May 23, 1961 D. M. UMPHREY ET AL 2,985,739

CIRCUIT BREAKER

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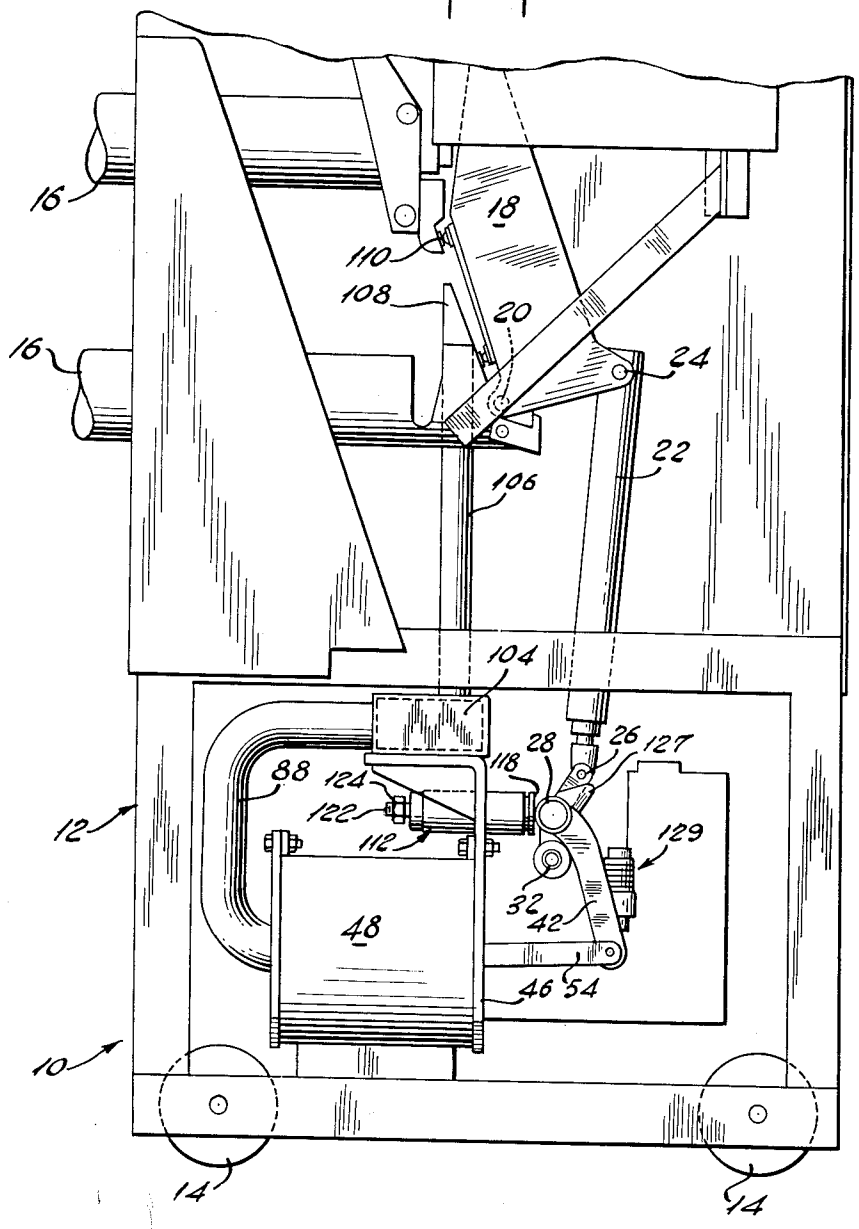
Fig. 1.



INVENTORS
DONALD C. MILLS
DONALD M. UMPHREY
BY
Paul S. Martin
ATTORNEY

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Fig. 2.

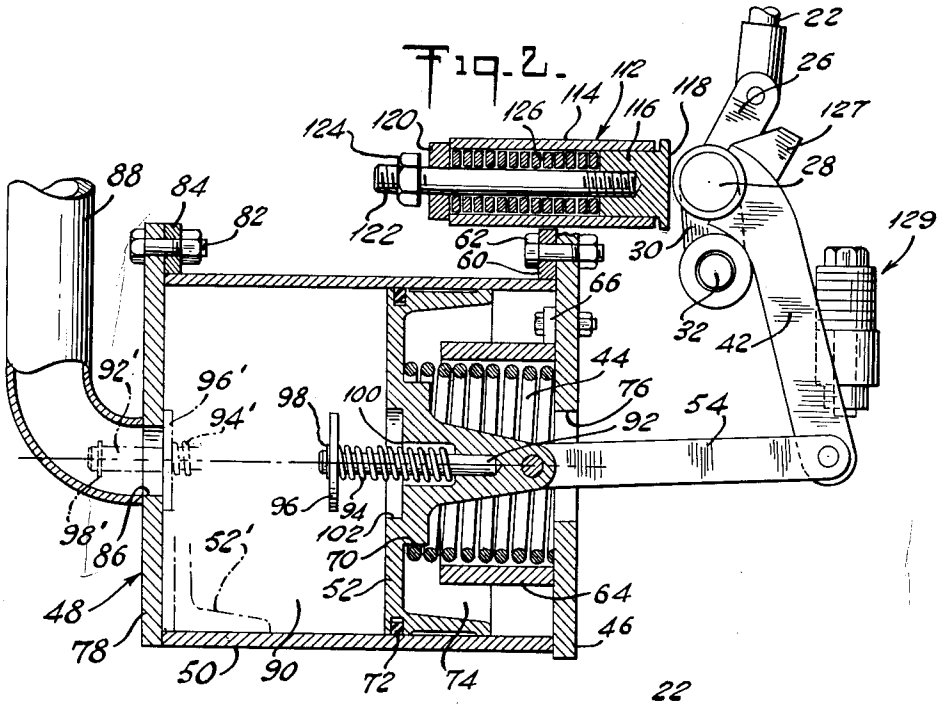
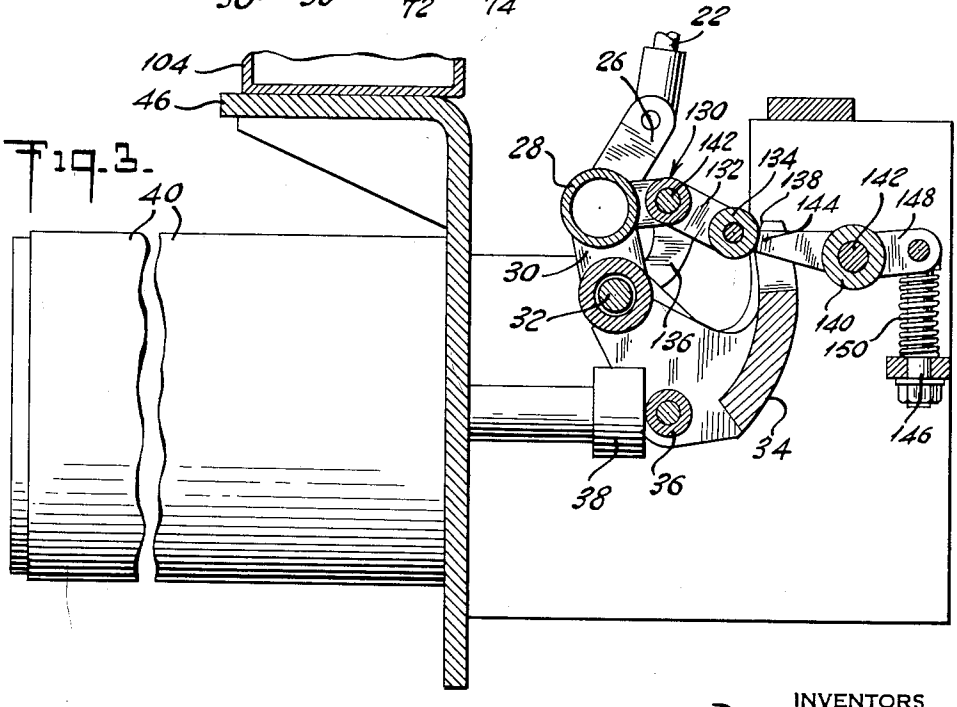


Fig. 3.



INVENTORS
DONALD C. MILLS
DONALD M. UMPHREY
BY
Paul S. Martin
ATTORNEY

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CIRCUIT BREAKER

Donald M. Umphrey, Palo Alto, and Donald C. Mills, Sunnyvale, Calif., assignors to Federal Pacific Electric Company, a corporation of Delaware

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7 Claims. (Cl. 200—148)

This invention relates generally to a circuit breaker and, more particularly, to a heavy type as used in metal-clad switchgear.

In the operation of such a circuit breaker, an air puffer is desirable to transfer the arc from the arcing contacts into an arcing chamber. Such a puffer is especially useful in the case of a magnetic blowout arcing chamber designed for heavy currents but which may not be effective to lift arcs of weak currents into the arc chute.

The contact opening mechanism of such a circuit breaker is energized by a spring which is compressed or loaded on closing of the circuit breaker. Such a circuit breaker further includes means to absorb the shock that develops at the end of the spring-impelled contact-opening stroke, to guard against rebound of the movable contact assembly from its extreme open position.

An object of the present invention is to simplify and improve the operation and arrangement of the puffer, contact-opening spring and shock-absorber in circuit breakers. Pursuant to this object of the present invention the illustrative embodiment of the invention comprises a single assembly for all three functions, including a piston and cylinder assembly, and a contact opening spring within the cylinder. The initial movement of the piston, mechanically coordinated with the contact-opening operation of the contacts, results in the flow of high-velocity air to the region of the contacts as they part. Near the end of its stroke, the piston closes an escape passage in the end of the cylinder chamber to cushion the contact-opening mechanism. Thus in accordance with the present invention there is provided improved unitary apparatus for accomplishing the functions of providing contact-opening energy, air puffer and shock absorber.

Yet another object of the present invention is the provision of a generally improved assembly which efficiently and effectively combines an air puffer with a shock absorber in a circuit breaker of the aforenoted character.

The illustrative embodiment of the invention, which has been outlined above as incorporating certain novel features forming part of the invention, is more fully described in the remainder of this specification, from which further novel features and objects and advantages will become apparent. In the following description reference is made to the accompanying drawings forming part of this disclosure, in which drawings:

Fig. 1 is a side elevational view, with portions removed for clarity, of a circuit breaker formed in accordance with the present invention;

Fig. 2 is an enlarged vertical sectional view of the cylinder assembly and associated apparatus of Fig. 1, which houses the contact-opening spring and functions as an air puffer and shock absorber; and

Fig. 3 is a side elevational view of the contact-closing solenoid and associated contact closing mechanism in the closed-contact position.

Referring to the drawings, there is shown a circuit breaker **10** which is of the general type disclosed in application Serial No. 684,268, filed September 16, 1957, for Circuit Breakers in the name of Donald C. Mills, and assigned to the assignee hereof, and differs therefrom in the respects to be pointed out in detail below.

The circuit breaker **10** comprises a main frame **12** having the usual wheels **14** of drawout switchgear. The frame carries main conductors **16** that are bridged by the moving contact unit **18** having a pivotal mounting **20**. A link **22**, pivoted to contact unit **18** at **24** has its lower end pivoted to an arm **26** on a bar **28** and is vertically reciprocated for swinging the contact assembly between open and closed positions. The circuit breaker illustrated is a three-pole unit having three sets of contacts and three operating links **22** and three arms **26** carried by a common bar. Bar **28** is rigidly carried by a pair of arms **30** which swing about main shaft **32** carried by fixed frame members. Bar **28** is part of a multi-armed driven member which is operated by a driving member **34** mounted on shaft **32**. In Fig. 3, driving member **34** is shown at the instant of completing its contact-closing stroke. Member **34** in turn is operated by engagement of head **38** of the operating solenoid **40** with roller **36** on member **34**. Immediately after completion of this stroke the solenoid is deenergized and members **34** and **38** are withdrawn to the left. Details of the drive coupling between members **28** and **34**, as well as the latch that holds the contacts closed when member **34** is withdrawn, are described below.

A link **42** extends rigidly from bar **28** for applying contact-opening bias of compression spring **44** to bar **28**. This spring tends to operate bar **28** in a contact-opening direction; and the operation of the contact-closing linkage by solenoid **40** overcomes this bias and compresses spring **44** so as to be in condition to open the contacts on release. The contact closing linkage will be described generally below and corresponds to the linkage described in detail in the aforereferred to copending application.

The frame **12** carries a supporting plate or bracket **46** which mounts the solenoid **40** and assembly **48** at different positions along bar **28**, solenoid **40** being concealed by assembly **48** in Fig. 1. Pursuant to the present invention, assembly **48** houses the spring **44** and functions as an air puffer and shock absorber in the manner to be described hereinafter. Assembly **48** comprises a cylinder **50** having a piston **52** reciprocable therein. Piston rod **54** connects piston **52** to the link **42**. The cylinder **50** is provided with peripherally spaced flanges **60** which are clamped to bracket **46** by bolts **62**. A spring guide part **64** has flanges **66** bolted to bracket **46** concentrically within the cylinder. The part **64** defines a compartment and guide for the spring **44**. One end of the spring seats against the bracket **46** and the opposite end seats against the piston, fitting over the peripheral shoulder **70** thereof. The piston is provided with the usual piston ring **72** and the chamber **74** behind the piston is vented to the atmosphere through port **76** in bracket **46**. The cylinder head or end plate **78** is secured to the cylinder by bolts **82** which extend through said head and the flanges **84** of the cylinder. The cylinder head is provided with a central port **86** which is in communication with puffer conduit **88** suitably secured to said head.

In Fig. 2 the piston **52** is shown in the contact-closed position with spring **44** fully compressed and conditioned to open the contacts on release, the piston being in the broken line position **52'** at the end of its travel in a contact-opening direction. Secured to the center of the piston **52** and projecting into the compression chamber **90** coaxially therewith is a rod **92** which has fitted thereon a relatively light compression spring **94**. The rod **92** also mounts valve member **96** which is axially mov-

able on said rod and which is biased against the retainer ring 98, secured at the end of the rod, by spring 94. The piston is provided with a bore 100 to receive the spring 94 and a counterbore 102 to provide clearance for the valve member 96 in the extreme position of the piston in a contact-opening direction. Thus one end of the spring 94 seats against the valve member and the opposite end of the spring seats against the piston. The relative position of the parts 92, 96 and 98 is indicated in broken lines at 92', 96' and 98', respectively at the end of piston travel in a contact-opening direction.

On contact release, the contact opening bias is supplied by spring 44 which drives the piston towards the cylinder head to develop a volume of compressed air in chamber 90 which flows through port 86 and conduit 88, this being the air puffer phase of the piston stroke. Conduit 88 is in communication with manifold 104 which in turn has three tubes 106 corresponding to the three poles of the circuit breaker, connected thereto for delivering the compressed air to the region of the contacts, said tubes 106 having outlets 108 adjacent contacts 110. Thus the compressed air in chamber 90 performs a "puffing" operation which is especially effective to interrupt low-current arcs. This is especially advantageous in the case of a magnetic blowout air circuit breaker in which magnetic forces cause the arc to lift into the arc chute. The "puffing" action continues until the piston advances to the position where valve member 96 closes port 86, which is near the end of the compression stroke of the piston. At this point the puffing action abruptly terminates and then the cylinder and piston act as a shock absorber, the latter action resulting from the compression of air in the now closed chamber 90. This action cushions the fast-moving contact-opening travel of the linkage connected to piston 52. After valve member 96 closes port 86, the continued travel of the piston towards the cylinder head results in the yielding of spring 94 and the projection of the rod 92 to position 92'. The spring 94 is a relatively light spring compared to spring 44 and the latter spring overrides spring 94 in this phase of the piston stroke. Thus the cylinder and piston assembly, which houses the spring 44, functions as a puffer and shock absorber during the contact-opening stroke of the piston, the puffer phase terminating and the cushioning phase commencing on the closing of port 86 by valve 96. Spring 44 drives the contact opening mechanism and additionally drives piston 52 through its operating stroke. The spring 44 is reloaded and the piston is returned to the contact-closed position by the solenoid 40. On the return movement of the piston the chamber 90 through conduits 88, 104 and 106 opens to atmosphere when the piston has advanced to a position in which valve member 96 uncovers the port 86. No substantial retardation of the piston in the contact-closing direction is effected because of the chamber venting as described above on both sides of the piston.

There is provided a bumper assembly 112 for the bar 28 which comprises a fitting 114, suitably secured to bracket 46, which mounts an axially reciprocable plunger 116 having a face 118 which coacts with said bar as shown in Fig. 2. The fitting 114 is closed at one end by retainer 120 which is apertured for the extension therethrough of the rod 122 which is secured to plunger 116. The end of the rod 122 has a nut or stop 124 suitably secured thereto which limits the movement of the plunger in a direction towards bar 28 by coaction with retainer 120. A compression spring 126 is fitted on rod 122 between the plunger and the retainer for biasing the plunger towards bar 28. In Fig. 2 the parts are shown in a contact-closed position, the plunger being depressed into fitting 114 and the spring 126 being compressed. On contact opening the plunger will reciprocate to the right (viewing Fig. 2) under drive impetus of spring 126 until stop 124 engages retainer 120 and said drive impetus supplies an initial thrust in movement of the contact opening linkage in the contact-opening direction. The position of bar 28 at the opening end point of the contacts is determined by the engagement of stop member 127, fixed to said bar, against shock absorber assembly 129 which may be of any suitable design and construction and which is suitably fixed to the frame.

Referring now to the contact closing linkage, driving member 34 and driven member 28 are coupled to each other by a latch 130 having an arm 132 that carries a roller 134. Latch 130 also has an arm 136 that is provided with a pivot (not shown) coaxial with shaft 32. Roller 134 engages slant face 138 of the driving member 34. Latch 130 is carried by driven member 28–30–140 that is biased by spring 44 in the direction to resist this drive. The driving face 138 biases the latch 130 in the clockwise direction about the pivot 142 on arm 140 carried by the bar.

The energization of solenoid 40 projects its operating head 38 to the right to rotate the driving member 34 counter-clockwise about its pivot. Engagement of surface 138 against roller 134 transmits driving thrust for member 28 about the pivotal axis of shaft 32. This same driving thrust of member 34 causes arm 132 to be biased about its pivot 142 in the clockwise direction but such motion is prevented by restraint of the pivot of arm 136 as detailed in the above referred to copending application. Operating of member 28 operates the links 22 in the contact-closing direction and compresses contact-opening spring 44. In order to hold the mechanism that operates the contacts in the contact-closed position after members 34 and 38 are withdrawn, there is provided a prop 140 pivotally mounted on shaft 142. Prop 140 has an arm with a slant face 144. Latch 130 is thus biased in the release direction by action of the contact-opening spring after deenergization of the solenoid at which time prop 140 furnishes the desired reaction. A rod 146 is pivoted to an arm 148 of prop 140, there being a compression spring 150 on said rod which biases the prop counterclockwise.

Thus member 130 is lifted to a position which indicates the operating linkage of the contact-closing mechanism in full contacts-closed position and prop 140 drops into latching position in relation to roller 134, said prop holding the linkage "closed" on the retraction of the drive member 34 and member 38. The circuit breaker is provided with suitable latching mechanism (not shown) which on release concomitantly releases member 130 to thereby release the spring 44 which drives the piston 52 in the contact-opening direction as aforedescribed, and initiates the puffer and cushioning action of assembly 48.

Various additional modifications of the above embodiment of the invention will readily occur to those skilled in the art, and therefore the invention should be broadly construed in accordance with its full spirit and scope.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. In a circuit breaker having a contact assembly movable between open and closed positions and operating mechanism therefore, a cylinder and piston assembly operatively connected to said operating mechanism, said assembly defining a compression chamber between said cylinder and piston, a port in said chamber opposite the piston, conduit means extending from said port to the region of said contact assembly, a valve resiliently operable in the closing direction by said piston for closing said port on predetermined movement of said piston towards said port, said piston being moved towards said port coordinately with said contact operating mechanism to supply a volume of compressed air from said chamber through said conduit means during the initial opening movement of said contact assembly to thereby provide an air puffer operation, and said valve closing said port during the terminal movement of said piston towards said port to close said chamber and compress the air therein to thereby provide a cushioning operation,

said resiliently operable valve automatically venting said chamber during reverse travel of said piston.

2. In a circuit breaker having contacts, contact-operating mechanism and a puffer conduit, a cylinder and piston assembly defining a compression chamber having a port, said piston being linked to said contact operating mechanism, means for closing said port on predetermined movement of said piston towards said port, said piston being moved towards said port to supply a volume of compressed air from said chamber through said port during the initial movement of said piston to thereby provide an air puffer operation, said closing means closing said port on the terminal movement of said piston towards said port to close said chamber and compress the air therein to thereby provide cushioning action, and a compression spring in said cylinder on the side of said piston opposite said chamber for providing impetus for said contact operating mechanism.

3. In a circuit breaker having contacts, contact-operating mechanism and a puffer conduit directed at said contacts, a cylinder and piston assembly defining a compression chamber having a port opposite said piston, a valve member resiliently carried by said piston for closing said port on predetermined movement of said piston towards said port, the initial movement of said piston towards said port supplying a volume of compressed air from said chamber through said port to thereby provide an air puffer operation for said puffer conduit, and said valve member closing said port during the terminal part of the movement of said piston towards said port to close said chamber and compress the air therein to thereby provide cushioning action for said contact operating mechanism.

4. In a circuit breaker having contacts, contact-operating mechanism and a puffer conduit directed at said contacts, a cylinder and piston assembly defining a compression chamber having a port opposite said piston, a valve member resiliently carried by said piston for closing said port on predetermined movement of said piston towards said port, the initial movement of said piston towards said port supplying a volume of compressed air from said chamber through said port to thereby provide an air puffer operation for said puffer conduit, and said valve member closing said port during the terminal part of the movement of said piston towards said port to close said chamber and compress the air therein to thereby provide cushioning action for said contact-operating mechanism, and a heavy spring disposed in said cylinder and arranged to operate said piston towards said port and to operate said contact-operating mechanism in the contact-opening direction.

5. In a circuit breaker including separable contacts and a puffer conduit adjacent thereto, a cylinder and piston assembly defining a compression chamber having a port beyond the travel range of the piston, contact-operating mechanism including a heavy spring operatively connected to said piston for actuating the latter towards said port and for biasing said mechanism in the contact-opening direction, means for closing said port on predetermined movement of said piston towards said port, said piston being moved towards said port under the impetus of said contact-operating mechanism to supply a volume of compressed air from said chamber through said port during the initial movement of said piston to thereby provide an air puffer operation, and said closing means being arranged for closing said port only during the terminal movement of said piston towards said port to compress the air in said chamber and thereby provide cushioning action for said contact-operating mechanism, said closing means comprising a valve member yieldingly operated by said piston, reverse operation of the piston tending to produce a retarding vacuum in said chamber which vacuum is automatically vented by said yieldingly operated valve member during contact-closing operation of said contact-operating mechanism.

6. A combined air puffer, cushioning and contact-opening spring device for a circuit breaker, comprising a cylinder and piston defining a compression chamber having a port, a heavy compression spring disposed in said cylinder to press against said piston on the side thereof opposite said chamber for actuating the piston towards said port, a valve member yieldingly carried by said piston in said chamber and spaced a substantial distance therefrom when the piston is at one end of its travel and arranged for closing said port on predetermined movement of said piston towards said port, said piston being moved towards said port by said spring to supply a volume of compressed air from said chamber through said port during the initial movement of said piston to thereby provide an air puffer operation, and said valve member closing said port on the terminal movement of said piston towards said port to close said chamber and compress the air therein and thereby provide cushioning action, reverse travel of the piston being unretarded by vacuum developing in the chamber due to the vacuum relief inherently provided by said yieldingly operated valve.

7. A combined air puffer, cushion and contact-opening spring device for a circuit breaker, comprising a cylinder having a piston reciprocable therein, one sde of said piston and said cylinder defining a compression chamber having a port opposite the piston and the opposite side of said piston being vented to atmosphere, a cylindrical compression spring disposed in said cylinder to act against said piston at said opposite side thereof, cylindrical guide means within said spring, a valve member carried by said piston in said chamber and resilently based away from said piston and spaced from the piston a substantial distance but less than the stroke of the piston, said piston providing a volume of compressed air from said chamber through said port during the initial movement thereof to thereby provide an air puffer operation, and said valve member closing said port during the terminal movement of said piston towards said port to close said chamber and compress the air therein and thereby provide mechanical cushioning, said valve member being lifted from said port automatically to admit air through said port to said chamber on the initial reverse movement of said piston, said valve member and port being aligned coaxially of said piston and cylinder.

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