the outer boundary of an inner piston chamber 22 in which a piston head 24 which is provided with an annular O-ring seal 26 reciprocates. The piston rod 28 which is integrally united to the piston head 24 projects through a cylindrical bore 30 in the upper end wall 14. A threaded upper end 32 of the piston rod is secured to a part to be reciprocated by the air cylinder. By way of example, the threaded upper end may engage a plate or similar member which may be placed a workpiece to be clamped between said plate or similar member and another workpiece engaging surface while the workpiece is milled.

A suitable source of pressure fluid such as a pressurized air is intended to be connected to the threaded bore 34 in the lower piston end wall 12. The pressure fluid acts upon the lower face of the piston head 24 adjacent the lower end wall to elevate the piston and to effect the working stroke of the piston.

During upward movement of the piston head 24, a small amount of the air flows from the lower portion of the inner chamber 22 through a small bore 36 which is considerably smaller in diameter than the diameter of the bore 34. The amount of pressure fluid flowing through bore 36 is sufficient to move ball valve 38 off its seat against the action of spring 40 so that the air may flow upwardly through a longitudinal bore 42 into an outer annular chamber 44 which is defined between the inner and outer cylindrical members 16 and 18. The pressure fluid which follows this flow path accumulates in chamber 44 for a purpose to be described hereinafter.

The upward movement of piston head 24 causes air in the inner chamber 22 above the piston head to be compressed with the result that this air is forced out of the chamber through a vent passage 46 in the upper end wall 14. The pressure of the exiting air in passage 46 is sufficient to unseat one way ball valve 48 against the action of its spring 50 so that this air is vented to the atmosphere through bore 52. A small amount of the pressurized air in vent passage 46 may also flow into the outer chamber 44 via a longitudinal bore 54 which opens into vent passage 46.

At the conclusion of the upward stroke of the piston, the supply of pressure fluid through bore 34 is terminated and pressure fluid beneath the piston head 24 is exhausted through bore 34. At the same time, the accumulated pressurized air in the outer chamber 44 expands and passes upwardly through bore 54 and passage 46 into the upper end of the inner chamber 22 to act against the upper surface of the piston head 24 and commences the return stroke of the piston to the position illustrated in FIG. 2.

It will of course be appreciated by those skilled in the art that in order to achieve the objectives of the invention, it is necessary to properly dimension the various flow paths with respect to each other and to utilize springs 40, 50 of suitable strengths so that the one way ball valves open and close at the appropriate times. Once appraised of the objectives of the present invention, such dimensioning is well within the scope of those skilled in the art. Since the bore 36 in the lower end wall 12 is of considerably smaller diameter than the bore 34 through which the high-pressure fluid enters, only a small portion of the entering high-pressure fluid will pass through the bores 36 and 42 into the outer chamber 44. Spring 40 should be dimensioned so that ball valve 38 will open when the pressure fluid is flowing through bore 36. Similarly, spring 50 should be selected to allow ball valve 48 in the upper end wall 14 to be unseated when air is to be vented from the upper part of the inner chamber 22 as the piston head rises and com-

presses the air above it. On the other hand, spring 50 should be sufficiently strong to seat the ball valve 48 against the action of the lower pressure fluid passing from the outer chamber 44 and bore 54 into passage 46 during the return stroke of the piston.

The maximum pressure which is reached in the outer chamber 44 is determined by such factors as the pressure of the air supplied through threaded bore 34, the relative diameters of bores 34 and 36, and the size of the inner and outer chambers 22 and 44. By way of illustration, if threaded bore 34 has a minimum diameter of about one-fourth inch, chamber 22 has a diameter of about 1.50 inch and a height of 1.375 inch, cylindrical member 16 has an outside diameter of 1.75 inch, outer cylindrical member 18 has an inside diameter of 2.75 inch, and bore 36 has a diameter of about 0.16 inch; then upon supplying 100 p.s.i. air through bore 34, the maximum pressure reached in outer chamber 44 is about 30 p.s.i.

FIG. 3 illustrates another embodiment of the present invention which differs from that of the embodiment described previously only with respect to modifications of the fluid flow paths in the lower end wall. In this embodiment, the pressure fluid is supplied to the cylinder through a radial bore 53 which extends from the periphery of the end wall 12 to the center thereof at which point it connects with an axial bore 55. This arrangement for supplying pressure fluid provides a more compact system. As in the embodiment described previously, some of the pressure fluid passes from the inner chamber 22 to the outer chamber 44 to subsequently effect the return stroke of the piston. This pressure fluid reaches the outer chamber through a vertical bore 56 which communicates with the inner chamber 22, a radial bore 58, and a vertical bore 60 which opens into the outer chamber 44. The outer end of the radial bore 58 is closed by a plug 62. It should be noted that in this embodiment no valve or other hinderance to fluid flow is pro-

vided in the flow path from the lower end of chamber 22 to the outer chamber 44.

While preferred embodiments of the present invention have been shown and described, it will be appreciated that various changes and modifications may suggest themselves to those of ordinary skill in the art when appraised of the present disclosure. It is intended to encompass all such changes and modifications as fall within the scope and spirit of the appended claims.

What is claimed is:

1. Apparatus comprising an air cylinder having a self-contained pneumatic piston return and comprising a pair of fixed end walls, a cylindrical member extending between said end walls and defining therewith a piston chamber, a fluid impermeable piston head reciprocable in said piston chamber and having a piston rod passing through a bore provided in one of said end walls, a pressure fluid inlet port provided in the other of said end wall to supply pressure fluid to said piston chamber, a second chamber disposed outside of said cylindrical member and concentrically about said piston chamber, supply means including passage means provided in said other end wall to supply a predetermined amount of said pressure fluid to said second chamber, vent means to vent air from an upper portion of said piston chamber upon movement of said piston head towards said one end wall, means including passage means in said one end wall to automatically supply pressure fluid from said second chamber to the upper portion of said piston chamber to actuate return movement of said piston head upon stopping the supply of pressure fluid through said inlet port, and workpiece clamping means for temporarily holding a workpiece while work is performed thereon, said workpiece clamping means being secured to and reciprocated by said piston rod.

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