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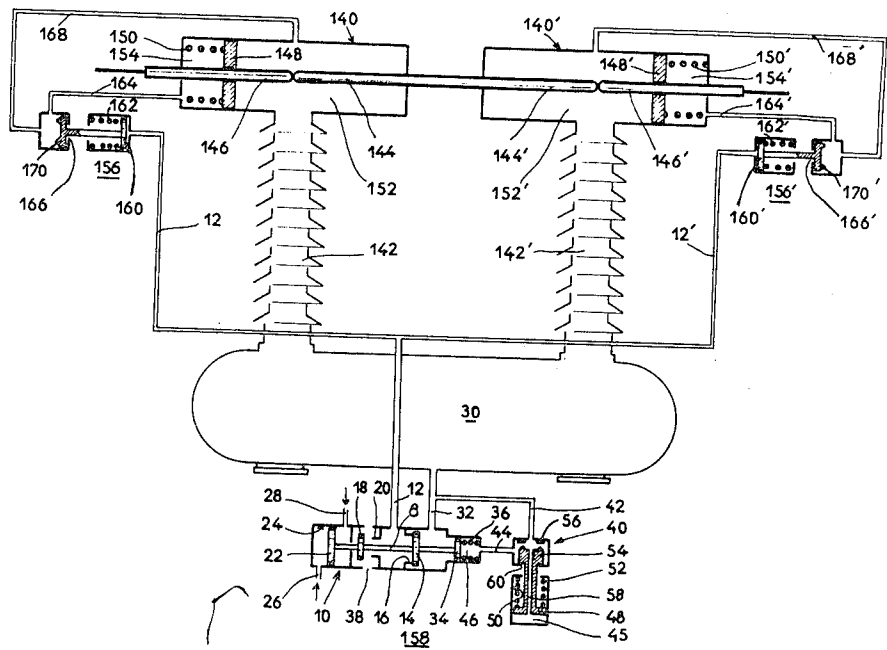
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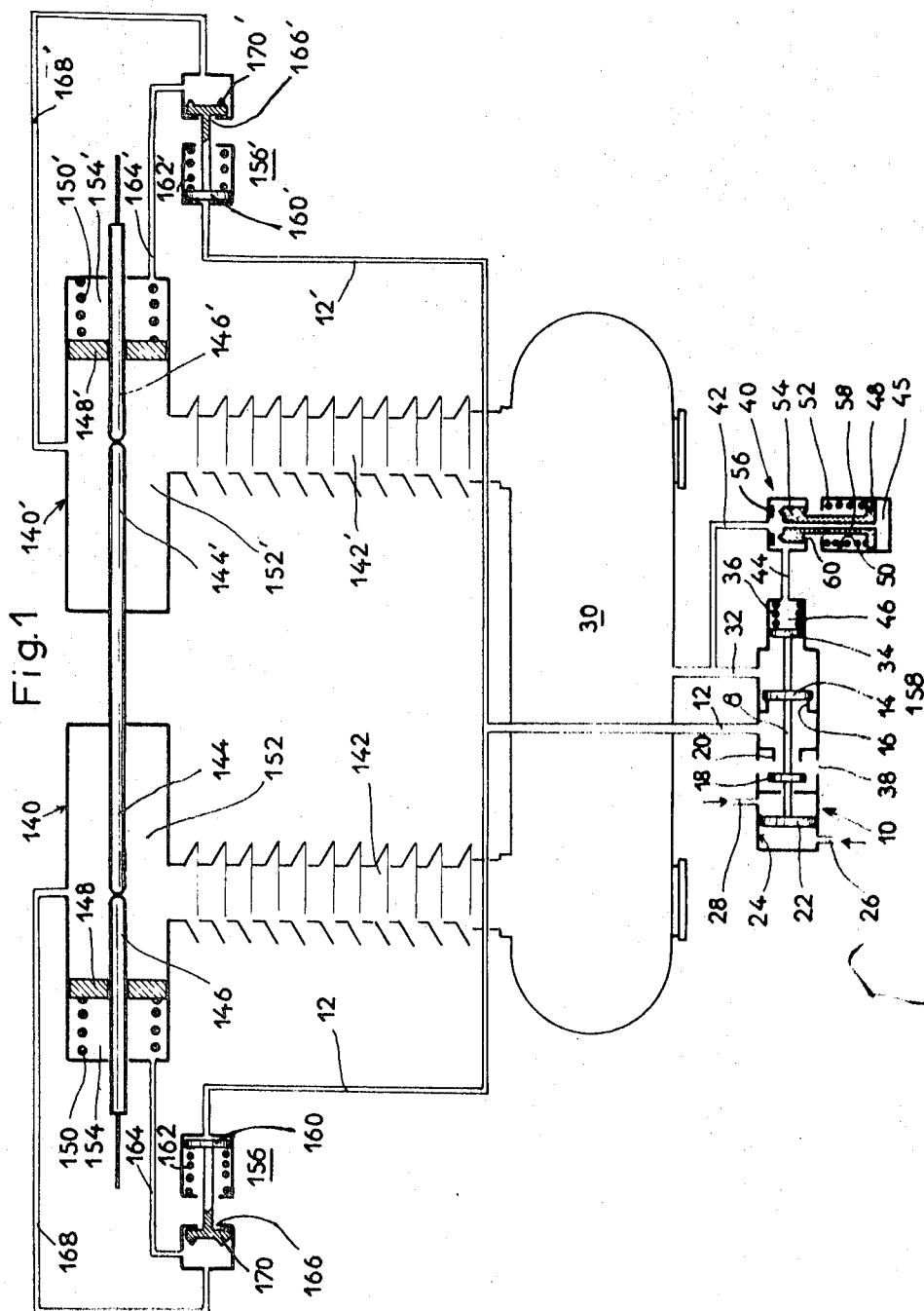
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[54] GAS BLAST CIRCUIT BREAKER WITH CONTACT
CLOSING LOW PRESSURE RESPONSIVE SAFETY
DEVICE
6 Claims, 2 Drawing Figs.
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200/82 B, 200/148 R, 317/59
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ABSTRACT: A gas blast circuit breaker having a safety device which causes the positive closing of the contacts of the opened circuit breaker according to the normal closing cycle and the locking of the closed contacts when an abnormal pressure drop occurs below the value of the pressure necessary to maintain the contacts in their opened position.

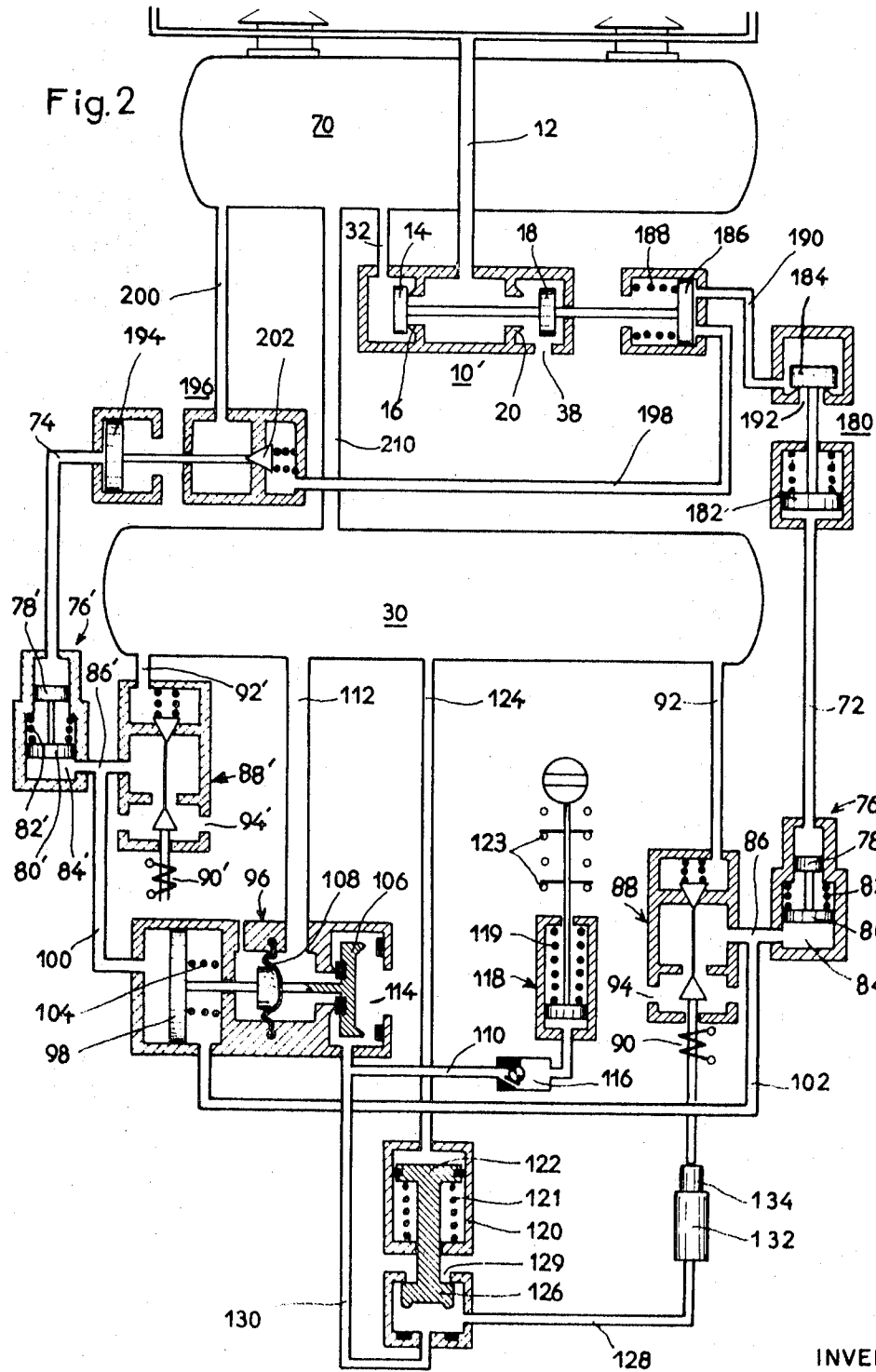




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GAS BLAST CIRCUIT BREAKER WITH CONTACT CLOSING LOW PRESSURE RESPONSIVE SAFETY DEVICE

The present application is a continuation-in-part of my earlier application Ser. No. 708,661 filed Feb. 27, 1968, and now abandoned.

The present invention relates to a gas blast circuit breaker in which the arc extinction chambers are continually under pressure both in the opened position and in the closed position of the contacts which are pneumatically held in their opened position by the pressure prevailing in the chambers, a safety device entering into operation in case of any abnormal drop of the pressure in at least one of the chambers.

If a pressure drop occurs, the pressure may become too low to maintain the contacts in their opened position and mechanical closing of all of the contacts affected by the drop in pressure is then inevitable. The time when this closing takes place depends upon the mechanical properties particularly of the spring which urges the contacts into their closed position, which properties are not always uniform.

This results in a random closing of the contacts affected which results in the destruction of the circuit breaker, particularly upon the release of a main contact prior to the release of its auxiliary shunting contact, or upon the nonsimultaneous closing of elements which are connected in series or in parallel. This latter eventuality necessarily occurs in the case of circuit breakers having a compressed-gas reservoir common to different zones of contact.

An object of the present invention is to overcome this drawback. The circuit breaker in accordance with the present invention is characterized by the fact that each pole comprises a plurality of contacts and that the safety device causes positive closing of the plurality of contacts of the opened circuit breaker in accordance with the normal closing cycle and the locking in the closed position of the plurality of contacts of the closed circuit breaker when the pressure drops below a predetermined value, which value is greater than the value of the pressure necessary to maintain the contacts in their open position.

The closing of the circuit breaker then takes place under normal conditions, avoiding any damage to the circuit breaker. Of course, this accidental closing may have repercussions downstream of the circuit breaker, which repercussions would in any event have occurred upon the inevitable later mechanical closing.

According to the present invention, the safety device obtains its operating energy from the gas pressure which prevails, for instance, in the arc extinction chambers, and is capable of operating without any external auxiliary source of energy. There is thus obtained an independent safety device whose operation does not depend upon any external factor.

The means for accomplishing the foregoing objects and other advantages, which will be apparent to those skilled in the art, are set forth in the following specification and claims, and are illustrated in the accompanying drawings dealing with several embodiments of the present invention. Reference is made now to the drawings in which:

FIG. 1 is a schematic cross section through a pneumatic safety device in accordance with the invention provided on a pneumatically controlled circuit breaker having two arc extinction chambers electrically connected in series;

FIG. 2 shows a device in accordance with the invention on an oleopneumatically controlled circuit breaker.

In FIG. 1, the gas blast circuit breaker comprises two cylindrical chambers 140 and 140' to defining arcing or arc extinction chambers 152 and 152', and second chambers 154 and 154', respectively. The cylinders are mounted by hollow insulators 142 and 142' onto a joint compressed-gas reservoir 30. Two tubular contacts 144, 146 and 144', 146' are placed in arc extinction chambers 152 and 152', respectively. Contacts 144 and 144' are stationary, while contacts 146 and 146' are movable and have fixedly mounted thereon drive pistons 148 and 148', respectively. Compression springs 150 and 150' are inserted in the second chambers 154 and 154' between the

pistons 148 and 148', and the ends of the cylinders 140 and 140' and urge the movable contacts 146 and 146' towards the position in which the contacts are closed. Pneumatic relays 156 and 156' connect pipes 12 and 12', respectively, and in a well-known way to chambers 154 and 154' (see U.S. Pat. No. 3,185,82 to Amalric issued May 25, 1965, and owned by a common assignee) to cause venting the second chamber behind the drive piston of the movable contact in response to an opening order and a pressurizing of the second chamber behind the drive piston in response to a closing order.

More particularly, pressurizing of pipes 12 and 12' urges pistons 160 and 160' against compression springs 162 and 162' in a sense causing chambers 154 and 154' to be vented through pipes 164 and 164' to atmosphere at 166 and 166', feed pipes 168 and 168', which communicate with pressurized chambers 152 and 152', being closed by valve members 170 and 170' of relays 156 and 156', which members are secured to pistons 160 and 160', respectively.

Through the interior of the hollow pedestal insulators 142 and 142' which communicate freely with reservoir 30, the arc extinction chambers 152 and 152' are continually under pressure both in the opened position and in the closed position of the contacts. This pressure, which acts on the pistons 148 and 148' in opposition to the springs 150 and 150', is sufficient to maintain the contacts in their opened position. It can easily be seen that any leak which occurs, for instance, in the insulator 142, will bring about a drop of pressure in the chamber 152, causing the action of the spring 150 to become predominant and thereby causing the closing of the contacts 146 and 144. The chamber 152' is also affected by this leakage via the tank 30, but it is improbable that the contacts 146 and 146' will close simultaneously. This accidental and random closing of the contacts may cause the destruction of the circuit breaker if a chamber is not capable of withstanding the voltage, and the object of the present invention is to prevent such a closing of the contacts.

On the other hand, it will now be apparent that depressurization of pipes 12 and 12' causes pistons 160 and 160' to return with valve members 170 and 170' to their initial position under the action of springs 162 and 162', so that chambers 154 and 154' are pressurized by pipes 68 and 168' communicating now with pipes 164 and 164', respectively, to admit the high pressure of arcing chambers 152 and 152' in chambers 154 and 154' behind pistons 148 and 148' which cause contacts 146 and 146' to close under the action of springs 150 and 150'.

In order to prevent random closing of contacts 146 and 146' in case of pressure drop in the high-pressure circuit 152, 152'; 142, 142'; 30, the inventive circuit breaker comprises a pneumatic control device having valve assembly device 158 hereinafter to be described.

The moving unit 8 of the valve assembly 10 comprises valve disc 14 cooperating with a stationary seat 16 and a valve disc 18 cooperating with a stationary seat 20.

A control piston 22, which slides in a stationary cylinder 24 of the body of the valve assembly, controls the movement of the moving unit 8 of the valve assembly. The pressurization of conduit 26 and depressurization of conduit 28 causes the displacement of the unit 8 towards the right of the valve assembly to open the contacts 146 and 146' and the pressurization of the conduit 28 and depressurization of the conduit 26 causes the unit 8 to move towards the left and to close the contacts. The compressed gas reservoir 30 is at the pressure of the arc extinction chambers 152 and 152'. This pressure is communicated through a pipe 32 to the right-hand side of the valve disc 14, as well as to the left-hand side of a balancing piston 34 which is also rigidly connected with the moving unit 8, its right side being subjected to the action of a compression spring 36 which tends to urge the moving unit 8 of the valve assembly 10 towards the left. The pipes 12 and 12' are connected as hereinbefore described to the relays 156 and 156' so that the placing of the pipe 12 under pressure causes the opening of the contacts, while the removal of pressure therefrom causes

the opening of the contacts, while the removal of pressure therefrom causes the closing of the contacts as mentioned above.

This device operates in the following manner:

In the position of the valve assembly shown in the drawing, the compressed gas is admitted at 28, the conduit 26 being depressurized. The piston 22 is urged towards the left, the valve disc 14 applies itself to its seat 16 and the valve disc 18 leaves its seat 20 so that the pipe 12 is brought into communication with the atmosphere at 38. This condition corresponds to the closed position of the contacts of the circuit breaker. The active surface of the valve disc 14 is slightly greater than that of the piston 34 so that the compressed gas coming from 32 urges the moving unit slightly towards the left into a position of stable equilibrium. In order to open the contacts, pressure is admitted at 26 and pressure is removed from the conduit 28. The pressure which acts on the left-hand face of the piston 22 overcomes the differential opposing pressure exerted by the gas at 32 so that the valve disc 14 leaves its seat 16, while the valve disc 18 comes onto its seat 20. The pipe 12 then communicates with the pipe 32, is pressurized and the circuit breaker opens. As the active surface of the valve disc 18 is slightly less than that of the piston 34, the pressure prevailing in pipe 32 urges the moving unit 8 slightly towards the right and therefore holds it in position.

In accordance with the invention, a manometric relay 40 communicates via a pipe 42 with the compressed gas reservoir 30 and via a pipe 44 with a chamber 46 of the valve assembly 10, within which chambers the piston 34 moves.

The moving unit of the relay 40 comprises a control piston 48 sliding in a fixed cylinder 50 and acted on by a compression spring 52 as well as a valve disc 54 cooperating either with a seat 56, in order to close the opening of the pipe 42, or with an orifice 60 leading to the atmosphere. A calibrated conduit 58 provides communication for the inside of the chamber 45 of the cylinder 50 below the piston 48 with the space above the valve disc 54.

The relay 40 and the spring 52 are calibrated in such a manner that when the pressure is normal in the reservoir 30 and arcing chambers 152, 152', the moving unit of the relay 40 is in its upper position, the cylinder 46 communicating with the atmosphere via the pipe 44 and the orifice 60 which is opened by the valve disc 54. The lower face of the piston 48 receives the pressure prevailing in pipe 42 via the passage 58, and in this way the moving unit of the relay 40 remains in its upper position.

An abnormal drop of pressure in the reservoir 30 and therefore in pipe 32, in pipe 42 and in the chamber 45 below the piston 48 causes the descent of the moving unit of the relay 40, at a pressure which is slightly above the pressure at which the contacts would close by themselves. In this way, the valve disc 54 closes the passage 60 and permits the space 46 to communicate with the pressure prevailing at 32 so that the pressures on the two sides of the piston 34 become identical. As a result, the spring 36 (and possibly the residual pressure prevailing in pipe 32 and acting on the right-hand side of the valve disc 14 in its right-hand position and on the right-hand face of the valve disc 18 in its right-hand position) urges the moving unit 8 of the valve assembly 10 towards the left assuming the unit is in the right-hand position or holds and locks said unit in the left-hand position if said unit were in the left-hand position. In the first case, the circuit breaker is closed positively and locked in this closed position, and in the second case, the circuit breaker is locked in the closed position, regardless of any opening orders which maybe given and which remain inoperative.

In FIG. 2, which shows a safety device in accordance with the invention on an oleopneumatically controlled device, particularly a gas blast circuit breaker with several interrupting chambers in series, a compressed gas reservoir 70 feeds and is at the same pressure as the arc extinction chambers. These chambers, as in the embodiment previously described, are under pressure both for the opened position and for the closed

position of the main contacts, which are held in the opened position by the pressure in the arc extinction chambers, overcoming an opposing pressure coming, for instance, from closure springs. The gas reservoir 70 communicates with a main reservoir 30 by a pipe 210, so that the arc extinction chambers, the reservoir 70 and the reservoir 30 are at the same pressure.

The closing and opening of the main contacts is controlled in a well-known manner by a hydraulic transmission via a closing conduit 72 and an opening conduit 74 both of which are filled with a noncompressible liquid such as oil.

The closing pipe 72 is connected to valve 180, disposed in the high-potential region of the circuit breaker having a high-potential compressed gas reservoir 70 and which is similar to the circuit breaker shown in FIG. 1 as regards the arcing chamber and their control by means pistons 148, 148' and pneumatic relays 156 and 156' connected to pipes 12 and 12'. Piston 182 of valve 180 opens valve member 184 as soon as pipe 72 is pressurized and the result is that control piston 186 biased by compression spring 188 moves to the right as pipe 190 is vented to atmosphere in 192 by valve member 184.

On the other hand, piston 186 is moved to the left against the action of spring 188 as soon as pipe 74 is pressurized (and pipe 72 depressurized), piston 194 of valve 196 connecting pipe 198 to pipe 200 and thus to reservoir 70 by lifting of valve member 202 causing pressurizing of piston 186.

The movement of piston 186 is communicated to valve members 18 and 14 of valve assembly 10' which is identical to valve assembly 10 of FIG. 1 as far as concerns the part controlling pressurizing and depressurizing of pipe 12.

The hydraulic closing control is obtained by an oil-pressure transmitter 76 which comprises an oil-filled cylinder in communication with the conduit 72 in which a piston 78 can slide to cause the displacement of the column of liquid in the conduit 72. This piston 78 is rigidly connected with a pneumatic control piston 80 which moves in a cylinder and is subject on one of its faces to the action of a return spring 82 and on the other face, to the pressure prevailing in a chamber 84 of the cylinder.

The chamber 84 is connected by a conduit 86 to a three-way valve 88 with an electromagnetic control 90 which places the conduit 86 in communication either with the atmosphere via a passage 94 or with the compressed-gas reservoir 30 via a conduit 92.

The opening control device is identical to the closing device and therefore will not be described in detail. The same reference numbers, provided with a prime sign, have been used in FIG. 2 to designate similar parts. The three-way tripping valve 88' places the chamber 84' either in communication with the atmosphere or under the pressure of the reservoir 30, which causes the displacement of the column of oil in the conduit 74 and an order for the opening of the main contacts.

A limit relay 96 comprises a control piston 98, one of whose faces is subject to the pressure prevailing in the conduit 86' via a pipe 100, while the other face is subject to the pressure prevailing in the conduit 86 via a pipe 102, as well as to the action of a compression spring 104. The piston 98 is rigidly connected with a three-way valve 106 balanced by a diaphragm 108 which places a pipe 110 in communication either with the atmosphere via a passage 114 or with the reservoir 30 via a conduit 112. The pipe 110 is connected via a delay device 116 which delays flow in one direction to an end-of-stroke detector 118, known per se, which can control the control or locking contacts 123.

The operation of this known device is clear and will be described only briefly: an electric engagement order imparted to the electromagnet 90 actuates the three-way valve 88 so as to admit the pressure from the reservoir 30 via the conduits 92 and 86 into the chamber 84. This pressure acts on the piston 80 and moves it upward, against the action of the spring 82, to drive the piston 78 thereby displacing the liquid in the conduit 72 and lifting the valve member 184. The control piston 186 moves to the right and 48 pipes 12 and 12' are depressurized to bring about the closing of the contacts.

The pressure of the reservoir 30 will have simultaneously been admitted into the pipe 102 which, acting on the piston 98 of the limit relay 96, brings the three-way valve thereof into the left-hand position which corresponds to the venting of the pipe 110 to the atmosphere. The limit relay 96 is adapted to remain in this position under the action of the spring 104 and of the balancing diaphragm 108.

The end-of-stroke detector 118 is brought by its return spring 119 into the position shown in FIG. 2, the compressed gas escaping through the delay device 116 and the pipe 110 to the atmosphere.

A tripping order given to the electromagnet 90' causes in a similar manner the displacement of the column of fluid in the conduit 74 and thereby, in mentioned manner, an opening of the main contacts. At the same time, due to the fact that the pipe 100 is placed under pressure, the piston 98 of the limit relay 96 is urged towards the right, causing the pipe 110 to be placed in communication with the pressure reservoir 30. It is easy to see that this position is also a stable position the pressure of the compressed gas then acting on the entire surface of the valve 106 against the action of the return spring 104.

The placing of the pipe 110 under pressure actuates the end-of-stroke detector 118. The safety device, according to the invention, comprises a manometric valve 120, one control piston 122 of which is subjected on one of its faces to the pressure prevailing in the reservoir 30 via a conduit 124. This piston 122 is rigidly connected with a three-way valve 126, which in one position corresponding to the upper position shown in FIG. 2, places a conduit 128 in communication with the pipe 110 via a conduit 130 and in the other position, the bottom position, places the conduit 128 in communication with the atmosphere through a passage 129.

The manometric valve 120 is of such a nature that the resultant of the forces acting on the moving unit, due to the active surfaces subjected to the pressure and possibly to the spring 121 acting on it, maintains the latter in the bottom position as long as the pressure in the conduit 124, which is equal to that of the reservoir 30, is not less than a predetermined critical value. This critical value is as previously, greater than the minimum pressure causing an automatic closing of the contacts.

The conduit 128 feeds a pneumomechanical converter 132 which may be a simple pneumatic actuator whose rod 134 cooperates with the moving unit of the three-way valve 88, the assembly being arranged in such a manner that in case the conduit 128 is placed under pressure, the rod 134 positively pushes the three-way valve 88 into the position in which the pressure is admitted into the chamber 84 of the oil-pressure transmitter 76.

The safety device functions as follows:

As long as the pressure in the reservoir 30 and therefore in the conduit 124 is greater than the critical value, the manometric valve 120 will be in its bottom position which places the pneumomechanical converter 132 in communication with the atmosphere so that the latter will therefore not participate in any manner in the operation of the control device.

In case of an accidental drop of pressure in the reservoir 30 to below the critical value, the moving unit of the manometric valve 120 moves upward, as described above, closing off the communication with the atmosphere of the conduit 128 and placing the latter in communication, via the conduit 130, with the pipe 110.

If the circuit breaker or circuit breakers are in the closed position, the limit relay 96 is in the position shown in FIG. 2, in which the pipe 110 communicates with the atmosphere through the passage 114.

The actuation of the manometric valve 120 will therefore have the sole effect that the communication with the atmosphere is established by the passage 114, and no longer by the passage 129, which is without importance.

If, on the other hand, the circuit breaker or circuit breakers are in the opened position, the limit relay 96 is necessarily in the other position in which the pipe 110 is under pressure. The

gas under pressure will feed the actuator 132 via the conduits 128, 130 110, 112, from the reservoir 30 and, under the action of said pressure, the rod 134 will actuate the valve 88 which causes the positive closing of the contacts.

It should be noted that upon placing in operation after complete discharge of the pressure, for instance, after a checkup or repair of the apparatus, the actuator 132 will not bring about an unintended closing command. In case of a lack of pressure in the reservoir 30, the limit relay 96 is, as a matter of fact, automatically brought back into the position shown in FIG. 2 by the spring 104, thus venting the conduit 130 to the atmosphere. The increase in pressure in the conduit 112 can in no way cause a displacement of the three-way valve 106 and any operation of the actuator 132 is therefore excluded.

It should be noted that the safety devices of FIGS. 1 and 2 do not require any external source of energy and thus assure great reliability in operation.

Of course, the invention is by no means limited to such independent devices, and the pneumatic safety device in FIG. 2 can, for instance, be supplemented or replaced by a pneumatic-electric safety device (not shown), in which a pressure contact subject to the pressure of the compressed gas in the reservoir is actuated in case the pressure drops below the critical value, and causes the energizing of the solenoid closing valve 88.

It is obvious that certain pneumatic systems described can be replaced by equivalent mechanical, hydraulic or electrical systems, and, vice versa, in a manner well known to those skilled in the art. The device of the invention can also be applied to other types of circuit breaker controls.

In the embodiments more particularly described, the circuit breaker comprises a plurality of elements in series whose contacts are closed simultaneously. The same problem of damage to the circuit breaker arises in the case of a circuit breaker having a plurality of chambers in parallel or a single arc extinction chamber per pole, but having auxiliary contacts which must be actuated in a predetermined order, and the device in accordance with the invention provides a solution to these problems.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore to be embraced therein.

I claim:

1. A gas blast circuit breaker comprising at least one arcing chamber containing at least one pair of separable contact members, means to pressurize said arcing chamber in the open-circuit and in the closed-circuit position of said contact members, first biasing means biasing said contact members in their open-circuit position towards their closed-circuit position, second biasing means responsive to the pressure in said arcing chamber biasing said contact members continually toward their open-circuit position, normal service control means to selectively effect the opening and the closing of said contact members, whereby in the open-circuit position of said contact members said second biasing means override said first biasing means and maintain said contact member in their open-circuit position only when said pressure is higher than a first predetermined value, emergency means responsive to the pressure in said arcing chamber, said emergency means feeding a positive closing order into said normal service control means to effect closing of said contact members when in their open-circuit position and maintaining in the closed-circuit position of the closed contact members when said pressure in said arcing chamber drops below a second predetermined value, said second predetermined value being higher than said first predetermined value.

2. A gas blast circuit breaker as set forth in claim 1 comprising, for each pole, a plurality of series-connected pairs of con-

tact members, wherein said emergency means effect the closing of all the pairs of contact members from the open-circuit position when said pressure drops below said second predetermined valve.

3. A gas blast circuit breaker as set forth in claim 1, wherein said normal service control means effect a pneumatic control of the movement of said contact members, said emergency means comprising a pressure-sensitive valve feeding a pneumatic closing order into said normal service control means when said pressure drops below said second predetermined value.

4. A gas blast circuit breaker as set forth in claim 3, wherein said pneumatic closing order is obtained by bleeding of the pressurized arcing chamber.

5. A gas blast circuit breaker as set forth in claim 1, wherein said normal service control means comprise an electromagnetic control valve initiating the closing of said contact members, said emergency means comprising a pressure-sensitive switch actuating said electromagnetic valve when said pressure drops below said second predetermined value.

6. A gas blast circuit breaker as set forth in claim 1, wherein said normal service control means comprise a mechanical operated member initiating the closing of said contact members, said emergency means comprising a pressure-sensitive valve cooperating with a pneumomechanical converter to operate said mechanical operated member when said pressure drops below said second predetermined value.

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