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[72] Inventor **Rintje Boersma**
Harmelen, Netherlands

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[73] Assignee **N.V. "COQ"**
Utrecht, Netherlands
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[54] ISOLATOR SWITCH WITH BRIDGING RESISTANCE AND EXTINGUISHING GAS CONTROL

5 Claims, 1 Drawing Fig.

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[50] **Field of Search** 200/148, 148.2, 148.4, 166, 148.6

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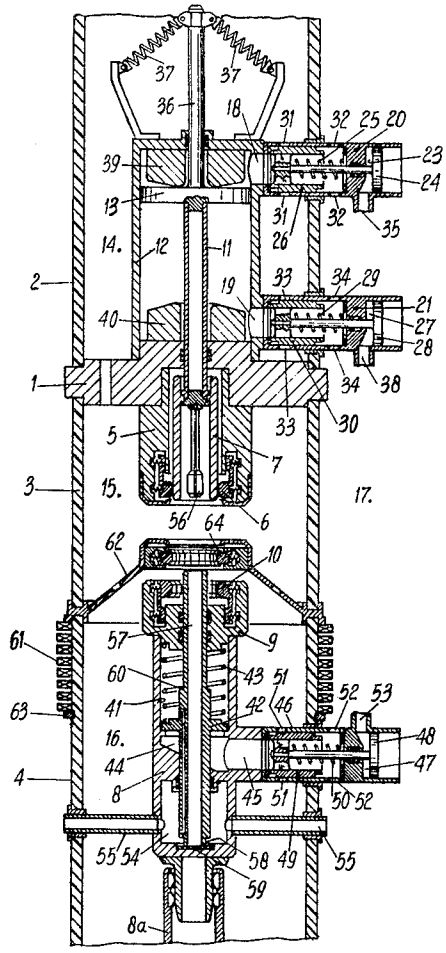
Primary Examiner—Robert S. Macon
Attorney—Imirie, Smiley, Snyder & Butrum

ABSTRACT: A gas blast circuit-breaker for isolating purposes and switching normal loads only, comprising a fixed main contact, a movable main contact cooperating therewith and two cooperating movable arcing contacts, of which the first one is rigidly connected with the movable main contact and the second one is electrically connected with the fixed main contact and is adapted to move, during the switching-off operation, together and in contact with the first arcing contact till a little past the separation of the main contacts, said second arcing contact being formed as a nozzle contact, the passage of which is opened during the switching-off operation as to allow extinguishing gas to escape from the switching chamber to quench the switching arc set up between the arcing contacts after their separation.



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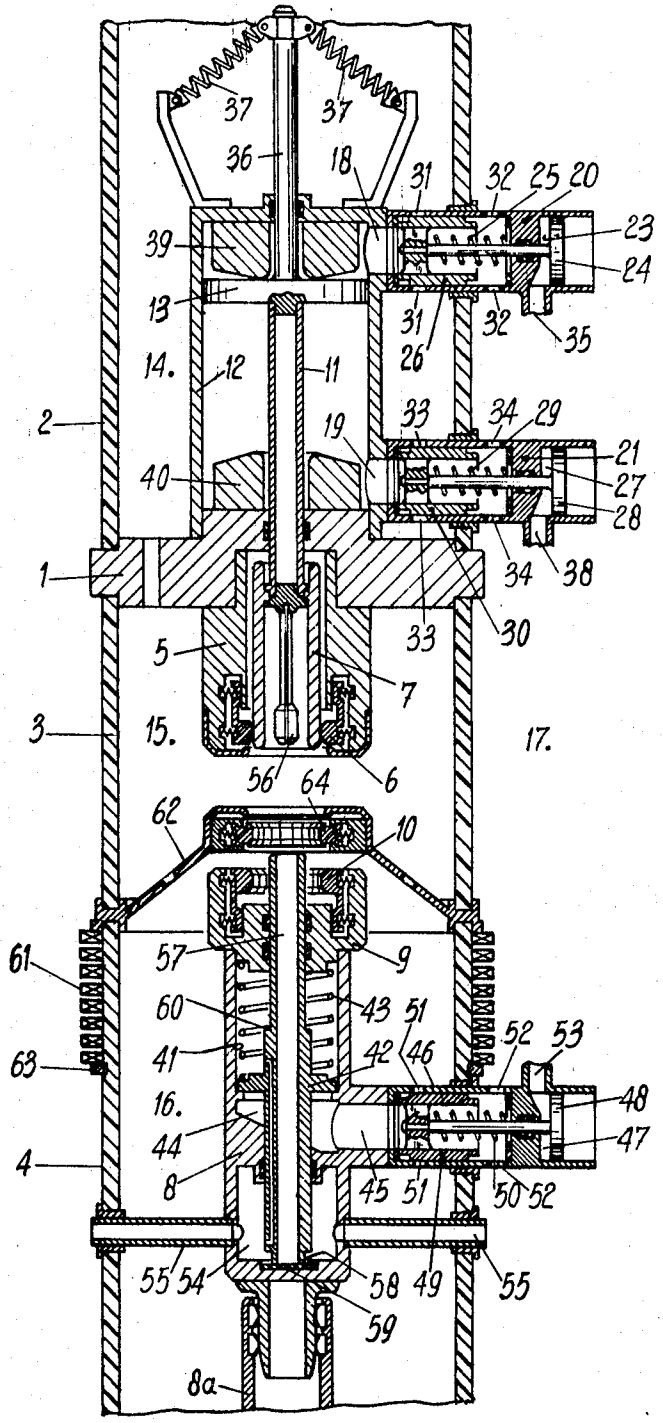

INVENTOR

RINTJE BOERSMA

BY Inskip & Smiley

ATTORNEYS

ISOLATOR SWITCH WITH BRIDGING RESISTANCE AND EXTINGUISHING GAS CONTROL

The invention relates to an electric circuit-breaker for high voltage comprising a switching chamber filled with extinguishing gas under high pressure, in which a fixed main contact and a movable main contact cooperates therewith and also two cooperating arcing contacts, each one electrically conductively connected with a main contact, are provided, at least one of said arcing contacts being movably mounted, in such a manner, as to remain, during the switching-off operation, in contact with the other arcing contact till a little past the interruption of the current path through the main contacts, and at least one of the contacts, all of which are provided in the switching chamber, being constructed as a closable nozzle-contact which is opened during the switching-off operation and then allows extinguishing gas to pass from the switching chamber to a space, in which the pressure is lower. Such a circuit-breaker is particularly adapted for combination with a power circuit-breaker which is exclusively used for the interruption of the circuit. In such a combination the meant circuit-breaker operates as an isolating switch to keep the circuit interrupted and to close same. However, it can also be used in other places of a switch-gear plant as an isolating switch which is adapted to operate under normal load.

The invention has for its object to provide a circuit-breaker of the kind referred to, which has a simple and compact structure in respect of known circuit-breakers and is easily controlled, in such a manner, that during the switching-off operation only a little quantity of extinguishing gas is spent to quench the switching arc. It consists in that the arcing contact, which is electrically conductively connected with the fixed main contact, is constructed as a closable nozzle-contact adapted to be moved with respect to said fixed main contact and to be driven, during the switching-off operation, in the switching-off direction of the movable main contact and said nozzle-contact then being moved together with the movable main contact through a part of the stroke of the latter only and being opened by said movement. In this circuit-breaker the extinguishing gas escapes from the switching chamber with full force not before the arcing contacts have been separated from one another. Owing to the fact that this nozzle-contact is driven back to its position of rest immediately after the switching arc has been quenched and the nozzle-contact is closed in said position, the consumption of extinguishing gas can be considerably reduced.

The invention allows a construction, in which the arcing contact acting as a nozzle-contact is driven by a single-acting cylinder-piston-system in the switching-off direction and by a spring in the opposite direction. By means of said cylinder-piston-system the nozzle-contact can be easily returned, during the switching-off operation, to the position of rest at the desired point of time, so that the passage provided in said contact is closed and extinguishing gas cannot flow out of the switching chamber anymore. To close and to open the passage provided in the arcing-contact acting as a nozzle-contact this nozzle-contact may cooperate with its end face remote from the movable main contact and from the switching chamber with a fixed seating surface and it may be so controlled as to be forced, in both end positions of the circuit-breaker, with said end face against said seating surface so as to close its passage. Only when, during the switching-off operation, the nozzle-contact moves along together with the movable main contact and the arcing contact attached thereto, the valve constituted by said end face and said seating surface is opened and extinguishing gas to quench the switching arc escapes from the switching chamber.

An important advantage of the circuit-breaker constructed in accordance with the invention is that it may be provided with a bridging resistance in a simple manner and that the provision of such a resistance hardly requires additional space in the circuit-breaker. Preferably, the circuit-breaker provided with a bridging resistance is constructed, in such a manner that a fixed intermediate contact is provided between the fixed main contact and the switched-off movable main contact and a bridging resistance is connected between the fixed main contact and said intermediate contact, said intermediate contact also operating with the movable main contact and the arcing contact acting as a nozzle-contact being movably mounted in such a manner as to remain, during the switching-off operation, in contact with the other arcing contact till a little past the separation of said movable main contact from said intermediate contact. In this circuit-breaker, it is easy to assure that during the switching-off operation, the extinguishing gas flowing towards the opened nozzle-contact is not hampered by the intermediate contact, so that the switching arc produced between the arcing contacts is well quenched. During the switching-in movement the movable main contact is first brought into contact with the intermediate contact only, whereby the bridging resistance is switched in. A little later the arcing contacts and still somewhat later the movable main contact are brought into contact with the fixed main contact. Consequently, in the switched-in condition of the circuit-breaker the bridging resistance is short-circuited.

The invention will be further elucidated with the aid of the drawing, which shows, by way of example, an axial sectional view of the switching element of an isolating switch constructed in accordance with the invention and provided with bridging resistance. In the drawing **1** is a contact holder which is held in place by insulators **2,3,4** in a metal casing (not shown) to be connected with earth and which is electrically conductively connected (in a manner not shown either) with the circuit to be controlled by the circuit-breaker. The contact holder **1** supports a holder **5** provided with a number of contact fingers **6** arranged in a circular row which are in permanent contact with a tubular movable main contact **7**. A second contact holder **8** which is also rigidly secured in the said casing by insulators carries a holder **9** with a corresponding circular row of contact fingers **10** constituting together the fixed main contact, with which the movable main contact **7** can be brought into contact to close, or from which the main contact **7** can be removed to interrupt the circuit. The contact holder **8** is connected through a conductor **8***a* with another part of the external circuit.

The movable main contact **7** is pneumatically driven and to that end coupled by a piston rod **11** with a piston **13** mounted for reciprocation in a cylinder **12**. The spaces **14,15, 16** inside the insulators **2,3,4** are filled with extinguishing gas, e.g. sulfurhexaflouride (SF_6)having an overpressure of say 14 atmospheres and the space **17** outside the insulators **2,3,4** but inside the metal casing is filled with the same gas having an overpressure of say 3.5 atmospheres.

For the pneumatical driving of the movable main contact **7** by means of the piston **13** the cylinder **12** is provided on its cylindrical wall with ports **18,19**. Connected to these ports are slide valves, of each of which the housing **20,21** extends in a gastight manner through the insulator **2**. Provided in the housing **20** is a slide valve **26** adapted to be moved to the right by a piston **24** mounted for reciprocation in a cylinder **23** and to the left by a spring **25**. In the same manner the housing **21** is provided with a piston **28** mounted for reciprocation in a cylinder **27**, a spring **29** and a slide valve **30**. The slide valve **26** controls ports **31** for the connection of the high-pressure space **14** with the port **18** and it controls also ports **32** for the connection of the low-pressure space **17** with said port **18**. In the same manner the slide valve **30** is used to control the ports **33, 34** to establish the communication between the port **19** and the high-pressure space **14** and the low-pressure space **17**, respectively.

If compressed gas is supplied through a conduit **35** to the cylinder **23**, the slide valve **26** is moved to the right by the piston **24** and the ports **31** are opened and the ports **32** are closed. The extinguishing gas then flows into the cylinder space above the piston **13** and it drives said piston downwards, whereby the main contact **7** is brought into contact with the main contact **10** and the circuit-breaker is switched in. After the circuit-breaker has been switched in, the slide valve **26** is

returned to the shown left-hand end position. In order to keep the circuitebreaker in the switched-in position the piston 13 is coupled by a rod 36 to compression springs 37 which hold the main contact 7 and the piston 13 in position in each one of the two end positions. For the switching-off operation compressed gas is fed through a conduit 38 into the cylinder 27, whereby the slide valve 30 is moved to the right, the ports 33 are opened and the ports 34 are closed. The cylinder space below the piston 13 then receives gas under higher pressure from the space 14, so that the piston and the movable main contact 7 are again moved upwards and the circuit-breaker is switched off.

The end positions of the movable switching contact 7 are defined by stop members 39, 40 of resilient material provided in the cylinder 12 and use at the same time to damp the switching movements.

The holder 8, the holder 9 and the fixed main contact 10 contain a cylinder space 41, in which a piston 42 is mounted for reciprocation. This piston is loaded by a spring 43. The cylinder space 44 below the piston 42 is connected through a port 45 to a slide valve, of which the housing 46 extends in a gastight manner through the wall of the insulator 4. In this housing a cylinder 47 and a piston 48, a slide valve 49 coupled with said piston and a spring 50 are accommodated. The slide valve controls ports 51 opening into the high-pressure space and ports 52 communicating with the low-pressure space 17. If gas under high pressure is fed through the conduit 53 into the cylinder 47 the slide valve 49 is forced to the right and the cylinder space 44 is brought into communication with the high-pressure space 16. A chamber, indicated by 54, is in permanent communication with the low-pressure space 17 through the conduits 55 extending in a gas tight manner through the insulator 4.

In accordance with the invention an arcing contact 56 is mounted centrally within the movable main contact 7. This arcing contact is rigidly and electrically conductively connected with said main contact so that it is moved together with said main contract throughout the entire stroke thereof. There is also provided centrally within the fixed main contact 10 an arcing contact 57 which is formed as a nozzle-contact and operates as the bushing contact of a plug-contact-connection, of which the plug is formed by the arcing contact 56. The nozzle-contact 57 extends in a gastight and axially movable manner through the contact holder 9 and the bottom of the cylinder 41 and it is coupled with the piston 42. The lower end face 58 of the nozzle-contact 57 cooperates with a seat 59 mounted in the bottom of the chamber 52, so that a valve is formed. The nozzle-contact 57 is adapted to be moved together with the movable switch part comprising the main contact 7 and the arcing contact 56 through a part of the switching-off stroke of said movable switch portion.

In the illustrated switched-off condition of the circuit-breaker the main contact 7 and the arcing contact 56 are in their highest positions and the spring 43 forces the tubular arcing contact 57 with its end face 58 against the seat 59, so that the passage of the nozzle-contact 57 is closed and the high-pressure switching chamber on one hand and the low-pressure chamber 52 and the low-pressure space 17 on the other hand are separated from one another. The circuit-breaker is held in the switched-off condition by the compression springs 37, since then both spaces of the cylinder 12 are in open communication with the low-pressure space 17 through the ports 18, 32 and 19, 34 so that they contain the same gas pressure.

If the circuit-breaker must be switched in high pressure is supplied through the conduit 35 to the cylinder 23 and the slide valve 26 is moved to the right. As a result thereof the ports 32 are closed and the ports 31 are opened, so that the cylinder space above the piston 13 is filled with extinguishing gas under high pressure and said piston is moved together with the movable main contact 7 towards the fixed main contact 10. The rod-shaped arcing contact 56 then engages the tubular arcing contact 57, so that in the switched-in condition of the circuit-breaker the circuit is closed both through the main contacts 7 and 10 and through the arcing contacts 56 and 57. Immediately after the switched-in condition has been reached the cylinder 23 is brought into communication with the low-pressure space 17, so that the slide valve 26 is forced back by the spring 25 into the illustrated left hand end position and thereby the cylinder space above the piston 13 is connected through the ports 32 with the low-pressure space 17.

If the circuit-breaker has to be switched off gas under high pressure is fed through the conduit 38 into the cylinder 27 and through the conduit 53 into the cylinder 47. The slide valves 30 and 49 are then moved to the right, so that the space in the cylinder 12 below the piston 13 and the space 44 in the cylinder 41 below the piston 42 receive gas under high pressure. The main contact 7, the arcing contact 56 and the arcing contact 57 are then simultaneously moved in the switching-off direction. This also results in that the valve 58, 59 is opened After a part of the switching-off stroke has been covered, the shoulder 60 of the arcing contact 57 engages the contact holder 9. However, this does not happen before the movable main contact 7 has left and fixed main contact 10, so that the contact interruption occurs exclusively between the arcing contact 56 and 57 and the switching arc is only set up between said arcing contacts. At the moment of separation of the arcing contacts 56 and 57, whereby the passage of the nozzle-contact 57 is completely opened, extinguishing gas flows with great speed from the switching chamber 15 through the nozzle-contact 57, the opened valve 58,59, the chamber 52 and the tubes 55 to the low-pressure space 17. This extinguishing gas quenches the switching arc produced between the arcing contacts 56, 57. Immediately after the circuit-breaker has been brought into the switched-off condition the pressure in the cylinders 27 to 47 is decreased to such an extent that the slide valves 30 and 49 are forced again into their left hand end positions. Owing thereto the cylinder space 44 is again connected with the low-pressure space 17, so that the spring 43 is capable of forcing the nozzle-contact 57 to the illustrated lowermost position, in which the valve 58, 59 is closed.

In the shown embodiment the circuit-breaker, of which only the arcing contacts control the quenching of the switching arc, is also provided with a bridging resistance 61. This resistance is connected between a metal contact holder 62 and a metal ring 63 which is electrically conductively connected with the holders 8 and 9 of the fixed main contact 10. The contact holder 62 supports an intermediate contact in the shape of a circular row of contact blocks 64. This intermediate contact is placed at a short distance above the contact 10 in the space extending between the fixed main contact 10 and the switched-off main contact 7. The stroke of the tubular arcing contact 57 is so chosen as to permit, during the switching-off operation, the arcing contacts 56, 57 of being separated from one another only after the movable main contact 7 has been separated from the intermediate contact 64.

It will be apparent that during the switching-in operation first a connection through the bridging resistance 61 is effected and thereupon said resistance becomes short-circuited by the movable main contact 7 which then comes into contact both with the intermediate contact 64 and the fixed main contact 10. The closing of the circuit thus occurs through the bridging resistance 61. During the switching-off operation this resistance is inoperative, since the contact interruption takes place exclusively between the arcing contacts 56, 57. The annular intermediate 64 is so mounted that it does not hamper the extinguishing gas escaping from the switching chamber 15. The arcing contacts 56, 57 do not become separated from one another before the entrance of the nozzle-contact 57 has reached a position near or a little bit above the upper face of the intermediate contact 64. The illustrated embodiment also shows that the provision of the bridging resistance 61 and the intermediate contact 64 requires very little additional space in the circuit-breaker. This makes it possible to construct the circuit-breaker in such a way that it can be used with or without the bridging resistance without leading to unpractical dimensions of the circuit-breaker, when the said resistance is omitted.

I claim:

1. An isolator switch for high voltage electrical systems adapted to make and break normal currents, said switch comprising a switching chamber filled with pressurized extinguishing gas, a fixed main contact, a movable main contact cooperating with said fixed contact, means for driving the movable contact through a predetermined stroke from and towards said fixed contact, a first movable arcing contact secured to and electrically conductively connected with said movable main contact, a tubular second movable arcing contact cooperating with said first arcing contact and electrically conductively connected with said fixed main contact, means for driving said second arcing contact through a predetermined stroke in directions toward and from said first arcing contact, the stroke of the second arcing contact being smaller than the stroke of the movable main contact and the first arcing contact, a fixed intermediate contact also cooperating with said movable main contact and situated in the space between the main contacts when the isolator switch is in its open condition, a bridging resistance connected between said intermediate contact and said fixed main contact, said tubular second arcing contact forming a discharge passage for the extinguishing gas, and two cooperating valve members, one valve member being associated with the second arcing contact and the other member being associated with a stationary part of the isolator switch, said valve members constituting together a valve which keeps said discharge passage closed, both when the isolator switch is in its closed and in its definite open condition, and opens said discharge passage during the switching-off operation, all of said contacts being accommodated in said switching chamber, all of said movable contacts being driven simultaneously from their closed positions during the switching-off operation and the second arcing contact being returned to its closed position shortly after having reached the other end of its stroke, the stroke of the second arcing contact having such a length that during the switching-off operation the arcing contacts are separated after the movable main contact has left the intermediate contact and during the switching-in operation the movable main contact is brought into contact with the intermediate contact before the first arcing contact is brought into contact with the second arcing contact, so that said bridging resistance becomes operative only during the switching-in operation.

2. An isolator switch for high voltage electrical systems comprising, in combination;

a switch body defining a switching chamber filled with pressurized extinguishing gas;

first and second main contacts within said chamber;

first and second arcing contacts electrically conductively connected respectively to said first and second main contacts;

means for moving said first main contact selectively from a closed position in which said first main contact engages said second main contact to an opened condition in which said first main contact is spaced from said second main contact and vice versa;

a bridging resistance contact spaced from aid second main contact such that said first main contact is spaced therefrom in said opened position thereof but electrically engages same while out of contact with said second main contact during movement of said first main contact both to its opened condition and to its closed position;

bridging resistance means electrically connecting said bridging resistance contact to said second main contact;

first actuating means for maintaining said arcing contacts in contact with each other during opening movement of said first main contact until said first main contact has cleared said bridging resistance contact whereby the electrical circuit between said first and said second main contacts is maintained by said arcing contacts until said first main contact has cleared said bridging resistance contact;

second actuating means for moving one of said arcing contacts to separate said arcing contacts after said first main contact has cleared said bridging resistance contact during opening movement of said first main contact;

said one arcing contact being of tubular form defining a discharge passage adapted to convey extinguishing gas to the region of an arc drawn between said arching contacts;

valve means opened and closed respectively by operation of said first and second actuating means to control flow of extinguishing gas through said discharge passage whereby said flow of extinguishing gas occurs only incidental to opening movement of said isolator switch; and

said second actuator means being effective relatively position said arcing contacts when the isolator switch is opened so that said first main contact engages said bridging contact before said arcing contacts engage during subsequent closing movement of said first main contact.

3. The isolator switch according to claim 2 wherein said first arcing contact is connected to and movable with said first main contact, said second arcing contact is of tubular form, said first actuator means moves said second arcing contact from a rest position to follow and remain in contact with said first arcing contact until said first main contact has cleared said bridging resistance contact, and said second actuator means returns said second arcing contact to its rest position.

4. The isolator switch as defined in claim 3 wherein said valve means is formed by one end of said second arcing contact and a fixed portion of said isolator switch which are in contact when said second arcing contact is in its rest position.

5. The isolator switch according to claim 2 wherein said first main contact is of tubular form, said second main contact and said bridging resistance contact are of annular form, said first arcing contact is connected fixedly to and centrally disposed within said first main contact, an said second arcing contact is of tubular form.