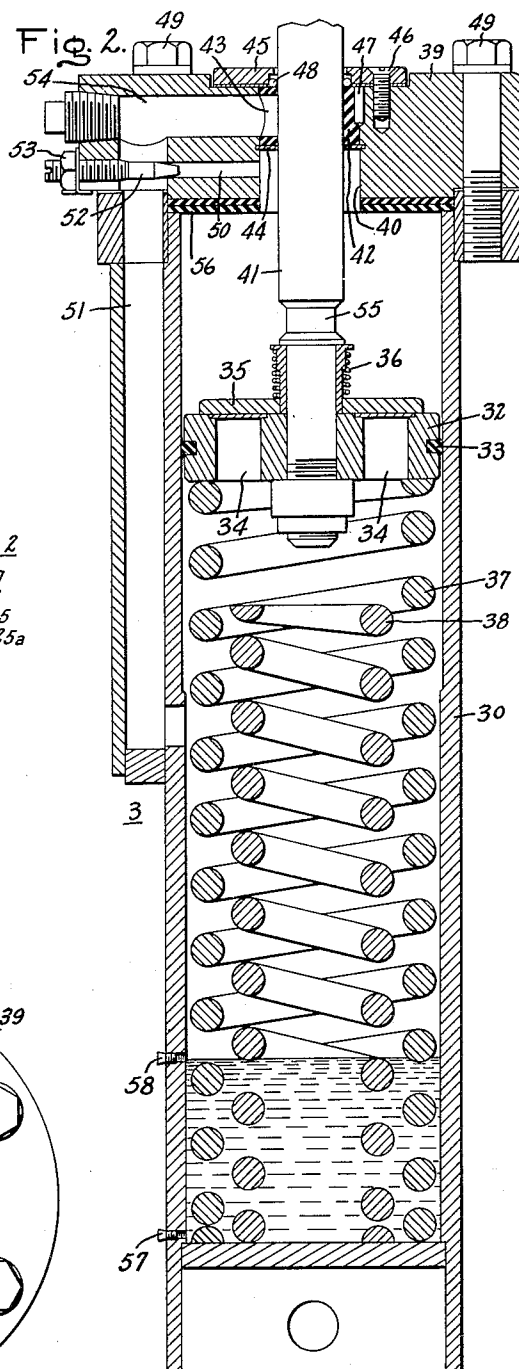
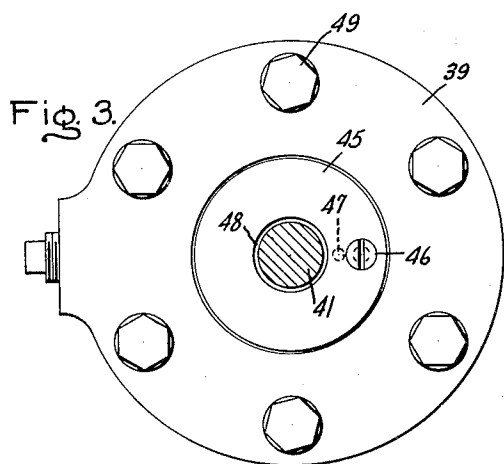


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PNEUMATICALLY CONTROLLED OPERATING DEVICE FOR ELECTRIC CIRCUIT BREAKERS

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5 Claims. (Cl. 200-97)

This invention relates to pneumatically controlled operating devices for electric circuit breakers and, more particularly, to a controlled spring-operated arrangement for imparting opening movement to electric circuit breakers of the latched-closed biased-open type.

In circuit breakers of the type wherein relatively movable contacts are separable within an enclosing arc chute structure so as to draw an arc which is extinguished by a blast of fluid pressure, a continuing circuit isolating operation may be performed by the simple expedient of completely withdrawing one of the contacts from the arc chute so as to establish an external isolating air gap. Of course, it is desirable to have the arc extinguished before the movable contact is withdrawn to isolative position from the chute. To this end, it is desirable to control the opening speed of the contacts throughout the stroke so as to allow an adequate opportunity for the fluid blast supplied to the interrupting unit to extinguish the arc, for it will be appreciated that wastage of the fluid is prevented so long as the movable contact effectively fills the opening in the interrupting chamber through which such contact is movable. Thus an operating device for a circuit interrupter of this type should, after a fast initial opening movement for drawing an arc length favorable to extinguishment by the fluid blast, continue to impart a moderated opening movement for a period of time sufficiently long for the blast of fluid to effect the extinguishment of the arc and begin scavenging the arc chute of ionized arc products. Thereafter, the fluid blast is shut off while the movable contact completely withdraws from the interrupting unit to its fully open position. Furthermore, in circuit interrupters of the type referred to above, it is desirable to arrest the opening movement of the contacts thereof smoothly and without objectionable rebound from their fully open position of the associated moving parts.

A principal object of this invention is to provide a pneumatic control system for the opening spring device of a circuit breaker of the fluid-blast type which system effects a controlled opening movement of the breaker which in addition is arranged to arrest the opening movement of the parts in a smooth fashion so as to avoid any tendency for the parts to rebound.

In accordance with the invention, a spring-dashpot device having a cylinder and piston for controlling the opening movement of the contacts of a circuit interrupter is provided with a by-pass duct communicating with opposite ends of the dashpot cylinder and having therein an adjustable valve for regulating the speed of the piston during the interrupting and isolating opening movement of the circuit breaker contacts. Means including a dumping passage and an undercut portion of the piston rod associated with the dashpot piston quickly relieve the pressure built up ahead of the piston at the end of a circuit breaker operating stroke thereby to prevent undesired rebound of the moving parts.

The invention will be better understood from the following description taken in conjunction with the accom-

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panying drawing in which Fig. 1 is a schematically represented side view of a circuit breaker and its operating mechanism in which the principles of the invention are embodied, Fig. 2 is an enlarged cross-sectional view at mid-stroke of the opening-spring device and its fluid dashpot control system as contemplated by the invention, and Fig. 3 is a top view of the same device shown in Fig. 2.

With reference to Fig. 1, an interrupter, generally designated by the numeral 1, is in the closed position and is normally maintained in the circuit-closed position by the latch-held closing mechanism generally designated by the numeral 2. In this arrangement, opening movement of the breaker, which occurs upon tripping of the operating mechanism 2, is controlled by the spring-dashpot mechanism generally designated by the numeral 3.

The interrupter arrangement 1 comprises a movable sickle-type contact 4 which is pivotally mounted at 5 and which cooperates with a fixed contact (not shown) which is disposed within the arc chute structure 6. Thus the circuit through the interrupter comprises terminals L1, the fixed contact with chute 6, contact 4 and terminal L2. As is indicated in the drawing, the pivot 5 for the sickle-type contact 4 is mounted on a conduit 7. Conduit 7 comprises insulating tubular means for supplying a blast of fluid from a source (not shown) to the arcing passage formed within the lower portion of the structure 6. Sickle-type contact 4 is opened when rotated in a clockwise direction about the pivot 5 by means of the insulating operating rod 8 which is pivotally connected to the contact 4 at 9. Operating movement of operating rod 8 is controlled by operating crank 10 which is secured about the square-sectioned shaft 11 which is mounted for rotation in a fixed journal support (not shown). The shaft 11 may constitute a jack shaft for simultaneously operating three interrupters, such as 1, in a triple pole circuit breaker.

For rotating the shaft 11, crank arm 12 is secured thereto which is pivotally coupled at 15 both to the connecting rod 13 from the operating mechanism 2 and to the crosshead 14 of the opening-spring-dashpot device 3.

The closing mechanism 2 comprises an output crank 16 rotatable about a fixed pivot 16a which is driven by a collapsible trip-free thrust structure comprising the links 17, 18 and 19. Crank 16 is pivotally connected to rod 13 at 20 and to the link 17 at 21. Links 17 and 18 which comprise the closing toggle are pivotally connected together at the knee 22 while the guide link 19 is mounted for rotation about its fixed pivot 23 and is pivotally connected to the toggle link 18 at pin 24 which also carries a latch roller. The linkage comprising links 17, 18 and 19 is maintained in the closed position shown in the drawings by the non-trippable prop latch 25 which is pivotally mounted at 25a and by the electrically or manually trippable latch 26 which is pivotally mounted at 26a.

The circuit breaker opens to interrupt its circuit when tripping motion is imparted to the trip latch 26 such as by known suitable means thereby causing rotation of the latch from its holding position in the clockwise direction about its pivot 26a. Upon tripping of the latch 26, the toggle mechanism comprising links 17, 18 and 19 collapses toward the left so that the output crank 16 is then freed to rotate in a clockwise direction about the pivot 16a under the bias of spring means forming an internal part of device 3 acting through crosshead 14 and connecting rod 13 thereby imparting counterclockwise rotation to the crank arms 10 and 15 accompanied by clockwise or opening rotation of the movable contact 4.

For the purpose of applying closing power to the operating mechanism, a suitable solenoid element such as is represented by the numeral 27 may be used. Element 27 comprises a solenoid 28 having an armature plunger 29. Thus upon energization of solenoid 28, plunger 29 is moved upwardly while engaging a suitable part of the

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linkage comprising links 17, 18 and 19 such as a roller mounted at the pivot 22. At the end of its upward stroke plunger 29 establishes the linkage upon the prop latch 25 with these parts and the tripping latch 26 in the positions indicated in the drawing so as to latch the breaker in the closed position; the de-energized plunger 29 falling back to its initial position shown. The details of the solenoid operative mechanism such as is shown in the drawing and designated by the numeral 2 are more fully disclosed in United States Patent 2,458,240 granted January 4, 1949 upon an application of R. J. Baskerville which is assigned to the assignee of this invention.

The spring-dashpot device generally designated by the numeral 3, as shown in detail in Fig. 2, comprises a cylinder 30 which is pivotally mounted at 31 about a fixed pivot so that it may rock with the angular sweep of the crank 12. Disposed within the cylinder 30 is a piston 32 having a piston ring 33 which functions in the usual manner to form a seal between the walls of cylinder 30 and the piston 32. Piston 32 is provided with a plurality of ports 34 and a non-return valve 35 together with its spring 36 which operates normally to maintain the non-return valve 35 in the position shown so as to close the ports 34. Piston 32 is biased strongly and upwardly by a pair of compressional contact-opening springs 37 and 38 whose function is to supply the driving force to the piston and its associated parts upon tripping of the latch member 26 and collapse of the latching structure of the operating mechanism 2 as already explained. The inner spring 38, being the shorter and stronger, may be regarded as the kick-off spring which produces a fast initial contact separation, while 37 serves as the follow-through spring for ensuring a full opening stroke to the contact blade; it being understood that the piston 32 is depicted at an instant in mid-stroke on its way upward when its opening stroke will terminate at the top end of the cylinder 30. Such springs may be augmented by others which might conveniently be incorporated in the closing operating mechanism 2.

Disposed at the upper end of the cylinder 30 is a closure member 39. Closure member 39 is provided with an aperture 40 through which the piston rod 41 is slidable. Disposed about the piston rod 41 in close fitting relationship is a throat bushing 42 constructed of appropriate anti-friction material and having a radially disposed port opening 43 therein. Throat bushing 42 is maintained in position by a retaining washer 44 on which the bushing rests and a gasketed packing plate member 45 which is sealed to the closure member 39 by suitable fastening means such as the screws 46. Shifting of the throat bushing 42 is prevented by the dowel pin 47 which is entered into the hole drilled partially in the throat bushing and in the closure member 39 as will be obvious from the drawing. A resilient packing ring 48 which is constructed of rubber or other similar material nests in the recess of the packing plate 45 and effectively seals the cylinder end about the piston rod 41 so that inside air is not discharged outside to atmosphere, nor is contaminated air admitted to the cylinder from without. Closure member 39 is gasketed and secured to cylinder 30 by suitable bolts 49.

For the purpose of regulating the upward opening movement imparted by springs 37 and 38 to the dashpotting piston 32 when the latched-closed mechanism 2 is tripped, a by-pass passage including the horizontally disposed passage 50 formed in closure member 39 and the vertical passage 51 defined along one side of cylinder 30 establishes communication between the opposite ends of cylinder 30. Flow of fluid through the passage 50 and 51 can be regulated by the valve means comprising the needle valve 52 which, as is indicated, is adjustable and which may be secured in any desired position by the locknut 53. Thus, as upward motion of the piston 32 progresses, build up of pressure fluid ahead of the piston in

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the upper portion of the cylinder 30 is regulated by the particular adjustment chosen for the needle valve 52.

Thus by suitable adjustment of the needle valve 52, the accelerating opening movement of contact 4 will be moderated, after an initial fast contact-parting movement under the urge of both short and long springs 38 and 37 and before appreciable pressure builds up above the piston 32, so that the moderated opening speed gives the fluid supplied through the blast conduit 7 a better opportunity to extinguish the arc drawn within the arc passage of the chute 6 and, furthermore, such supply of fluid pressure may be cut off and the chute interval pressure diminished before the contact 4 is withdrawn exteriorly from the passage so as to prevent needless waste of the fluid blast.

Normally, the limited relief of pressure fluid due to the action of needle valve 52 and by-pass passage 50, 51 would not prevent a certain amount of shock and rebound to the mechanism due to an excess of pressure being built up as stored energy ahead of piston 32 near the end of its upward travel.

For the purpose of eliminating any such rebound by advantageously disposing of this energy, the dumping or transfer passage 54 is provided together with a valve constituted by an undercut portion 55 of the piston rod 41. As will be obvious from Fig. 2, the radially extending dumping passage 54 registers with the radial port 43 formed within the throat bushing 42. Thus as the parts approach the end of an opening operation of the breaker, the undercut portion 55 of the piston rod 41 establishes communication between the space above the piston 32 within cylinder 30 and the dumping passage 54. Since the dumping passage 54 is in communication with the by-pass passage 51, the accumulated pressure ahead of piston 32 is not only quickly relieved but is reapplied usefully to the lower face of the piston to equalize the pressure thereabout so that the follow through spring of the device will preponderate upwardly, thereby to prevent undesired rebound of, and smoothly stop, the moving parts. The gasket 56 of resilient material conveniently serves as the limiting stop which determines the full open position.

As is shown in the drawing, the cylinder 30 is provided with a drain plug 57 and a fill plug 58 by means of which a suitable level of oil is maintained in the bottom of the cylinder 30. This constitutes a sump for receiving and retaining disturbed dust or metallic particles as well as providing an oil reservoir, the vapor from which is available for lubricating the cylinder walls.

During a closing operation of the breaker by the solenoid device 27, downward motion of the piston rod 41 and of piston 32 charges the opening device 3 by compressing springs 37 and 38. Such motion is achieved without the additional burden of compressing fluid within the lower portion of the cylinder since the disk valve 35 opens against the light spring 36 so that fluid from below the piston escapes through the ports 34 to the region above the piston 32 without generating objectionable back pressure.

In thus providing a closed pneumatic dashpot system, external dust and grime are excluded such as might impair the reliable operation of the close-fitting piston in its machined cylinder walls.

While I have shown and described a particular embodiment of the invention, it will be understood that I do not wish to be limited thereto and intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A biased-open dashpot device for producing a controlled opening movement of a latched-closed circuit breaker, said device comprising a cylinder containing a compressible working fluid, a piston movable against the fluid and having a piston rod adapted to be operably con-

ected to the breaker, said piston having a normal charged position intermediate the ends of said cylinder and being adapted for movement therefrom toward one end of said cylinder in response to tripping of the breaker, a closure member mounted at said one end of said cylinder and having an opening therein, said piston rod being slidable in said opening, a bypass passage having its ends in communication with opposite ends of said cylinder, adjustable valve means for restricting the flow of fluid in said bypass passage from said one end of said cylinder to the other end thereof during said movement of said piston, and a dumping passage formed in said closure member and leading from the opening therein to said bypass passage, said piston rod having an undercut portion for establishing communication between said one end of said cylinder and said dumping passage as said piston nears the end of its operating stroke.

2. A biased-open dashpot device for controlling the opening movement of a latched-closed circuit breaker, said device comprising a cylinder containing a compressible working fluid, a piston movable against the fluid and having a piston rod adapted to be operably connected to the breaker, said piston having a normal charged position intermediate the ends of said cylinder and being adapted for movement therefrom toward one end of said cylinder in response to opening of the breaker, a closure member mounted at said one end of said cylinder and having an opening therein, said opening being larger in diameter than said piston rod, said piston rod being slidable in said opening, means including a bushing affixed in position within said opening and forming a substantially fluid tight seal with said piston rod, said bushing having a radially disposed passage therein, a bypass passage having its ends in communication with opposite ends of said cylinder, adjustable valve means in said bypass passage for controlling the flow of fluid from said one end of said cylinder to the other end thereof during said movement of said piston, a dumping passage formed in said closure member and leading from said radially disposed passage in said bushing to said bypass passage, said piston rod having an undercut portion for establishing communication between said one end of said cylinder and said dumping passage as said piston nears the end of its operating stroke.

3. A biased-open dashpot device for controlling the opening movement of a latched-closed circuit breaker, said device comprising a cylinder containing a compressible working fluid, a piston movable against the fluid and having a piston rod adapted to be operably connected to the breaker, said piston having a normal charged position intermediate the ends of said cylinder and being adapted for movement therefrom toward one end of said cylinder in response to opening of the breaker, a closure member mounted at said one end of said cylinder and having an opening therein, said opening being larger in diameter than said piston rod, said piston rod being slidable in said opening, a bushing affixed in position within said opening and forming a substantially fluid tight seal with said piston rod, said bushing having a radially disposed passage therein, a bypass passage having its ends in communication with opposite ends of said cylinder, a dumping passage formed in said closure member and leading from said radially disposed passage in said bushing to said bypass passage, said piston rod having an undercut portion for establishing communication between said one end of said cylinder and said dumping

passage as said piston nears the end of its operating stroke.

4. In combination, a cylinder containing a compressible working fluid and a piston movable against the fluid and having a piston rod, said piston having an initial position intermediate the ends of said cylinder, an electric circuit breaker operably related with said piston rod, a latch for holding said breaker in the closed position, means for moving said piston from its initial position toward one end of said cylinder to open the breaker in response to tripping of said latch, a closure member mounted at said one end of said cylinder, said closure member having an opening therein through which said piston rod is slidable, a bypass passage having its ends in communication with opposite ends of said cylinder, adjustable valve means in said passage for controlling the flow of fluid from said one end of said cylinder to the other end thereof during an operating stroke of said piston, a dumping passage leading from the opening in said closure member to said bypass passage, and an undercut portion formed on said piston rod for establishing communication between said one end of said cylinder and said dumping passage quickly to transfer fluid compressed in said one end of said cylinder to the other end thereof through said dumping and bypass passages when said piston nears the end of its operating stroke.

5. A dashpot controlled operating device for producing controlled movement of a member, said device comprising a cylinder containing a compressible working fluid, a piston movable against the fluid and having a piston rod adapted to be operatively connected to said member, driving means adapted to be charged so as to be in a condition to actuate said piston, said piston occupying a normal charged position intermediate the ends of said cylinder when said driving means is charged, said piston being adapted for movement from said normal charged position toward one end of said cylinder in response to discharge of said driving means, a closure member mounted at said one end of said cylinder and having an opening therein, said piston rod being slidable in said opening, a bypass passage having its ends in communication with opposite ends of said cylinder, adjustable valve means for restricting the flow of fluid in said bypass passage from said one end of said cylinder to the other end thereof during said movement of said piston, and a dumping passage formed in said closure member and leading from the opening therein to said bypass passage, said piston rod having an undercut portion for establishing communication between said one end of said cylinder and said dumping passage as said piston nears the end of its operating stroke.

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