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OPERATING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

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Fig. 1.

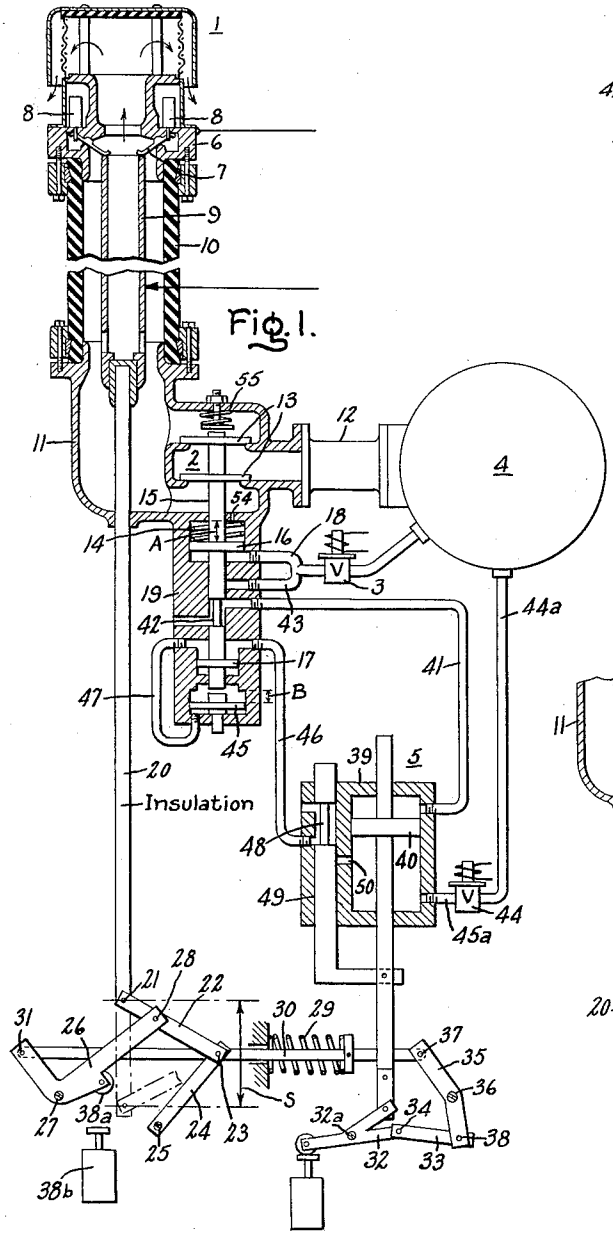


Fig. 2.

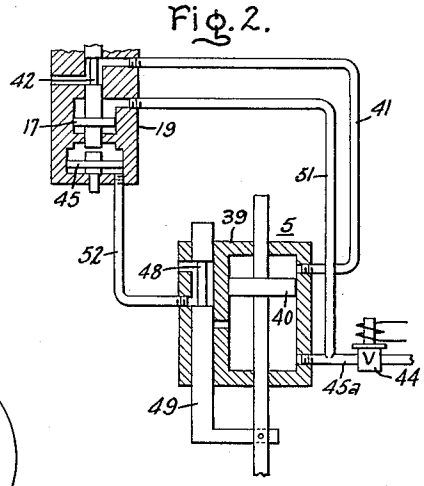
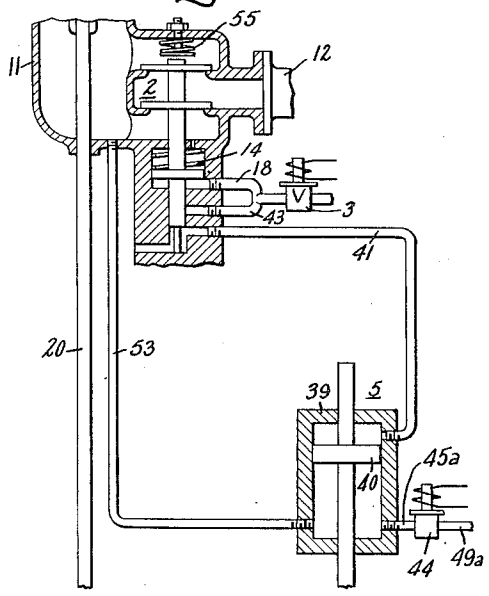


Fig. 3.



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OPERATING MECHANISM FOR ELECTRIC CIRCUIT BREAKERS

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14 Claims. (Cl. 200—148)

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This invention relates to operating mechanisms for electric circuit breakers and more particularly to a mechanism for supplying a controlled blast of gas to the contacts of a high voltage circuit breaker of the gas blast type during the performance of circuit closing operations by the breaker.

A blast of gas such as high pressure air is commonly employed in gas blast circuit breakers to extinguish an arc drawn between the breaker contacts during circuit opening operations. During circuit closing operations of high voltage breakers, an arc may strike between the breaker contacts while the contacts are still separated by a substantial distance. Such arcs cause damage to the breaker contacts and may necessitate frequent inspection and repair or replacement of the contact members resulting in undesirable outage time for the breaker. The tendency for an arc to strike prematurely during circuit closing operations can be controlled by supplying a blast of gas to the space between and around the contacts. Since such a blast is not for the purpose of extinguishing an arc, as during circuit opening operations of the breaker, the magnitude of the blast need not be as great during closing of the breaker as is required during opening operations. In view of this fact it is possible to supply a controlled blast of a lesser magnitude during closing operations then is required during opening operations of the breaker and in this way the supply of pressure gas is not needlessly wasted. This invention is concerned primarily with an arrangement whereby a limited blast of gas is supplied to the breaker contacts while the breaker is performing a circuit closing operation.

A principal object of this invention is to provide an improved operating mechanism for high-voltage gas blast circuit breakers wherein a blast of gas is supplied to the breaker contacts both during opening and closing operations of the breaker and wherein simple and reliable means are provided for limiting the magnitude of the blast during breaker closing operations so as to conserve the supply of pressure gas.

In carrying out the invention in one form as applied to a single pole circuit breaker, a blast valve of the balanced type is moved to a fully-opened position during opening operations of the breaker by one valve operating means so as to supply an effective blast to extinguish the arc during opening of the breaker, and during circuit closing operations, the blast valve is moved to a partially-opened position by another valve

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operating means so as to supply a blast of a lesser magnitude during closing of the breaker. Since the valve is of the balanced type, and hence would tend to move to its fully-opened position once it is partially opened during breaker closing operations, means are provided for limiting the opening movement of the valve during breaker closing operations.

For a better understanding of the invention, reference may be had to the following description taken in conjunction with the drawing in which Fig. 1 represents schematically a circuit breaker of the gas blast type and an operation mechanism therefor embodying the principles of the invention, Fig. 2 represents an alternative arrangement of the parts, and in which Fig. 3 represents a construction whereby the breaker contacts are blasted directly from air supplied from the breaker operating cylinder.

In the drawing the numeral 1 generally designates an interrupting unit comprising one pole of a gas blast circuit breaker. The supply of pressure fluid to interrupting unit 1 is supplied through blast valve 2, which is under the control of opening control valve 3, from a source of fluid pressure 4. Once the circuit controlled by the breaker has been interrupted by interrupter unit 1, a circuit isolating operation of the breaker is accomplished due to operation of fluid-actuated device 5 as will be more fully explained.

Interrupter unit 1 comprises metallic structure 6 which supports finger contacts 7 biased by spring means 8 into engagement with tubular contact 9. The structure 6 is supported by an insulating casing 10 which in turn is mounted upon the metallic base member 11. The specific construction of the unit 1 is more fully described and is claimed in application Serial No. 233,637—Beatty, filed June 26, 1951, and an interrupter of the general type disclosed in Fig. 1 is disclosed and broadly claimed in application Serial No. 202,100—Beatty, filed December 21, 1950, now Patent No. 2,645,697, dated July 14, 1953, both of which applications are assigned to the assignee of this invention. The finger contacts 7 are separated from the tubular contact 9 by a blast of gas supplied through valve 2 and through the space between the tubular contact 9 and the casing 16. Such a blast causes the contacts 7 to move out of engagement with the tubular contact 9 against the bias of spring means 8 and also extinguishes the arc drawn between these contacts. This supply of gas flows in the direction of the arrows to atmosphere and is supplied to the valve 2 from the air receiver 4 through

the short conduit 12. The terminals of the breaker are indicated schematically by a line connected to member 6 and by another line in sliding contact with the contact 9.

Blast valve 2 is of the balanced type and comprises a pair of disks 13 mounted on a valve spindle 15 on which is disposed a main operating piston 16 and a valve restraining piston 17. The valve is biased toward the closed position by spring means 14. A conduit 18 interconnects opening control valve 3 with the enclosing structure 19 in which the main operating piston 16 is movable. As illustrated, opening control valve 3 is of the electromagnetically-actuated type. Opening control valve 3, as is well known, could be responsive to an electric condition of the system controlled by the breaker 1. Valve 3 also could be manually actuated or, of course, could be both manually and automatically operable.

Full opening movement of blast valve 2 is accomplished when opening control valve 3 is opened. Opening of the opening control valve 3 supplies pressure fluid underneath the piston 16 and causes the valve 2 to move to its fully-opened position. In this way a major blast is supplied to the interrupting unit 1 to separate the finger contacts 7 from the tubular contact 9 and to extinguish an arc drawn between these contacts. When blast valve 2 is reclosed due to the closing of control valve 3 and to the action of spring 14, the contacts 7 will return to the position illustrated due to the bias of springs 8.

After interruption of an arc drawn between the contacts 7 and 9, a suitable isolating gap is esablished before the blast of fluid is shut off. To this end the arrangement shown in the drawing is constructed so that the tubular contact 9 can be drawn downwardly after or coincident with the completion of an interrupting operation. Contact 9 is connected at its lower end to a vertical operating rod 20 of insulating material which is pinned at 21 to a link 22 which in turn is pivoted at 23 to a guide link 24 mounted at fixed pivot 25. Operating crank 26 mounted for rotation about a fixed pivot 27 is pinned at 28 to the link 22. Opening bias for contact 9 is supplied in the form of compressional spring 29 which biases a transversely-disposed rod 30 toward the right. Rod 30 is pinned to crank 26 at 31. Spring 29 normally is ineffective to separate contact 9 from finger contacts 7 due to the toggle construction comprising links 32 and 33 which are pinned together at 34. Rod 30 is connected to link 33 through crank 35 pivotally mounted at the fixed pivot 36 and pinned at its upper extremity to rod 30 by pin 37 and at its lower end to link 33 by a pin 38. Link 32 is mounted on a fixed pivot 32*a*. With the toggle comprising links 32 and 33 in the overcenter position indicated, the bias of spring 29 is ineffective to separate the contacts. However, if the toggle is moved downwardly through dead center and beyond the spring 29 then imparts a rapid opening movement to the contact 9 through rod 20 and parts associated therewith. The lower position of rod 20 and of link 22 are indicated by dotted lines and the full isolating stroke is indicated by the distance S. Opening movement of the parts is arrested when roller 38*a* on crank 26 engages buffer 38*b*.

For the purpose of breaking the toggle comprising links 32 and 33, the fluid-actuated device 5 is arranged to respond to the opening of control valve 3 and the resulting operation of the fluid motor comprising piston 16 and structure 19, to impart downward motion to break the toggle.

Fluid-actuated device 5 is provided with an enclosing cylinder 39 and an operating piston 40. Thus when fluid pressure is supplied above piston 40, downward motion will be imparted thereto so as to break the toggle 32—33 whereupon spring 29 quickly opens the isolating contact 9.

Fluid pressure is supplied above the piston 40 by means of a conduit 41 which connects to the enclosing structure 19. Valve spindle 15 is provided with an undercut portion 42 and fluid pressure is supplied from opening control valve 3 to the structure 19 through a conduit 43. Thus when opening control valve 3 is opened, fluid pressure in conduit 18 will cause piston 16 to move upwardly. Simultaneously, fluid pressure supplied through conduit 43 passes through the structure 19 to the conduit 41 to operate piston 40 of fluid-actuated device 5 after the undercut portion 42 of the spindle 15 establishes communication between conduits 43 and 41. Thus, it is impossible to supply fluid to the device 5 to cause isolating movement of contact 9 unless the blast valve 2 has been opened. This particular interlocking arrangement is more fully disclosed and claimed in application Serial No. 233,542—Shores, filed June 26, 1951, assigned to the assignee of the present invention and now Patent No. 2,667,554.

As already mentioned, a full breaker opening stroke is completed with the opening of the isolating contact 9; the cycle being terminated by the timed reclosing of the closing valve 3 as through the operation of an auxiliary switch actuated by some appropriate moving part during the downward stroke of the piston 40 of the pneumatic operator 5. Thus, pressure below the blast valve piston 16 is relieved through the atmospheric vent of the closing control valve 3 so that the blast valve 2 closes under the urge of its spring 14, while pressure above the motor piston 40 is relieved, when the blast valve closes, through the vent to atmosphere in the structure 19 adjacent the undercut portion 42 of the blast valve spindle; the opening spring 29 ensuring that a full opening stroke is attained by the isolating contact 9.

Since the finger contacts 7 return to the position indicated due to the action of biasing means 8 after the fluid blast is cut off, closure of the breaker is accomplished by imparting upward movement to the contact 9. To this end, fluid pressure is supplied to the underside of piston 40 of device 5 to cause upward movement thereof and movement of the operating linkage against the bias of spring 29 to close the breaker. Fluid pressure is supplied to the lower portion of structure 39 by means of breaker closing control valve 44 which, as indicated schematically on the drawing, is of the electromagnetically-operated type. Valve 44 is connected with cylinder 39 through a conduit 45*a* and is constructed so as to vent the lower portion of cylinder 39 to atmosphere when closed. Fluid pressure is supplied to valve 44 through suitable means such as the conduit 44*a*.

In order to prevent an arc from striking between contacts 7 and 9 as contact 9 approaches the closed position, it is desirable to supply a minor blast of gas to the contacts. This minor blast is supplied by opening the valve 2 a partial distance only. In this way, the supply of pressure fluid in air receiver 4 is not needlessly wasted.

For the purpose of imparting partial opening movement to blast valve 2 a fluid motor comprising piston 45 and a restraining means in the form of piston 17 are provided in accordance with this invention. Fluid pressure for this purpose is supplied to pistons 17 and 45 through conduits 46 and 47 from an auxiliary valve comprising undercut portion 48 of a slidable member 49 which is movable in accordance with movement of piston 46. Fluid pressure is supplied to conduit 46 from the lower portion of cylinder 39 through port 50 due to the establishment of communication between port 50 and conduit 46 as the undercut portion 48 of control member 49 moves upwardly.

Fluid pressure supplied through conduit 46 bears against the upper surface of restraining piston 17 and through conduit 47 is caused to bear against the lower surface of piston 45 which is of larger diameter than piston 17. It will be observed that the travel B of piston 45 is less than the travel A of piston 16. Thus fluid pressure supplied below piston 45 will impart upward movement to valve stem 15 to force valve 2 to open partially. Valve 2, being provided with the two disks 13, is of the balanced type. Thus the momentum of the parts, being sufficient to overcome the force of spring 14, would cause the valve to open fully once it is partially opened by piston 45. According to the invention, the piston 17 is arranged to exert a downward force on the valve spindle 15 so as to maintain the valve 2 in a partially-opened position as determined by the position of piston 45 after that piston completes its upward travel. Furthermore, piston 17 causes a slower opening of the valve than when the valve is opened by piston 16 during opening of the breaker.

It will be understood that it is within the purview of this invention to segregate the control of the supply of fluid to piston 17 from the control member comprising the undercut portion 48 of control member 49. To this end a conduit could be connected directly from closing valve 44 to the space above piston 17 as indicated by conduit 51 in Fig. 2. If a conduit such as 51 is utilized, the conduits 46 and 47 would be eliminated, and in their place would be substituted the conduit 52 connected directly to the space underneath piston 45 as is indicated in Fig. 2. Thus pressure would be established above piston 17 before the establishment of pressure below the piston 45 in the arrangement shown in Fig. 2.

Partial opening movement of blast valve 2 during a circuit breaker closing operation could be accomplished by a piston such as 45 and the restraining action to prevent movement of the valve 2 to the fully-opened position could be achieved or supplemented by means of a port 54 shown in Fig. 1 which would establish communication between conduit 12 and the upper surface of piston 16 once the blast valve 2 had opened partially, and the pressure exerted on piston 16 would be analogous to the pressure exerted on the upper surface of piston 17. While the construction embodying the port 54 is deemed within the purview of this invention, the arrangement utilizing piston 17 is regarded as a preferable embodiment of the invention.

It will also be understood that the valve 2 could be restrained in its partially-opened position after having been moved thereto by the piston 45 by buffing means in the form of the spring 55. Spring 55 would supplement the action of biasing spring 14 and would retain the valve in a partially-opened position after the piston 45 had completed its full stroke. It will be understood that spring 55 would be constructed so as not to prevent the full opening movement of valve 2 during a circuit breaker opening operation, the upward force of piston 16 being sufficient to compress buffer 55 enough to allow full opening movement of valve 2. Buffer 55 could be used as supplementary to, or in lieu of, arrangements using piston 17 or port 54.

For certain applications of gas blast breakers, a sufficient blast for closing operations of the breaker might be derived directly from the lower portion of fluid-actuated device 5 as indicated in Fig. 3. To this end a conduit such as that indicated at 53 could be directly connected between the lower portion of cylinder 39 and the space within the base member 11. In such a construction, the blast valve 2 would not be operated during closing operations of the breaker and the buffer 55 would merely arrest the upward movement of the blast valve during breaker opening operations.

While we have shown and described certain embodiments of the invention, it will be understood that we do not wish to be limited to the specific arrangements disclosed and intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of this invention.

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

1. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor movable independently of said blast valve and engageable therewith for moving said blast valve from a closed to a partially opened position, means including a control valve for supplying pressure fluid to said motor to cause operation thereof, restraining means including a piston arranged to move with said blast valve, and means for supplying pressure fluid to a surface of said piston coincident with the operation of said fluid motor, the force exerted on said blast valve by said piston being in opposition to the force produced by the pressure fluid supplied to said motor so as to prevent substantial further opening movement of said blast valve upon completion of an operating stroke by said motor.

2. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor having a piston movable independently of said blast valve and engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, means including a control valve for supplying pressure fluid to said fluid motor to cause operation thereof, restraining means including a restraining piston arranged to move with said blast valve, and means for supplying pressure fluid to a surface of said restraining piston coincident with the operation of said fluid motor, the pressure fluid supplied to said piston acting in opposition to the pressure fluid supplied to said motor whereby to prevent movement of said blast valve to its fully opened position.

3. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor movable independently of said blast valve and engageable therewith for moving said blast valve from a closed to partially opened position, means including a control valve for supplying pressure fluid to said

motor to cause operation thereof, restraining means including a piston arranged to move with said blast valve, and means responsive to operation of said control valve for supplying pressure fluid to a surface of said piston before completion of an operating stroke by said fluid motor, the pressure fluid supplied to said piston acting in opposition to the pressure fluid supplied to said motor whereby to prevent movement of said blast valve to its fully opened position.

4. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor having an operating stroke less than the full operating stroke of said blast valve, said motor being movable independently of said blast valve and being engageable therewith to move said blast valve from a closed to a partially opened position, restraining means including a piston arranged to move with said blast valve, and means including a control valve for supplying pressure fluid to said fluid motor and to a surface of said piston to cause operation of said fluid motor and movement of said blast valve to a partially opened position, the pressure fluid supplied to said piston acting in opposition to the pressure fluid supplied to said motor whereby to prevent movement of said blast valve to its fully opened position.

5. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor having an operating stroke less than the full operating stroke of said blast valve, said motor being movable independently of said blast valve and being engageable therewith to move said blast valve from a closed to a partially opened position, restraining means including a piston arranged to move with said blast valve, and means for supplying pressure fluid to a surface of said piston in response to the opening of said blast valve, the pressure fluid supplied to said piston acting in opposition to the action of said fluid motor whereby to prevent movement of said blast valve to its fully opened position.

6. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor for moving said blast valve from a closed to a partially opened position, restraining means including a piston arranged to move with said blast valve, said restraining means being arranged to oppose opening of said blast valve, and means including a control valve for supplying pressure fluid to a surface of said piston, means responsive to operation of said control valve for supplying pressure fluid to said fluid motor, and means interposed between said control valve and said fluid motor for preventing the application of pressure to said fluid motor until after fluid pressure has been supplied to said piston, said fluid motor being sufficiently strong to move said blast valve to its partially opened position in opposition to said restraining means.

7. In combination, a blast valve of the balanced type, means urging said blast valve toward closed position, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being movable independently of said blast valve and being engageable with a part of said blast valve to move said blast valve to a partially opened position, restraining means including a piston operably related with said blast valve, and means for supplying opposing pressure fluid to said motor and to said piston respectively, whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor.

8. An operating system for a high voltage gas blast circuit breaker comprising, a biased closed blast valve, a first fluid motor operably related with said blast valve and arranged to impart full opening movement thereto, means including a breaker opening control valve for supplying pressure fluid to said first motor to cause opening of said blast valve, a second fluid motor operably related with said blast valve and arranged to move said blast valve to a partially opened position, means including a breaker closing control valve for supplying pressure fluid to said second motor to cause blast valve opening movement thereof, restraining means including a piston operably related with said blast valve, said restraining means being arranged to oppose opening movement of said blast valve, and means for supplying pressure fluid to said piston in opposition to the pressure fluid supplied to said second motor and in response to opening of said breaker closing control valve, said piston being effective to prevent opening movement of said blast valve after said blast valve is moved to its partially opened position by said second fluid motor.

9. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact, a blast valve of the balanced type, means urging said blast valve toward closed position, fluid actuated means for imparting circuit closing movement to said isolating contact, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, restraining means including a piston operably related with said valve, and means including a closing control valve for supplying pressure gas to said fluid actuated means, and means effective after opening of said closing control valve for supplying opposing pressure gas to said motor and to said piston respectively, whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor, said piston being effective to prevent substantial further opening of said blast valve after completion of the working stroke of said motor.

10. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact, a blast valve of the balanced type arranged to supply a blast of gas to said contacts, means urging said blast valve toward closed position, fluid actuated means for imparting circuit closing movement to said isolating contact, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, restraining means including a piston operably related with said blast valve, means including a closing control valve for supplying pressure gas to said fluid actuated means, means responsive to opening of said closing control valve for supplying pressure gas to said piston, and means responsive to operation of said fluid actuated means for supplying pressure gas to said motor, the pressure gas supplied to said piston acting in opposition to the pressure gas supplied to said

motor whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor and said piston being effective to prevent substantial further opening of said blast valve after completion of the working stroke of said motor.

11. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact, a blast valve arranged to supply a blast of gas to said contacts, means urging said blast valve toward closed position, fluid actuated means for imparting circuit closing movement to said isolating contact, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, restraining means including a piston arranged to move with said blast valve, means including a closing control valve for supplying pressure gas to said fluid actuated means, and means responsive to operation of said fluid actuated means for supplying opposing pressure gas to said motor and to said piston respectively, whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor and said piston being effective to prevent substantial further opening of said blast valve after completion of the working stroke of said motor.

12. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact, a blast valve arranged to control the supply of pressure gas to said contacts, means urging said blast valve toward closed position, fluid actuated means for imparting circuit closing movement to said isolating contact, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, restraining means including a piston arranged to move with said blast valve, means including a closing control valve for supplying pressure gas to said fluid actuated means, means effective after opening of said closing control valve for supplying pressure gas to said motor and means responsive to opening of said blast valve for supplying pressure gas to said piston, the pressure gas supplied to said piston acting in opposition to the pressure gas supplied to said motor whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor and said piston being effective to prevent substantial further opening of said blast valve after completion of the working stroke of said motor.

13. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact, a blast valve arranged to supply a blast of gas to said contacts, means urging said blast valve toward closed position, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve from a closed to a partially opened position, restraining means including a piston operably related with said valve, and means effective after opening of said closing control valve for supplying opposing pressure gas to said motor and to said piston respectively, whereby the action of said piston is in opposition to the action of said motor, said motor being sufficiently strong to overcome the restraining action of said piston throughout the full working stroke of said motor and said piston being effective to prevent substantial further opening of said blast valve after completion of the working stroke of said motor.

14. An operating system for a high voltage gas blast circuit breaker having an interrupting contact and an isolating contact arranged in series, a blast valve of the balanced type arranged to supply a blast of gas to said contacts, means urging said blast valve toward closed position, fluid actuated means for imparting circuit closing movement to said isolating contact, a fluid motor having an operating stroke less than the full travel of said blast valve, said motor being engageable with a part of said blast valve to move said blast valve to a partially opened position, restraining means including a piston moveable with said valve and arranged to oppose opening movement thereof, means including a closing control valve for supplying pressure gas to said fluid actuated means, and means effective after opening of said closing control valve for supplying opposing pressure gas to said motor and to said piston respectively.

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