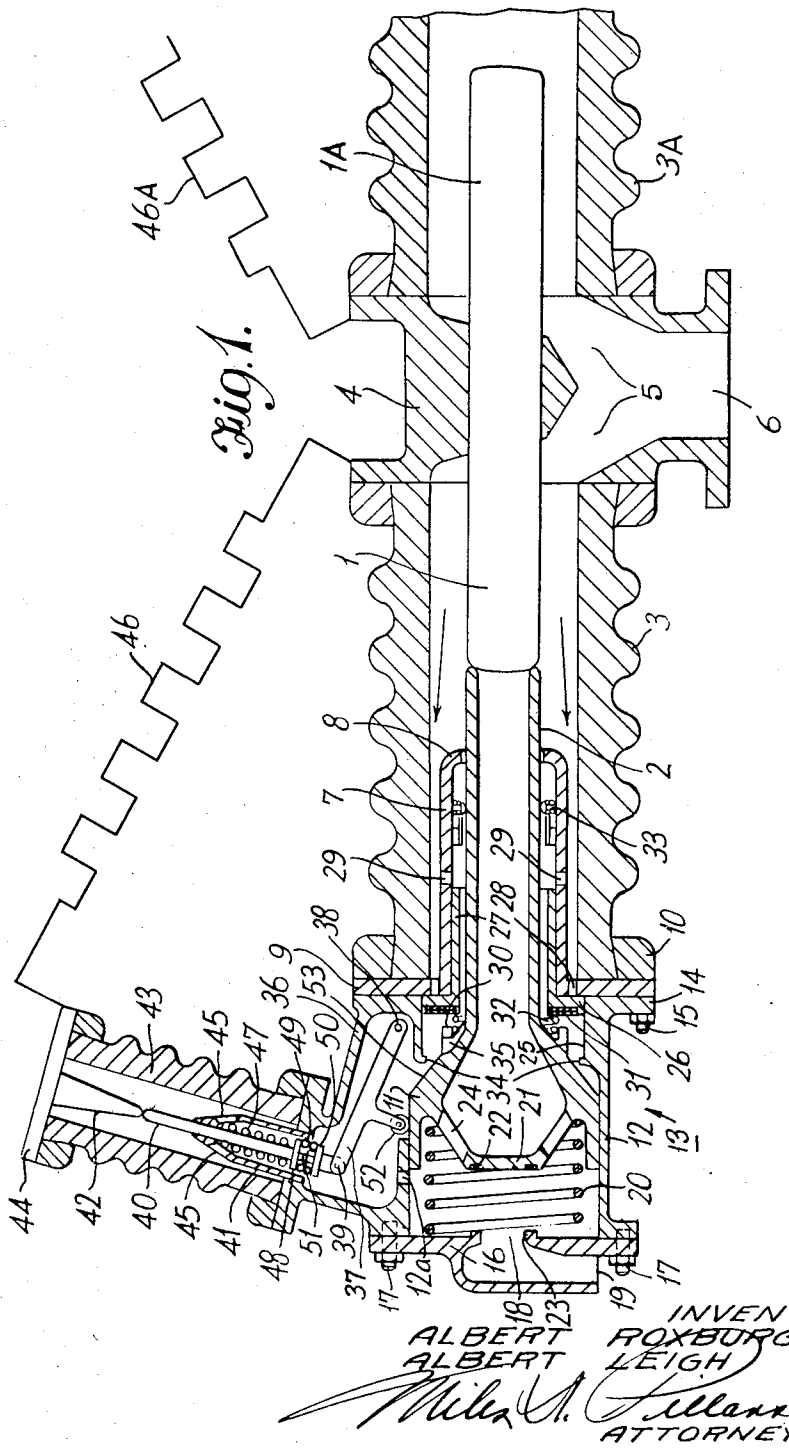
Sept. 1, 1959 A. ROXBURGH ET AL 2,902,570

AIR OR GAS BLAST ELECTRIC CIRCUIT BREAKERS

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Fig. 1.



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Fig. 2.

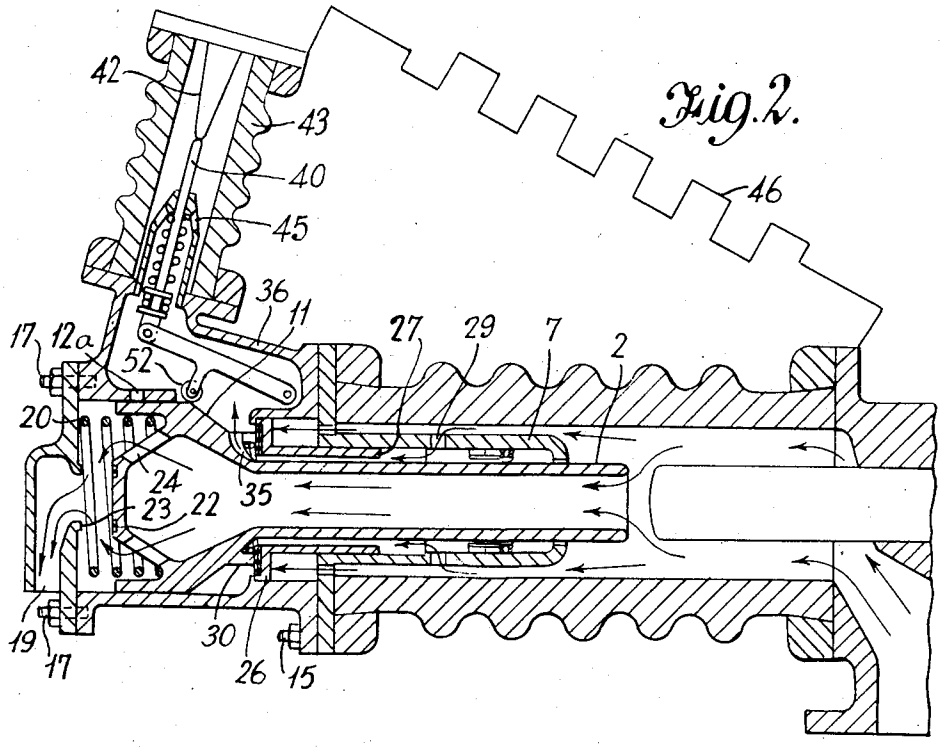
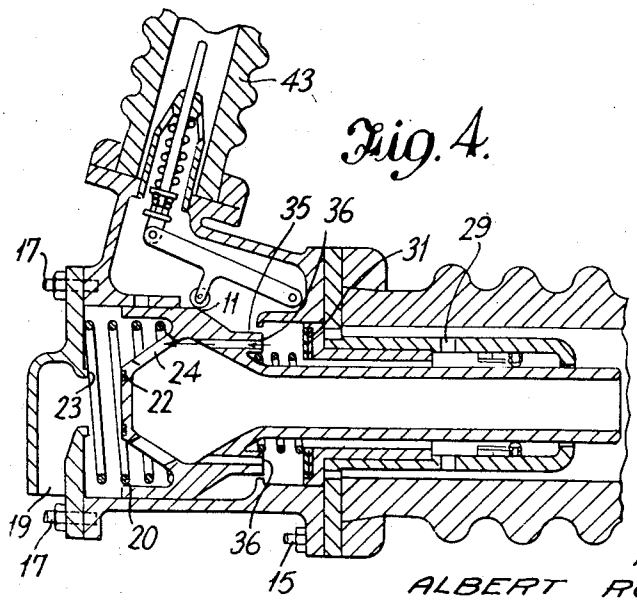


Fig. 4.



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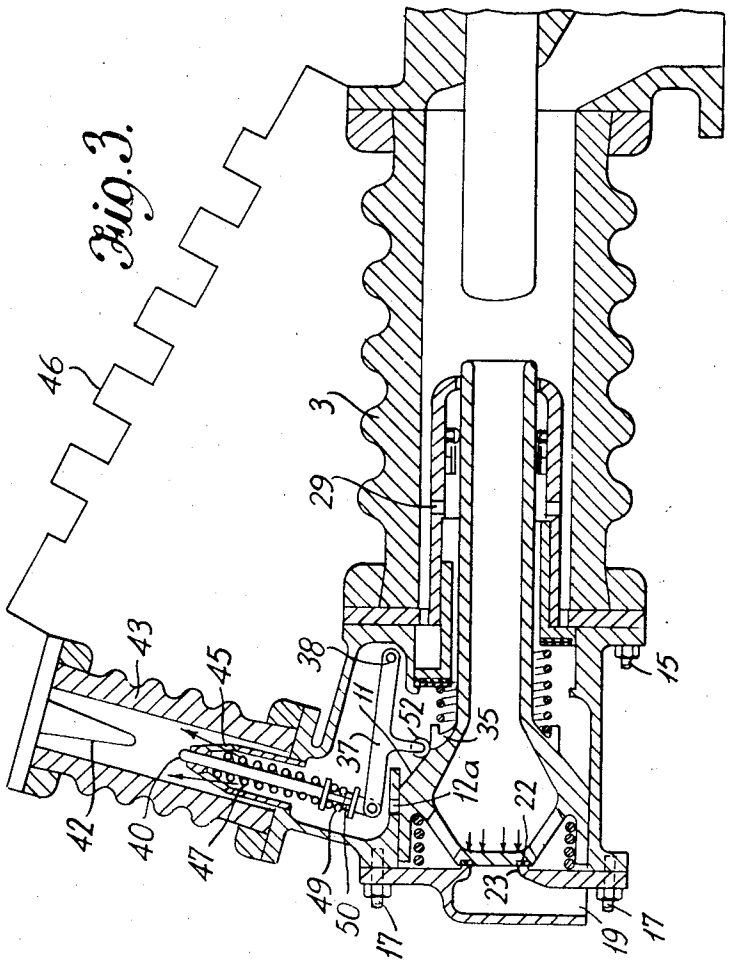
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3 Sheets-Sheet 3

Fig. 3.



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2,902,570

AIR OR GAS BLAST ELECTRIC CIRCUIT BREAKERS

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Application June 23, 1958, Serial No. 743,759

Claims priority, application Great Britain July 1, 1957

3 Claims. (Cl. 200—148)

This invention relates to electric circuit breakers of the air or gas blast type. It will be understood that air is a gas and that the operation of the circuit breaker described hereafter does not depend upon the chemical nature of the gas. Thus the expressions air and gas must be considered as equivalent throughout the specification, and where one is used it includes the other as driving and arc extinguishing medium, it being understood that in individual cases a gas of higher insulating quality, such as nitrogen, may be preferred to air.

According to the present invention, an air or gas blast electric circuit breaker which comprises a moving main contact adapted to be separated from a co-operating main contact by the application of air or gas pressure acting on said contact or a piston member coupled therewith, has a resistance or other impedance, hereinafter conveniently referred to simply as "resistance," for controlling the recovery voltage rise, or otherwise improving the circuit interrupting characteristics of the interrupter, connected in parallel with said main contacts by means of an auxiliary contact arrangement closing the circuit through said resistance when the main contacts are closed, and actuable directly by mechanical means from the movement of said moving main contact after the latter has separated by a predetermined amount from the co-operating contact. The main contacts are enclosed in a manner well known per se within an arc chamber to which pressure air or gas is applied by opening a blast control valve when the circuit is to be interrupted, and the pressure air or gas then causing separation of the contacts and an air or gas blast across the contact gap.

Generally this invention resides in a gas blast circuit breaker having a movable main contact, a biasing means to force said contact into engagement with a stationary main contact, and a contact operating mechanism to disengage said movable contact from the stationary contact, said mechanism being operated by pressure gas supplied from the same source as the main arc extinguishing gas blast, wherein a series circuit comprising an impedance and auxiliary contacts is connected across the main contacts, and a mechanism controlled by the movement of the main contact is provided to cause opening of the auxiliary contacts after disengagement of the main contacts and closing of the auxiliary contacts before the main contacts close.

Arrangements according to the invention have the advantage that the auxiliary contacts are closed intrinsically as a result of closure of the main contacts so as positively to complete the connection of the resistance in parallel with the main contacts and ensure that the current path through the resistance is already closed before the main contacts begin to separate on a circuit opening operation.

As will hereinafter appear, the invention enables simple and reliable means to be employed for controlling the contacts in series with the resistance and these advantages are of considerable importance in E.H.T. circuit breakers wherein there will commonly be a large number, for example as many as ten, breaks in each phase of the circuit breaker.

According to a further feature of the invention, the auxiliary contacts include a moving contact which is adapted to be operated mechanically into engagement with its co-operating contact by means of a cam surface formed on or connected with the moving main contact or a member moving therewith. The moving auxiliary contact is biased, such as by a spring, to its open position away from the co-operating auxiliary contact. Preferably, the cam surface referred to is arranged externally of an extension of the main moving contact, the latter, for example, being a tubular contact through which the air or gas blast is discharged to atmosphere, and the moving auxiliary contact or a cam follower member connected with said auxiliary contact is arranged to move transversely, or to have a considerable component of its movement transversely, of the movement of said main moving contact. Arrangements of this kind possess the further advantage that the main moving contact may be withdrawn from the circuit breaker, such as from the contact chamber hereinbefore referred to, without the disconnection or dismantling of any internal parts of the circuit breaker, and furthermore that after the main moving contact has been removed it may be replaced without interference from the operating mechanism for the auxiliary contacts and will automatically re-engage such operating mechanism for correct operation of the auxiliary contacts.

Conveniently in carrying out the arrangement just above indicated the moving auxiliary contact is connected with a cam follower lever arranged to press against the movable auxiliary contact through a spring and to be actuated by a guiding surface which moves in accordance with movement of the main contact. This guiding surface may conveniently be the cam surface of the main contact, although in some cases, as will be understood, the cam surface may operate directly on the auxiliary moving contact without the interposition of such lever.

In a preferred arrangement the main contact to the operating mechanism comprises two driving members to produce respectively an initial disengagement of the main contacts and after a short interval a further increase of the distance between the main contacts, and the auxiliary contact movement is derived from a motion produced by the second driving member.

The invention has general application in air or gas blast circuit breakers but is eminently applicable in circuit breakers of the type wherein after the main contacts have been opened by the air pressure in a contact chamber the exit of the pressure air from said chamber is closed so as to maintain pressure in said chamber without consumption of air and thereby hold the contacts open under pressure, whereby the circuit in which the circuit breaker is included may be disconnected continuously without the opening of series isolators as are otherwise required. In one application of the present invention to circuit breakers arranged as just indicated, the moving contact is arranged in accordance with co-pending application No. 743,758, that is to say, the moving contact is provided with a piston area formed by a part of the moving contact or a member connected therewith, said piston area working within a space to which pressure air is applied with a time delay after application of pressure air to a piston or equivalent member provided for operating the main contact in accordance with co-pending application for Letters Patent No. 692,459. The auxiliary contacts provided according to the present invention may then be arranged within an extension of the working space for the piston

area first above referred to and include a contact movable into and out of engagement with a cooperating contact in a direction substantially radially of the movement of the main moving contact, and operable directly or by a suitable linkage by means of a cam surface formed by an enlargement of the main moving contact forming said piston area.

Reference will now be made by way of example to the accompanying drawings, in which

Fig. 1 is a vertical sectional elevation illustrating one embodiment of circuit breaker according to the invention and arranged also in accordance with copending application for Letters Patent No. 743,758 to which attention is hereby directed.

Figs. 2 and 3 are sectional elevations similar to Fig. 1 but showing the circuit breaker respectively at intermediate and final stages in the contact opening operation; and

Fig. 4 is a fragmentary sectional elevation corresponding with part of Fig. 1 and illustrating a modification thereof.

The circuit breaker shown in the drawings comprises a fixed rod-like contact **1** and a co-operating movable contact **2** of tubular form arranged within a tubular insulating housing **3**. At its right hand end in the figures the housing **3** is secured to a metal supporting structure **4** in which the contact **1** is fixed. The structure **4** includes internal passages **5** whereby an entry port **6** in said structure is placed in communication with the interior of the housing **3**. As Fig. 1 shows, the circuit breaker may be of the otherwise known symmetrical double-break type wherein a second tubular housing partly shown at **3A** is also mounted on the structure **4** and encloses a fixed contact **1A** with which co-operates a moving contact (not shown) similar to the contact **2** and having in association therewith similar means as hereinafter to be described for the contact **2**. The structure **4** may be mounted at the upper end of a vertical insulating column as is well known per se for air blast circuit breakers. This vertical insulating column is of tubular construction providing a through passage in alignment with the entry port **6** and is connected at its foot with an air conduit adapted to be connected by means of a main control valve with an air pressure reservoir. Furthermore, valve means are provided whereby the foot of said insulating column may be placed in direct communication with atmosphere for operation of the circuit breaker in the manner hereinafter to be described.

A control valve is provided for admitting pressure air to the circuit breaker and for discharging the air from the circuit breaker to atmosphere. This valve may be of a known construction, does not form part of the invention, and therefore is not shown.

The tubular moving contact **2** extends through a fixed tubular member **7** having an in-turned end **8** serving to guide the adjacent end of the contact **2**. The tubular member **7** is formed with a flange **9** which by means of a clamping ring **10** and suitable studs or the like is rigidly secured to the end of the insulating housing **3** remote from the structure **4**.

At its end remote from the fixed contact **1** the moving contact has an enlarged diameter portion providing a piston **11** which works within a cylinder **12** in a metal assembly **13**, having a flange **14** which is secured to the flange **9** and clamping ring **10**, such as by studs **15** and nuts. The cylinder **12** is provided with an end cover **16** secured in place such as by studs and nuts **17**, said end cover being provided with a central air discharge port **18** and an external discharge passage **19**.

The moving contact **2** is urged into engagement with the fixed contact **1** by means of a compressing spring **20**. The piston part **11** of the moving contact includes a central surface **21** having an annular channel in which is located a sealing gasket **22** adapted as will hereinafter be described to engage with an annular seating **23** surrounding the port **18**. A plurality of ports, such as **24**, are provided within the piston **11** for allowing passage of air during operation as will hereinafter be described. The cylinder **12** includes a portion of reduced diameter providing a further cylinder **25** in which works a piston **26**. The piston **26** includes a trunk **27** slidable within the tubular member **7**. For a purpose which will hereinafter appear, ports, such as **28**, are formed in the flange **9** for admitting pressure air from the housing **3** to the face of the piston **26**. Ports are provided, such as at **29**, in the tubular member **7** for admitting such pressure air to the interior of the cylinder **12**, it being observed that a substantial annular clearance is provided between the piston trunk **27** and the moving contact **2**. The piston portion **11** of the moving contact includes an annular flange **30** which is adapted to be engaged by the left hand face of the piston **26**. Preferably an annular rubber or other resilient cushion **31** is carried by the piston **28** for providing the engagement between said piston and the flange **30**. A light compression spring is provided at **32** so as to tend to move the piston **26** away from the flange **30**.

For a purpose which will also hereinafter appear a port **12***a* is provided in the cylinder **12**.

The contact **2** may be connected electrically with the assembly **13** by means of a resilient sliding contact assembly or garter spring of any suitable construction indicated diagrammatically at **33**.

As so far described the circuit breaker is arranged in accordance with application No. 743,758 aforesaid.

The cylinder **12** is formed with a lateral extension or antechamber **36** enclosing a lever **37** which is mounted on a fixed pin **38**. At its free end the lever **37** has a pin connection **39** with an actuating member for a movable auxiliary contact **40** which is slidably located for axial movement in a guide member **41** secured to the wall of the antechamber **36**. The contact **40** and co-operating fixed auxiliary contact **42** are located within a tubular insulating housing **43** closed at its upper end by a cover plate **44** but in communication with the antechamber **36** by way of ports such as **45** in the member **41**. The auxiliary contact **42** is connected with one end of a resistor, shown diagrammatically at **46**, the other end of which resistor is connected with the assembly **4**. In the case of a symmetrical double-break circuit breaker such as indicated by Fig. 1 the assembly at the right hand end of the circuit breaker may be arranged similarly to that shown for the left hand end in Fig. 1, a second resistor being partly shown at **46A**.

The contact **40** carries an abutment disc **48** between which and the upper end of the member **45** a compression spring **47** acts to tend to move said contact downwardly. The connection between the lever **37** and the contact **40** is effected by means of a further compression spring **49** acting between the disc **48** and an abutment disc **50** having the pin joint at **39** with said lever. The arrangement comprises an elongated spigot **51** which has telescopic engagement with an aixal bore in the lower end of the contact **40**.

A roller **52** rotatably carried by the lever **37** engages with the piston portion **11** of the main moving contact. The arrangement is such that when the roller **52** is engaged by the peripheral surface of said piston portion as shown in Fig. 1 the lever **37** will be positioned so as to maintain the contact **40** in engagement with its co-operating contact **42**.

Fig. 1 illustrates the circuit breaker ports in the closed condition. In order to open the circuit breaker the control valve referred to is operated to admit pressure air from the reservoir to the housings **3** and **3A**. This pressure air flows through the ports **28** so as to move the piston **26** outwardly in its cylinder. The piston **26** is permitted a predetermined distance of free travel before the cushion **31** engages with the flange **30**. On engagement of the cushion **31** with the flange **30** the moving contact member is subjected to an impact due to the kinetic energy possessed by the piston **26** and its trunk

27. The arrangement is such that when the moving piston 26 impacts upon the seating 30 it has already gathered up speed and inertia so that the compression spring 20 is no longer able to maintain the end 2 of the moving contact in engagement with the fixed contact 1. Thus the initial acceleration of the contact 2 by means of the kinetic energy imparted to the piston 26 prior to the engagement of the latter with the moving contact member ensures a safe contact separation in a manner comparable with what has been shown in the said application for Letters Patent No. 692,459 to which attention is hereby directed.

The piston 26 and moving contact now travel together until as shown by Fig. 2 the piston 26 engages with an abutment formed by an in-turned flange 34 on the end of the cylinder 25. It will be understood that on the previously described impact of the piston 26 with the seating 30 all or the major part of the kinetic energy possessed at that time by the piston will be absorbed in accelerating the moving contact 2. If desired the cushion 31 may be arranged to engage with the abutment 34.

In the position shown by Fig. 2 the pressure air admitted to the housing flows through the annular gap between the fixed contact 1 and the adjacent end of the moving contact 2 and is discharged to atmosphere through the ports 24 and 18 and discharge passage 19 so as to extinguish the arc between said contacts. The moving contact 2 remains in the position illustrated in Fig. 2 until further separating movement of the contact 2 is provided in the following manner. During the operation above described pressure air flows also through the ports 29, the annular clearance between the contact 2 and piston trunk 27, and passages such as 35 in the flange 30, to the free space in the antechamber 36 and housing 43. It will be observed that whereas in the fully closed position of Fig. 1 the port 12*a* is unobstructed by the piston 11, in the position shown by Fig. 2 said port has been covered by the piston. Consequently the pressure air which is permitted to flow into said free space will build up pressure in said free space and after a predetermined time period determined by the size of passage 35 in relation to said free volume, said pressure will provide on the piston 11 a force sufficient to overcome the force of the spring 20. When these conditions are reached the piston 11 and moving contact 2 will be moved further in the opening direction so as to bring the sealing gasket 22 into engagement with the seating 23. The gasket 22 and area 21 of the piston then closes the discharge port 18 preventing further discharge of pressure air to atmosphere. The moving contact is retained in the position illustrated in Fig. 3 by the pressure air acting on the area 21 of the piston and the contact will therefore remain open so long as the control valve is opened to apply pressure air to the housing 3.

The operation as so far described is in accordance with application No. 743,758 aforesaid.

When the moving contact reaches the position illustrated by Fig. 2, at which the arc between the main contacts 1 and 2 is extinguished by the air blast, the peripheral surface of the piston portion 11 will have reached a position where the roller 52 is still located for maintaining the auxiliary contact 40 in engagement with the contact 42 but on further movement of the main contact 1 a sloping or conical portion 53 of the piston will move under the roller so that the further movement of the main contact 2 after the pause in the condition shown by Fig. 2, will allow the spring 47 to move the contact 40 downwardly out of engagement with the contact 42. By this means the current flowing in the resistor 46 consequent on the opening of the main contact will be interrupted, the auxiliary contacts being fully separated when the main contact reaches the fully open position as shown by Fig. 3. The separation of the auxiliary contacts is effected in a space which as above described is charged with pressure air, namely by way of the ports 45, the increase of air pressure surrounding said contacts facilitating the interruption of the resistor current.

In order to reclose the circuit breaker the control valve is operated to its position discharging air from the housing 3 to atmosphere. The pressure air within the housing 43 will also be discharged to atmosphere, since this air flows into the chamber 3 by way of the ports 35, the clearance between the piston trunk 27 and the contact 2, and the ports 29. With the reduction of air pressure the force acting on the piston area 21 falls below the pressure of the spring 20 and thereafter the spring will move the contact and piston 11 toward the closed position. So soon as the gasket 22 leaves the seating 23, air within the circuit breaker will also discharge to atmosphere through the ports 24 and 18. The air pressure within the housing 43 will continue to discharge to atmosphere in the same way as the air within the tubular housing 3 and additionally when the moving contact reaches the closed position as shown by Fig. 1 any air remaining at pressure within said housing 43 will be discharged directly to atmosphere through the port 12*a* and the port 18 when said port 12*a* is uncovered by the piston 11. The circuit breaker is then in readiness for subsequent re-opening. It will be observed that the port 12*a* provides that on reclosure of the contacts the circuit breaker is in immediate readiness for re-opening since the uncovering of the port 12*a* ensures that no residual pressure air will be trapped and maintained in any of the volumes associated with the housing 43 as well as housing 3.

During the closing movement of the main contact 2 the cam portion 53 of the piston 11 will progressively raise the lever 37 so as to re-close the auxiliary contacts 40, 42 when the main contact returns to the position of Fig. 2. It will be observed that the arrangement ensures that the auxiliary contacts will be closed to re-insert the resistor in circuit in direct response to the re-closing movement of the main contact 2. It is thus mechanically impossible for the main contacts to re-close without prior re-closing of the auxiliary contacts.

The connection of the moving contact 40 with the lever 37 by means of the compression spring 49 provides for a predetermined contact force to be obtained in the closed position of the main contact, such spring permitting further movement of the lever 37 by the conical surface 53 after the contact 40 has engaged the fixed contact 42.

In certain circumstances it may be desirable to provide, as is shown by Fig. 4, additional air discharge ports, such as 36, placing the right-hand side of the piston 11 in communication with the interior of the moving contact and said piston. By this means, on movement of the piston 11 from the fully opened position, air at pressure within the housing 43 may discharge directly through such ports 36 and the ports 24, to the port 18 and thereby to atmosphere. The ports 36 thus provide for rapid discharge of air pressure from the housing 43 to atmosphere on reclosing the circuit breaker, and rapid fall of pressure within said chamber 43 so that after an initial movement of the piston 11 away from the seating 23 the spring 20 is relieved of any opposition in reclosing the contacts, or by residual air pressure within the housing 43.

The ports 36 are arranged so as to be covered when the piston 26 engages the flange 30. Consequently during opening operation passage of air through said ports will be terminated when the piston 26 engages said flange and the piston 26 and moving contact move together to the position shown by Fig. 2. In the position of Fig. 2 there is therefore no discharge of air through the ports 36 and the air flows through port 35 to build up pressure in the housing 43 in the manner hereinbefore described.

It is to be noted that with constructions according to the invention such as shown in the accompanying drawings, the moving contact may readily be withdrawn from the circuit breaker. For this purpose it is necessary only to remove the end cover 16 when the spring 20 and con-

tact 2 together with the piston portion 11 thereof can be immediately withdrawn from the circuit breaker without the removal or displacement of any of the other parts associated with the moving contact. Conversely, the moving contacts may be replaced without any particular positioning of the lever 37 being necessary, and when said contact is replaced the auxiliary contact 40 and its operating means are automatically in condition for proper operation.

Modifications are possible without departing from this invention as defined by the appended claims.

It will be understood that the construction shown by way of example can be simplified by omitting the lever 37. The contact 40 would be still controlled through spring 49 and member 50, which member 50 however would then carry a roller corresponding to roller 52 and co-operating with a cam surface on the member 11.

What we claim is:

1. A gas blast circuit breaker having a movable main contact, a biasing means to force said contact into engagement with a stationary main contact, a contact operating mechanism to disengage said movable contact from the stationary contact, said mechanism being operated by pressure gas supplied from the same source as the main arc extinguishing gas blast, a series circuit comprising an impedance and auxiliary contacts connected across the main contacts, and a mechanism controlled by the movement of the main contact to cause opening of the auxiliary contacts after disengagement of the main contacts and closing of the auxiliary contacts before the main contacts close, wherein the contact operating mechanism comprises two driving members arranged to become successively effective, the first member to cause an initial disengagement of the main contacts, and the second member to cause after a short interval an increase in the distance between the main contacts, the mechanism for controlling the auxiliary contact position being arranged to cause opening of the auxiliary contacts when the second driving member operates to increase the said distance.

2. A circuit breaker as claimed in claim 1 wherein the auxiliary contacts are arranged in a separate chamber which has an inlet port for communication with the arcing chamber of the main contacts and an outlet port for communicating with a passage through which the pressure gas from the main arcing chamber is discharged to the outer air, the said ports being controlled by the first and second driving members respectively.

3. A gas blast circuit breaker having a movable main contact, a biasing means to force said contact into engagement with a stationary main contact, a contact operating mechanism to disengage said movable contact from the stationary contact, said mechanism being operated by pressure gas supplied from the same source as the main arc extinguishing glas blast, a series circuit comprising an impedance and auxiliary contacts connected across the main contacts, and a mechanism controlled by the movement of the main contact to cause opening of the auxiliary contacts after disengagement of the main contacts and closing of the auxiliary contacts before the main contacts close, wherein a means is provided to produce a biasing force which tends to disengage the auxiliary contacts, and the mechanism controlling their position comprises a lever arranged to press through a spring against the movable auxiliary contact and to be actuated by a guiding surface which moves in accordance with the movement of the main contact.

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