

May 22, 1956

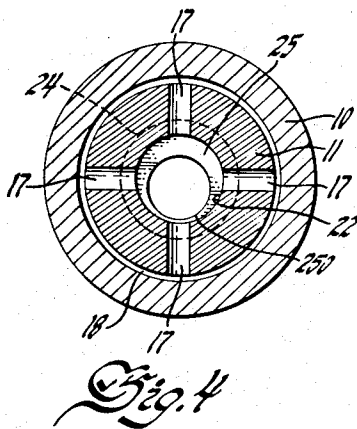
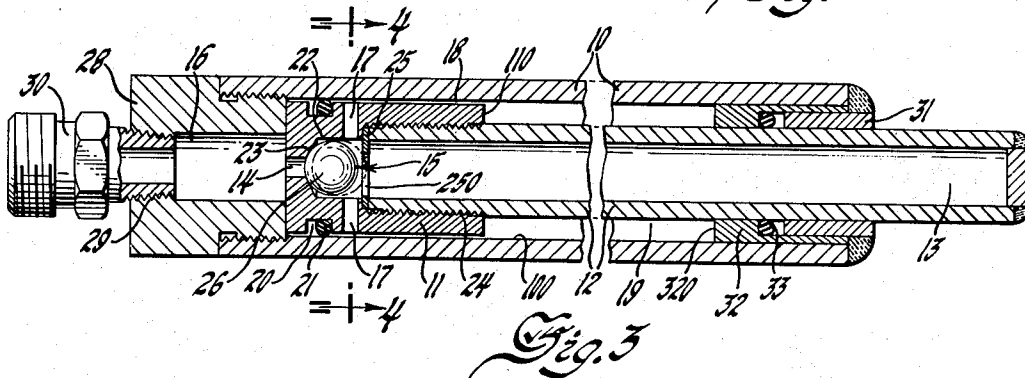
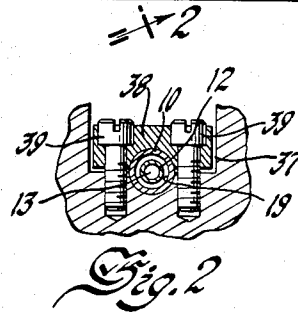
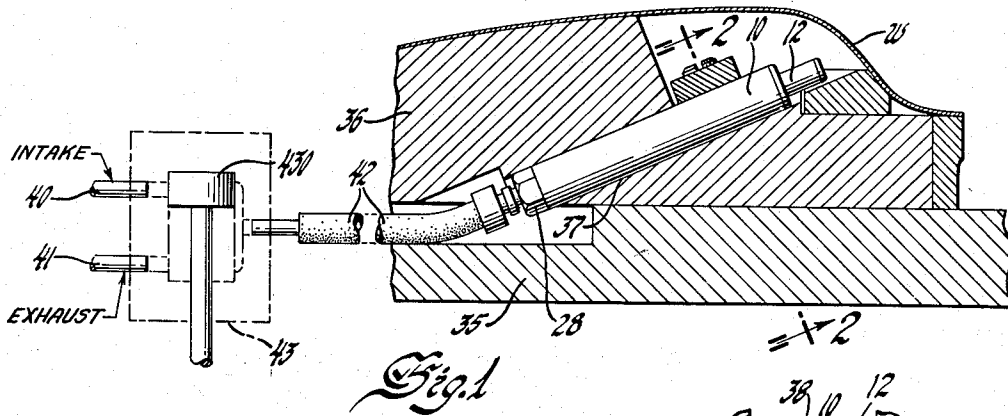
E. P. SCHAFER

2,746,425

AUTOMATIC RETURN AIR PISTON AND CYLINDER DEVICE

Filed Nov. 21, 1951

2 Sheets-Sheet 1



INVENTOR
Eugene P. Schafer
BY
Willits, Helming & Bailley
ATTORNEYS

May 22, 1956

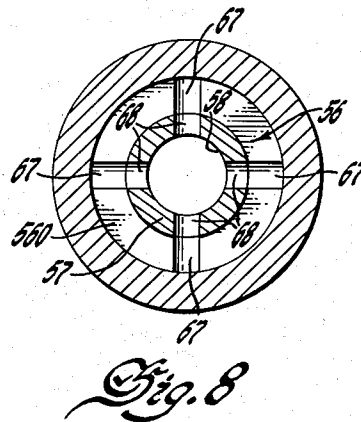
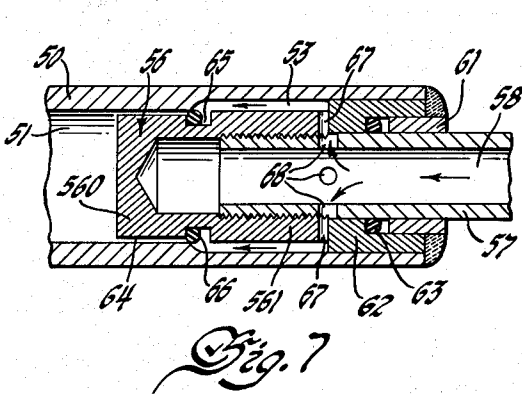
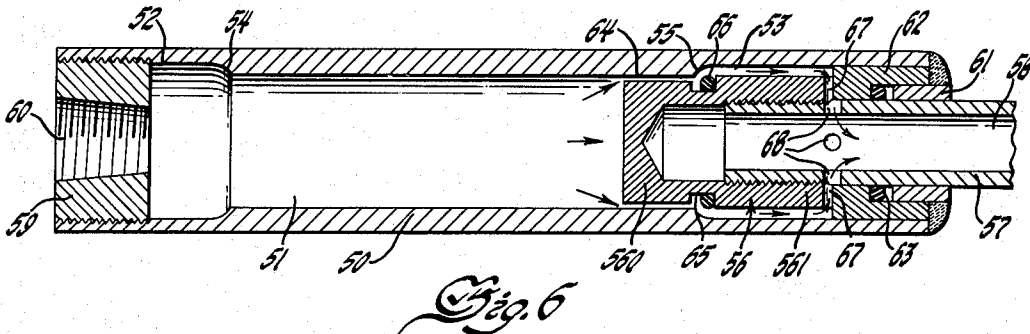
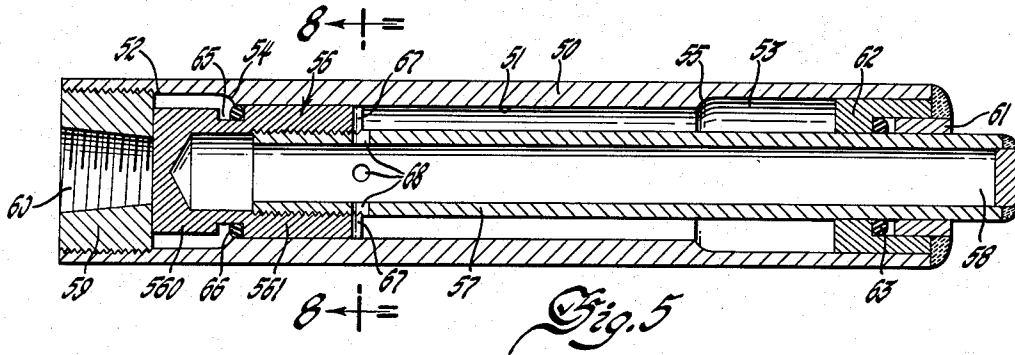
E. P. SCHAFER

2,746,425

AUTOMATIC RETURN AIR PISTON AND CYLINDER DEVICE

Filed Nov. 21, 1951

2 Sheets-Sheet 2



INVENTOR
Eugene P. Schaffer
BY
Willits, Helwig & Baillie
ATTORNEYS

1

2,746,425

AUTOMATIC RETURN AIR PISTON AND CYLINDER DEVICE

Eugene P. Schafer, East Cleveland, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application November 21, 1951, Serial No. 257,622

9 Claims. (Cl. 121—38)

This invention relates to air cylinders and in particular to air cylinders of the type wherein the power stroke of the piston thereof is accomplished upon the application of compressed air to the cylinder and the return stroke of the piston is automatically responsive to release of the compressed air applied to the cylinder.

The primary object of the invention is to provide improved, positive acting air cylinders with automatic piston return responsive to the release of accumulated compressed air applied thereto during the power stroke of the piston thereof.

A further object of the invention is to provide improved air cylinders with automatic piston return wherein a portion of the air employed to move the piston thereof on its power stroke is trapped within a plunger serving as an air accumulator movable with said piston, which entrapped accumulated air returns the piston and plunger automatically responsive to the release of air supplied to the cylinder during the power stroke of the piston.

Still another object of the invention is to provide improved and simply constructed valving and port means within automatic return air cylinders of the type embodying the invention.

Other objects of the invention will become apparent by reference to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view showing a typical installation of an automatic air return cylinder embodying the invention, a control valve therefor being shown diagrammatically.

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged longitudinal sectional view of the automatic air return cylinder shown in Fig. 1.

Fig. 4 is a detailed sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is an enlarged longitudinal sectional view of another embodiment of the invention with the piston and plunger disposed in its normal position before the application of air pressure to initiate the power stroke.

Fig. 6 is a longitudinal sectional view similar to Fig. 5 showing the piston and plunger at the end of the power stroke.

Fig. 7 is a fragmentary longitudinal sectional view similar to Fig. 6 showing the piston and plunger at the beginning of the return stroke.

Fig. 8 is a detailed sectional view taken on the line 8—8 of Fig. 5.

Referring now to the drawings where like numerals refer to like and corresponding parts throughout the several views, the embodiment of the invention disclosed in Figs. 1—4 inclusive is shown in application to a die as a "work kicker" for illustrative purposes only and without the intention of so limiting the application or use of the invention, and comprises in general a cylinder 10 having a piston 11 reciprocally mounted therein, a hollow piston rod 12 reciprocally extending through one end of the cylinder 10 connected to said piston forming an air reser-

2

voir 13 within the said piston rod 12, the said piston 11 having a passage 14 axially therethrough from its head end communicating with the piston rod reservoir 13, and a valve element shown in the form of a ball valve 15 located in said piston 11 arranged to open the passage 14 therethrough when compressed air enters the cylinder 10 through its single main port 16 to move the said piston 11 on its power stroke simultaneously compressing air in the piston rod reservoir 13, the said valve element 15 closing and entrapping compressed air in the piston rod reservoir 13 upon the exhaust of the compressed air in the cylinder 10 whereupon the said compressed air from the piston rod reservoir 13 then passes through the radial ports 17 in the piston 11 to behind the piston 11 to return the said piston 11 and piston rod 12 back to their normal position shown in Fig. 1.

At least a portion of the piston 11 is smaller in diameter than the bore 100 of the cylinder 10 to provide an air passage 18 from the radial ports 17 to the cylinder 10 behind the piston 11 which may be termed the return air chamber 19. The piston 11 is provided with a circumferential ring groove 20 preferably somewhat wider than the diameter of the O-ring seal 21 therearound whereby to permit compressed air entering the cylinder 10 through the main port 16 to get behind the said O-ring seal 21 to seal more effectively the clearance provided between the piston 11 and cylinder 10. Obviously, the O-ring 21 shifts in its ring groove 20 to the opposite shoulder of the groove when compressed air from the air reservoir 13 in the piston rod 12 passes through the radial ports 17 to the return air chamber 19.

The ball valve element 15 comprises a ball 26 seatable on a seat 23 formed in the head of the piston 11 at the base of a counterbore 22 therein enlarging the passage 14 therethrough, the said counterbore 22 communicating with a bore 24 further enlarging the passage 14 therethrough into which is threaded the hollow piston rod 12. A ball retainer ring 25 located at the bottom of the bore 24 retains the ball 26 of the ball valve element 15 in its proper operating position in the counterbore 22. The radial ports 17 in the piston 11 communicate with the ball counterbore 22 in such a location as to permit compressed air from the air reservoir 13 in the piston rod 12 which is open to the ball counterbore 22 to pass therethrough to the return air chamber 19 behind the piston 11 when the ball 26 of the ball valve element 15 is seated, which seating occurs upon the release of air pressure from the cylinder 10 ahead of the piston 11. The ball retainer ring 25 of the ball valve 15 has an aperture 250 therethrough eccentric in respect to the ball counterbore 22 which prevents the ball 26 of the ball valve 15 from closing communication between the air passage 14 in the piston 11 around the ball 26 to the air reservoir 13 in the piston rod 12 during the power stroke of the piston 11.

The head end of the cylinder 10 may be closed by any suitable means such as an exteriorly threaded nut 28 having the main port 16 therethrough. The nut 28 may be interiorly threaded at 29 to accommodate a suitable air hose connection 30. The rod end of the piston 11 is preferably sealed by welding a sleeve 31 in spaced relationship to the interior thereof whereby to telescopically accommodate an O-ring retainer 32 which is assembled into the cylinder 10 in the position shown in Fig. 3 with an O-ring 33 disposed longitudinally between the inner end of the said sleeve 31 and a shoulder on the O-ring retainer 32.

One of many uses and an installation of the invention is shown in Figs. 1 and 2 for illustrative purposes. A press bed 35 with a die 36 thereon has a groove 37 therein into which is disposed the cylinder 10 of an automatic return air cylinder embodying the invention. The

3

cylinder 10 is clamped in the desired position in the groove 37 by a clamp 38 and studs 39. The main port 16 in the head of the cylinder 10 is operatively connected to a source of compressed air or air intake 40 and to an air exhaust 41 through an air hose 42 and a suitable valve 43.

In the position of the automatic return air cylinder 10 shown in Figs. 1 and 3, the intake 40 has been closed, the exhaust 41 has been opened, and the piston 11 has been fully returned. By moving the valve element 430 of the valve 43 to open the intake and close the exhaust thereby causing compressed air to enter the cylinder 10, the piston 11 moves to the right as viewed in Fig. 3 until the annular shoulder 110 of the piston 11 abuts the annular shoulder 320 of the O-ring retainer 32. During the application of compressed air to the cylinder 10, compressed air also enters the air reservoir 13 of the hollow piston rod 12 through the air passage 14, the ball valve counterbore 22 around the ball 26, and through the ball retainer ring 25. The movement of the piston 11 to the right causes the piston rod 12 to lift or "kick" the work W off the die 36 ready for manual or conveyor movement from the press.

As soon as the valve element 430 of the control valve 43 is moved to close the intake 40 and open the exhaust 41, compressed air stored in the air reservoir 13 of the piston rod 12 takes over and closes the ball valve 15, and, as soon as the ball valve 15 is closed, compressed air from the air reservoir 13 passes through the ball retainer ring 25, the ball counterbore 22, the radial ports 17, through the air passage 18 around the piston 11 and to the return air chamber 19. Air under pressure in the return air chamber 19 acts on the piston 11 to return the piston 11 which retracts the piston rod 12.

Obviously, the invention may be used for many other purposes and installations than that illustrated above, particularly where a power stroke from a piston is required and a self-return of the piston is necessary or desirable.

Referring now to Figs. 5-8 inclusive, another illustration of an automatic air return cylinder embodying the invention is shown in detail and comprises a cylinder 50 having a bore 51 therethrough counterbored at each end at 52 and 53 preferably with a curved shoulder 54 and 55, respectively, at the base of the said counterbores, a piston 56 reciprocatingly mounted in the said cylinder 50, a hollow piston rod 57 having an air reservoir 58 therein secured to the said piston 56, a threaded plug 59 on the head end of the said cylinder having a single main port 60 therein through which compressed air is supplied to and exhausted from the said cylinder 50. A sleeve 61 at the rod end of the cylinder 50 welded in sealed relationship thereto closes the end of the cylinder 50 and provides a sleeve bearing for the reciprocation of the hollow piston rod 57. An O-ring retainer sleeve 62 is assembled in the cylinder 50 in the position shown in Figs. 5-7 inclusive and retains an O-ring 63 longitudinally between the inner end of the said sleeve 61 and a shoulder of the O-ring retainer 62. A valve and by-pass means is associated with the piston 56 and counterbore 53 as hereinafter described.

The head end 560 of the piston 56 is smaller in diameter than the body section 561 thereof to provide an annular air passage 64 around the said head end 560 of the piston 56. The piston 56 is provided with a circumferential ring groove 65 preferably somewhat wider than the diameter of the O-ring seal 66 therein whereby to permit compressed air entering the cylinder through the main port 60 to seal more effectively the joint between the large end 561 of the piston 56 and the bore 51 of the cylinder 50.

By referring to Fig. 5, it will be observed that compressed air entering the cylinder 50 moves the piston 56 to the right as viewed in Fig. 5, and continues to do so throughout the entire power stroke of the piston 56 until the large body section 561 of the piston 56 arrives sub-

4

stantially at its fully extended position as shown in Fig. 6. In the fully extended position of the piston 56 with the hollow piston rod 57 fully extended to the right as viewed in Fig. 6, compressed air travels through the annular air passage 64, by the O-ring 66, through the counterbore 53 of the cylinder 50, through radially disposed grooves 67 in the large body section 561 of the piston 56 and through radially disposed ports 68 in the hollow piston rod 57 to the air reservoir 58 thereof charging it with compressed air.

As soon as air pressure is removed from the cylinder 50 and exhaust therefrom begins, the piston 56 immediately starts its return stroke responsive to compressed air from the reservoir 58 in the hollow piston rod 57 entering the counterbore 53 of the cylinder 50 from the radially disposed ports 68 in the hollow piston rod 57 and the radially disposed grooves 67 in the head end 560 of the piston 56 which moves the O-ring 62 to the left as viewed in Fig. 7 sealing the annular air passage 64, and, responsive to compressed air stored in the air reservoir 58 of the hollow piston rod 57, the piston 56 and the rod 57 returns to their initial retracted position as indicated in Fig. 5 ready for another power stroke.

Although but two embodiments of the invention have been disclosed in the drawings and described in detail, it is obvious that many changes may be made in the size, shape, arrangement, and detail of the several elements of the invention, all without departing from the spirit and scope thereof as defined by the appended claims.

I claim:

1. An automatic return air cylinder comprising a closed end cylinder having a bore therethrough and counterbores adjacent the ends thereof, a piston having the head portion thereof smaller in diameter than the remainder thereof, the said piston having an O-ring groove therearound located where the diameter thereof is changed, an O-ring in said groove, a hollow piston rod serving as a compressed air reservoir connected to the large end of said piston and extending in reciprocating sealed relation through one end of said cylinder forming a return air chamber within said cylinder, the said compressed air reservoir having apertures therein located adjacent the said piston communicating with the said return air chamber.

2. An automatic return air cylinder as claimed in claim 1 wherein the end of the said counterbores in each end of said cylinder is opposite the said O-ring groove in said piston when the piston is at the ends of its stroke, and the shoulder at the end of the said counterbores is curved.

3. An automatic return air cylinder comprising a cylinder having a bore therethrough with an inlet port at its head end and a counterbore adjacent the other end, a piston slidably mounted within said cylinder bore for reciprocating movement substantially throughout the length of said bore and counterbore, a hollow piston rod serving as a compressed air reservoir connected to the end of said piston remote from said port and extending in reciprocating sealed relationship through the other end of said cylinder, the annular space between the inner wall of said cylinder and at least a portion of said piston and rod assembly forming a return air chamber within said cylinder, said compressed air reservoir having an aperture therein communicating with said return air chamber, said piston including a head portion of smaller diameter than the remainder thereof in air flow communication with said cylinder inlet, and valve means mounted on said piston for limited axial movement relative to said piston and sealingly slidingly engaging said cylinder bore to check air flow between said cylinder inlet and said return air chamber until said head portion enters said cylinder counterbore.

4. An automatic return air cylinder comprising a cylinder having a bore therethrough with a main port at its head end and a counterbore adjacent the other end, a

5

piston slidable in said bore, a hollow piston rod serving as a compressed air reservoir connected to the end of said piston remote from said port and extending in reciprocating sealed relationship through the other end of said cylinder, the annular space between the inner wall of said cylinder and at least a portion of said piston and rod assembly forming a return air chamber within said cylinder, said compressed air reservoir having an aperture therein communicating with said return air chamber, an annular groove located intermediate the ends of said piston, and a valve member axially shiftably mounted within said groove in sealing sliding engagement with said bore to check air flow between said main port and said return air chamber until said intermediate portion of said piston enters the counterbored portion of said cylinder.

5. An automatic return air cylinder comprising a closed cylinder having a bore therethrough with a main port at its head end and a counterbore adjacent the other end, a piston slidable in said bore, a hollow piston rod serving as a compressed air reservoir connected to the end of said piston remote from said port and extending in reciprocating sealed relationship through the other end of said cylinder, the annular space between the inner wall of said cylinder and at least a portion of said piston and rod assembly forming a return air chamber within said cylinder, said compressed air reservoir having apertures therein communicating with said return air chamber, said piston having a head portion of smaller diameter than the remainder thereof, an annular groove located between the different diameter portions of said piston, and an O-ring of predetermined diameter axially shiftably mounted within said groove to sealingly slidingly engage said bore and provide a radial clearance with said counterbored cylinder portion to permit air flow between said main port and said return air chamber as the ring enters said counterbored cylinder portion.

6. An automatic return air cylinder, as defined in claim 5, wherein the forward end of said counterbore is substantially opposite the O-ring groove when the piston is at the end of its power stroke.

7. An automatic return air cylinder unit comprising a cylinder having a bore therethrough with an air supply port at one end and a counterbore at the opposite end, a piston having a head portion of smaller diameter than said bore and a main body portion of smaller diameter than said counterbore, said piston being slidably mounted in said bore and forming with the inner wall of said cylinder a working chamber in communication with said supply port, a hollow piston rod serving as a compressed air reservoir connected to the main body of said piston remote from said port and extending in reciprocating sealed relationship through said opposite end of the cylinder, the annular space between the inner wall of said cylinder and at least a portion of said piston and rod assembly forming a return air chamber within said cylinder remote from said port, said compressed air reservoir having at least one aperture formed therein maintaining air flow communication with said return air chamber, an annular groove between the head and main body portions of said piston, and an O-ring axially shiftably mounted within said groove in sliding sealing engagement with the bore of said cylinder to preclude air flow between said working chamber and said air reservoir until said intermediate portion of the piston enters said counterbored cylinder portion.

6

8. An automatic return air cylinder unit comprising a cylinder having a bore therethrough with an air supply port at one end and counterbore at the opposite end, a piston having a head portion of smaller diameter than said bore and forming therewith a first annular air passage and having a main body portion of smaller diameter than said counterbore and forming therewith a second annular air passage, said piston main body being slidably mounted in said bore and the face of said piston head portion forming with the inner wall of said cylinder a working chamber in communication with said port and said first air passage, a hollow piston rod serving as a compressed air reservoir connected to the main body of said piston remote from said port and extending in reciprocating sealed relationship through the opposite end of said cylinder, the annular space between the inner wall of said cylinder and at least a portion of said piston and rod assembly forming a return air chamber within said cylinder remote from said port and adapted to communicate with said second air passage, said compressed air reservoir having apertures therein maintaining air flow communication with said return air chamber, an annular groove between the head and main body portions of said piston, and an O-ring axially shiftably mounted within said groove in sliding sealing engagement with the bore of said cylinder to check air flow between said working chamber and said air reservoir through said first and second passages.

9. An automatic return air cylinder comprising a cylinder having a bore therethrough with an inlet port at its head end and a counterbore at the other end, a piston assembly received within said cylinder for reciprocating movement substantially throughout the length of said cylinder bore and counterbore and including a piston and a hollow piston rod extending in reciprocating sealed relationship through the other end of said cylinder, said piston and rod assembly with the inner wall of said cylinder defining an annular return air chamber within said cylinder remote from said inlet port, said hollow piston rod including a compressed air reservoir therein having apertures communicating with said return air chamber, said piston being in sliding contact with said bore and out of contact with said counterbore throughout a first portion of its length and including a second portion of smaller diameter than said bore terminating in a pressure face in communication with said cylinder inlet, the first and second portions of said piston cooperating, respectively, with the cylinder counterbore and bore to form an annular air passage around the piston between said inlet port and said return air chamber, an annular groove between the different portions of said piston head, and a check valve ring axially shiftably mounted within said groove in sliding sealing engagement with said bore and free of said counterbore to control air flow through said air passage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,451,706	Aimes	Oct. 19, 1948
2,548,439	Moffett, Jr.	Apr. 10, 1951
2,703,558	Wilcox	Mar. 8, 1955

FOREIGN PATENTS

764,509	France	Mar. 5, 1934
52,700	France	June 12, 1944

(Addition to)