



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.09.2011 Bulletin 2011/39

(51) Int Cl.:
H01H 33/24 (2006.01)

(21) Application number: **10157975.3**

(22) Date of filing: **26.03.2010**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

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(54) **High-voltage circuit breaker**

(57) A gas-insulated high-voltage circuit breaker comprises in coaxial arrangement a contact assembly with two contact members (20, 30), an insulating nozzle (40) which is attached to a first (20) of the two contact members (20, 30) and an axially movable annular shield (70) surrounding the insulating nozzle (40).

In order to achieve a high availability of the circuit-breaker and to improve its switching performance a control device (80) links the movable annular shield (70) with the first contact member (20). During an opening operation the control device (80) forces the annular shield (70) to move together with the first contact member (20) into the fully open position when the annular shield (70) protrudes over an end of the first contact member (20) facing the second contact member (30). During a closing operation the control device (80) forces the annular shield (70) to move together with the first contact member (20) into the fully closed position when the first contact member (20) protrudes over an end of the annular shield (70) facing the second contact member (30).

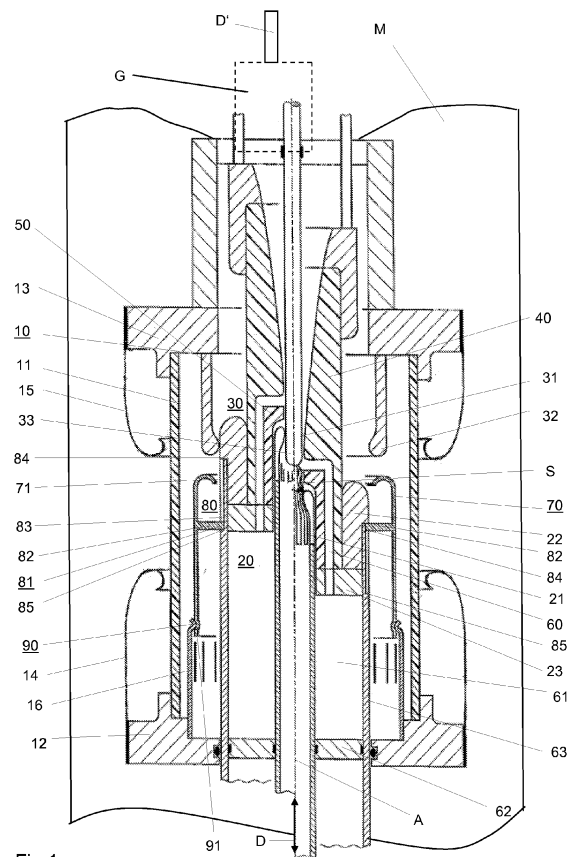


Fig. 1

Description

TECHNICAL FIELD

[0001] The invention relates to a gas-insulated high-voltage circuit breaker comprising coaxially arranged:

a contact assembly with two contact members that can be moved relative to one another along an axis,

an insulating nozzle which is attached to the first contact member and which coaxially is arranged between an arcing contact and a hollow nominal contact of the first contact member, and

an axially movable annular shield surrounding the insulating nozzle.

[0002] The main objective of such a circuit breaker is to disconnect a wide range of electric currents in a high-voltage network and to connect disconnected parts of the net. During disconnection or connection processes a dielectric breakdown may occur if a local electric field in a gap between two contact members exceeds a threshold value which depends on the character of the electric field and the dielectric design of the circuit breaker. In particular, a dielectric stressful disconnection or connection of a capacitive or an inductive circuit may weaken the dielectric strength of the circuit breaker and may eventually puncture the insulating nozzle and thus lead to a failure of the circuit breaker.

PRIOR ART

[0003] A circuit breaker of the afore-mentioned type is described in US 6,177,643 B1. The described circuit breaker comprises a contact assembly with two contact members from which a first is axially drivable and is firmly connected to an insulating nozzle. The second contact member comprises a pin-shaped arcing contact and a fixed contact for carrying persistent current, which surrounds the arcing contact. The circuit breaker further comprises an axially displaceable field electrode which surrounds the pin-shaped arcing contact and which is arranged between the fixed contact and the arcing contact of the second contact member. Fixed screening electrodes are intended to even out the electric field between the contacts members in the breaking operation.

[0004] During the breaking operation a gearing forces the field electrode to move with the same speed as the axially drivable first contact member. The field electrode remains in a position in which it together with one of the fixed screening electrodes and the arcing contact of the second contact member achieves an optimum field contour of the second contact member during the remaining breaking operation.

[0005] During the making operation the described phases are run through in reverse order. Thus, initially

the field electrode moves slowly, and faster toward the end of the making movement.

DESCRIPTION OF THE INVENTION

[0006] It is an object of the invention as described in the patent claims to specify a high-voltage circuit breaker which is of simple design and which at the same time comprises a high availability and an excellent switching performance.

[0007] The invention supplies a gas-insulated high-voltage circuit breaker comprising coaxially arranged:

a contact assembly with two contact members that can be moved relative to one another along an axis,

an insulating nozzle which is attached to the first contact member and which coaxially is arranged between an arcing contact and a hollow nominal contact of the first contact member, and

an axially movable annular shield surrounding the insulating nozzle,

in which a control device of the circuit breaker links the movable annular shield with the first contact member,

in which during an opening operation the control device forces the annular shield to move together with the first contact member into the fully open position when

the annular shield protrudes over an end of the first contact member facing the second contact member, and

in which during a closing operation the control device forces the annular shield to move together with the first contact member into the fully closed position when the first contact member protrudes over an end of the annular shield facing the second contact member.

[0008] The circuit breaker according to the invention is of simple design. Due to the controlled arrangement and the appropriate movement of the annular shield during the opening operation in the circuit breaker according to the invention the dielectric stress on its contact members is reduced. The annular shield during the whole opening operation preserves the whole inside and outside coordination of the breaker's dielectric design, in particular its radial coordination between the nominal and the arcing contacts in order to reduce the risk of nozzle puncturing.

[0009] During the closing operation the shield moves later than the first contact member and does not play a role in the distribution of the electric field. Thus a prestrike

can occur only in a configuration of the contact members in which the arcing contact of the first contact member is more exposed than the nominal contact of the first contact member. For this reason the radial coordination during the making operation is enhanced and a puncturing of the insulating nozzle or another dielectric fault can be avoided.

[0010] During the opening operation the annular shield moves along with the first contact member and the insulating nozzle. Thus the annular shield effectively screens the nominal contact of the first contact member. A deteriorated surface of the nominal contact, usually due to the effect of commutation arcs (commutation marks), can no more weaken the dielectric strength of the circuit breaker. Thus during the interruption of a current the dielectric stress in the circuit breaker is limited and is kept below a critical level. This is beneficial, in particular, if the circuit breaker interrupts capacitive or inductive currents. Thus the availability and the switching performance of the circuit breaker according to the invention are remarkably improved.

[0011] The afore-identified benefits can be achieved with a live-tank and with a metal-enclosed circuit breaker. In the case of a metal-enclosed circuit breaker the breaker comprises a metal enclosure which is filled with the insulating gas and which receives the contact assembly together with two hollow stationary shields that are spaced axially from another and from which the first surrounds the first contact member and the second contact member. The annular shield then can be arranged between the first hollow stationary shield and the nominal contact of the first contact member. During the opening operation the shield only moves when the free ends of the nominal and the arcing contact of the first contact member have entered the shadow of the annular shield. Then inhomogeneities in the surfaces of these contacts, like the commutation marks, do not play a role.

[0012] The afore-identified benefits can also be achieved with a live-tank or a metal-enclosed circuit breaker comprising two hollow stationary shields that are spaced axially from another and from which the first surrounds the first contact member and the second the second contact member, in which the annular shield can be arranged between the nominal contact of the first contact member and the insulating nozzle. In this case the worn surface of the nominal contact can be arranged face to face to the axis and can be surrounded with an outer section of the nominal contact. This outer section can be executed as a shield which together with movable annular shield screens the commutation marks of the worn surface against the electric field.

[0013] In a simple and reliable embodiment of the invention the control device can comprise an axially extended game between the nominal contact and the annular shield. The game can be sized such that the annular shield protrudes over the first contact member when during the opening operation the arcing contact of the first contact member becomes dielectrically more critical than

an arcing contact of the second contact member.

[0014] The game can be achieved with a longitudinal guide which comprises a slide block linked with the annular shield and glidingly supported on an axially extended guideway of the nominal contact. The guideway can be bordered with two stops which are arranged with a distance from another and which border the game between the nominal contact and the annular shield, such that the first stop hits the slide block during the opening operation and that the second stop hits the slide block during the closing operation of the circuit breaker. At least one of the two stops can be designed as a shock absorber.

[0015] The annular shield can glidingly engage a stationary rim of flexible contact fingers which are held on the potential of an electrical conducting section defining a current terminal for the first contact member.

[0016] The stationary rim of flexible contact fingers can be a part of a latching mechanism of the control device, which in the fully closed position of the circuit breaker is latched. The latching mechanism can further comprise a groove or a projection which is inserted in the annular shield and which in the fully closed position receives at least one of the tips of the contact fingers.

[0017] The benefits of high availability and improved switching performance are very important in an embodiment of the circuit breaker according to the invention in which a gear unit causes a fast movement of the arcing contacts of the two contact members in opposite directions.

[0018] In a most simple embodiment of a live-tank or a metal-enclosed circuit breaker according to the invention the circuit breaker comprises coaxially arranged:

a contact assembly with two contact members that can be moved relative to one another along an axis,

an insulating nozzle which is attached to the first contact member and which coaxially is arranged between an arcing contact and a hollow nominal contact of the first contact member, and

an axially movable annular shield surrounding the insulating nozzle,

in which the movable annular shield is part of the first contact member and surrounds the hollow nominal contact,

in which the circuit breaker further comprises two hollow stationary shields that are spaced axially from another and from which the first surrounds the first contact member and the second the second contact member, and

in which the circuit breaker further comprises a connection which during the whole opening and the whole closing operation rigidly connects the annular

shield and first nominal contact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] These and other characteristics of the invention will be clear from the following description of preferential forms, given as non-restrictive examples, with reference to the attached drawings, wherein:

- Fig.1 is a longitudinal section of a first embodiment of a high-voltage circuit breaker according to the invention, which is extended along an axis A, and which on the left of the axis is shown in the fully closed position and on the right of the axis during an opening operation,
- Fig.2 the circuit breaker of fig.1, which on the left of the axis is shown in the fully open position and on the right of the axis during a closing operation,
- Fig.3 a second embodiment of the circuit breaker according to the invention, and
- Fig.4 a third embodiment of the circuit breaker according to the invention.

DETAILED DESCRIPTION OF PREFERENTIAL EMBODIMENTS OF THE INVENTION

[0020] In the figures same reference symbols are used for identical parts and repetitive reference symbols may be omitted.

[0021] The circuit breakers disclosed in the figures 1 to 4 comprise a tubular housing 10 which is extended along the axis A. The housing 10 receives a contact assembly with two contact members 20, 30 and is filled with an insulating gas having arc-extinguishing properties, in particular a gas on the basis of sulfur hexafluoride, nitrogen or carbon dioxide or a mixture comprising one or more of these gases. Typically the insulating gas is pressurized up to some bar, for instance five to eight bar. The housing 10 is arranged in a gas-filled metal enclosure M (shown only in fig.1) which is connected to ground potential and which communicates with the interior of the housing 10.

[0022] The housing comprises a hollow cylindrical insulator 11 which on its lower end supports a hollow metal body 12 and on its upper end a hollow metal body 13. The hollow body 12 resp. 13 surrounds the first 30 resp. the second contact member 30, is electrical conductively connected to the contact member 20 resp. 30 and serve as one of the two current terminals of the contact assembly. Ends of the metal bodies 12, 13 are arranged face to face and border an axially extended range of the insulator 11 which during an opening or closing operation is charged with dielectric stress. These ends are designed as stationary hollow shields 14, 15 and control the electric field in a gap which during opening or closing

the contact assembly is arranged between the free ends of the two contact members 20, 30. In the three embodiments according to figures 1 to 4 the two shields 14, 15 can be eliminated if the circuit breaker is designed as a live-tank breaker and thus does not comprise the metal enclosure M but only the gas-filled housing 10.

[0023] The two contact members 20, 30 can be moved relative to one another along the axis A. Each contact member 20 resp. 30 in coaxial arrangement comprises an arcing contact 21 resp. 31 and a nominal contact 22 resp. 32 which surrounds the corresponding arcing contact 21 resp. 31. The nominal contact 22 and the arcing contact 21 in an electrical conducting manner are fixedly secured to an annular connection piece 23 of the contact member 20. The nominal contact 22 resp. a contact carrier of the contact 22 in an electrical conducting manner is glidingly connected to the hollow metal body 12 acting as current terminal.

[0024] In the fully closed position of the circuit breaker (shown on the left of fig.1 resp. of fig.3 and 4) both arcing contacts 21, 31 are surrounded by a tubular insulating nozzle 40 which is preferably manufactured of a polymer on the basis of a polytetrafluorethylene (PTFE), which is fixedly secured to the annular connection piece 23, and which is kept in coaxial arrangement between the arcing contact 21 lying inside and the hollow nominal contact 22 lying outside. An auxiliary insulating nozzle 50 is supported on the free end of the tulip-shaped, hollow arcing contact 21. The auxiliary nozzle 50 encircles the free end of arcing contact 21 and together with the surrounding insulating nozzle 40 borders an annular heating channel 60. Furthermore, in the closed position the arcing contact 21 receives a head 33 of the arcing contact 31 which is shaped as a plug.

[0025] In the embodiment of the circuit breaker according to figures 1 and 2 a movable annular metal shield 70 coaxially is arranged between the cylindrical insulator 11 of the housing 10 and the nominal contact 22. The shield 70 encloses an area 71 which is screened against the stress of the electric field effective between the separated contact members 20, 30 during opening or closing the circuit breaker. The shield 70 glidingly engages a stationary rim of flexible contact fingers 16. The contact fingers 16 are electrical conductively connected to an electrical conducting section of the housing 10, which is designed as the hollow metal body 12.

[0026] In order to open the circuit breaker the contact members 20, 30 are disconnected by means of a drive D which is schematically shown as an arrow and which moves the contact member 20 downwardly. After the separation of the nominal contacts 22, 32 a current to be interrupted commutates into a current path which includes the arcing contacts 21, 31. A commutation arc which is drawn during the commutation process may cause dielectric unfavourable wear and erosion deformation (commutation marks) on the nominal contacts 22 and 32. When the commutation of the current is finished, the arcing contacts 21, 31 separate and an arc S is struck

between the plug head 33 and an annular-shaped end of the arcing contact 21 (shown on the right of fig. 1). The arc S heats up and thus pressurizes the surrounding insulating gas which via channel 60 is guided into a compression chamber 61 in which it is stored as quenching gas. Meanwhile the arcing contact 31 travels through the insulating nozzle 40. As soon as the plug head 33 releases the compression chamber 61 the stored quenching gas - additionally pressurized by means of a puffer device with a stationary piston 62 and a movable cylinder 63 which is formed in a contact carrier of the contact member 20 - passes the nozzle 40 and blows the arc S beyond current zero until the current is interrupted.

[0027] During the opening operation the shield 70 does not move until the nominal 22 and the arcing contact 21 have entered its shadow region, that means the free ends of the nominal 22 and the arcing contact 21 facing the second contact member 30 have entered the shielded area 71 resp. the annular shield 70 protrudes over the free end of the contact member 20. As soon as the annular shield 70 protrudes over the nominal contact 22 and the arcing contact 21 the commutation marks of the nominal contact 22 and arc-worn and arc-eroded parts of the arcing contact 21 are no more exposed to the strong electric field which becomes effective when the current is interrupted and a voltage between the separated contact members 20, 30 begins to recover. Thus the dielectric stress in the gap can be kept below a critical level and the specified radial coordination of the breaker's dielectric design can be preserved.

[0028] A device 80 controls the movement of the annular shield 70. This control device keeps the shield 70 at the beginning of the opening operation stationary. When the circuit breaker has to interrupt a capacitive or an inductive current, after a definite travel of the contact member 20 the tubular arcing contact 21 becomes dielectrically more critical than the plug-shaped arcing contact 31. The definite travel resp. the corresponding game between the nominal contact 22 and the annular shield 70 is calculated such that the annular shield 70 afterwards becomes dielectrically active. The definite travel resp. the game usually is less than 50%, preferably between 10 and 30%, of the total travel.

[0029] After the execution of the definite travel the free end of the nominal contact 22 and the protruding free end of the tubular arcing contact 21 have entered the shielded region 71 and at the same time the control device 80 forces the annular shield 70 to move together with the contact member 20.

[0030] The afore-mentioned movement of the annular shield 70 can be achieved with a longitudinal guide 81 which is integrated in the control device 80. The longitudinal guide 81 comprises a slide block 82 linked with the annular shield 70 and glidingly supported on an axially extended guideway 83 which is integrated in the nominal contact 22. The guideway 83 is arranged on the outer surface of the nominal contact 22 resp. a contact carrier of the nominal contact and can comprise an annular sec-

tion of the outer surface or - as shown in the drawings - at least one axially extended groove. The guideway 83 is bordered with two stops 84, 85 which are arranged with distance from another. The distance represents the game between the nominal contact 22 and the annular shield 70 and enables the annular shield 70 to move during the opening operation only when the contact member 20 enters the shielded area 71 and when the stop 84 hits the slide block 82 (shown on the right of fig. 1). A reduction of the impact is achieved with a stop 84 which is designed as a shock absorber.

[0031] The stop 84 carries away the slide block 82 and thus also the annular shield 70 until the fully open position of the circuit breaker is reached (shown on the left of fig. 2). During this final section of the opening operation the shield 70 keeps the dielectric stress on the nominal contact 22 below an inception level and thus preserves the radial coordination of the circuit breaker during opening. This is beneficial, in particular in capacitive or inductive switching, when the disconnection of a capacitive or inductive load may result in a transient recovery voltage which rises very steeply. Thus the shield 70 improves the breaking performance of the circuit breaker remarkably.

[0032] The annular shield 70 in the fully open position of the circuit breaker slightly protrudes over the free end of the nominal contact 22. This helps for the open gas tests according to BIL/BIAS requirements and allows to expose the tubular arcing contact 21 more with respect to the nominal contact 22.

[0033] During the closing operation the annular shield 70 moves later with respect to the nominal 22 and the arcing contact 21 (shown on the right of fig. 2). Thus the annular shield 70 does not control the electric field existing in the gap between contact members 20 and 30. In making operation a prestrike then occurs in an electric configuration for which the arcing contact 21 is more exposed than the nominal contact 22. Thus during the whole closing operation the shield 70 preserves the inside and outside coordination of the breaker's dielectric design, in particular its radial coordination between the nominal and the arcing contacts in order to reduce the risk of nozzle puncturing.

[0034] The circuit breaker further comprises a latching mechanism 90 which in the fully closed position of the circuit breaker is latched. The latching mechanism 90 comprises the stationary rim of flexible contact fingers 16 and an annular groove 91 which is inserted in the annular shield 70 and which receives the tips of the contact fingers 16 in the fully closed position of the circuit breaker. Thus the latching mechanism 90 is latched in the fully closed position and the annular shield 70 then is stationary. During the opening operation the latching mechanism 90 is released as soon as the stop 84 hits the slide block 82. The annular shield 70 then moves together with the contact member 20. In the fully open position (shown on the left of fig. 2) the latching mechanism 90 remains unlatched. Thus during the closing op-

eration for reason of the game between the contact member 20 and the annular shield 70 the annular shield 70 is kept stationary. As soon as the stop 85 hits the slide block 82 the annular shield 70 together with contact member 20 moves upwardly until in the fully closed position the latching mechanism 90 becomes latched. In order to reduce the impact of the stop 85 hitting the slide block 82 the stop 85 can be designed as a shock absorber.

[0035] In the embodiment of the circuit breaker according to fig.3 the annular shield 70 is arranged between the nominal contact 22 and the insulating nozzle 40 and is guided through the annular connection piece 23. In the fully closed position (shown on the left of fig.3) the nominal contact 22 surrounds the nominal contact 32. During the opening operation the shielded area 71 can receive the arcing contact 21 (shown on the right of fig.3). The nominal contact 22 comprises a contact surface 24, which is arranged face to face to the axis A, which in the fully closed position touches an outer cylindrical surface 34 of the nominal contact 32, and which during opening may receive a root of the commutation arc. The contact surface 24 is surrounded by a section 25 of the nominal contact 22, which is executed as a shield. The shielding section 25 together with the annular shield 70 then screens the contact surface 24 which during the opening operation may be deteriorated by the commutation arc.

[0036] The control device 80 of this embodiment distinguishes over the control device of the embodiment according to figures 1 and 2 in the arrangement and design of the axially extended guideway 83 and of the slide block 82. The guideway 83 is arranged on the inner surface of the hollow nominal contact 22 resp. of a hollow contact carrier of the nominal contact 22 and can comprise an annular section of said inner surface or - as shown in fig. 3 - at least one axially extended groove. The slide block 82 is executed as a ring or as radially extending fingers. The slide block 82 is fixedly connected with the outer surface of the annular shield 70.

[0037] During the opening operation (shown on the right of fig.3) the stop 84 carries away the slide block 82 and thus also the annular shield 70 until the fully open position of the circuit breaker is reached. During this final section of the opening operation the shield 70 and the shielding section 25 keep the dielectric stress on the nominal contact 22 below an inception level and thus preserves the radial coordination of the circuit breaker during opening. The stationary shield 15 permanently protrudes over the nominal contact 32 and thus keeps the dielectric stress on this contact, in particular on its contact surface 34 which may comprise commutation marks, always below an inception level.

[0038] As already described in connection with the embodiment of the circuit breaker according to figures 1 and 2 in the fully open position (not shown) the annular shield 70 slightly protrudes over the free end of the nominal contact 22. Unlike the afore-described embodiment of the circuit breaker, in which a shielding section (not shown) of the nominal contact 32 surrounds a rim of con-

tact fingers (not shown) and thus shields the contact surface of the nominal contact 32, in the embodiment according to fig.3 the nominal contact 32 does not comprise such a shielding section. However, the stationary shield 15 protrudes over the free end of the nominal contact 32 and thus screens the nominal contact 32 resp. its contact surface 34 which may comprise commutation marks. This helps for the open gas tests according to BIL/BIAS requirements and allows to expose the tubular arcing contact 21 more with respect to the nominal contact 22. During the closing operation the annular shield 70 does not control the electric field existing in the gap between contact members 20 and 30. A prestrike then only occurs in an electric configuration for which the arcing contact 21 is more exposed than the nominal contact 22. Thus also in this case during the closing operation the shield 70 preserves the inside and outside coordination of the breaker's dielectric design.

[0039] In the fully closed open position a latching system (not shown in fig.3) similar with that shown in figures 1 and 2 holds the annular shield 70. Thus during the closing operation the annular shield 70 is arrested and is prevented from crashing against the nominal contact 32 for reason of inertia.

[0040] As already described in connection with the embodiment of the circuit breaker according to fig.3, also in the embodiment according to fig.4 the stationary shield 15 slightly protrudes over the free end of the nominal contact 32 and thus screens its contact surface 34 during the whole opening and closing operation. However, in the embodiment of the circuit breaker according to fig.4 the annular shield 70 is fixedly secured to the nominal contact 22 and surrounds a rim of contact fingers which on their tips carry the contact surface 24. In place of the control device 80 this embodiment of the circuit breaker only comprises a connection 35 which rigidly couples the annular movable shield 70 and the nominal contact 22. Thus during the whole opening and the whole closing operation the shield 70 then screens the commutation marks on the contact surface 24 of the nominal contact 22. Thus even this very simple design of the circuit breaker according to the invention comprises a high availability and an excellent switching performance.

[0041] As shown in the embodiment of the circuit breaker according to the figures 1 and 2 the first contact member 20 is linked with the operating rod D and the second contact member 30 is stationary. In a further embodiment the circuit breaker according to the invention further comprises a gear unit G which in fig. 1 is drawn with dashed lines. This gear unit links the insulating nozzle 40 (resp. the contact member 20) and the axially moving arcing contact 31. The gear unit can be executed as a rack or a lever mechanism and causes a movement of the arcing contacts 21 and 31 in opposite directions. The drive rod D can be substituted with a drive rod D'. The drive rod D' can be linked with the gear unit G or with the arcing contact 31.

[0042] Instead of a longitudinal guide 81 the control

device 80 may comprise a control mechanism which is integrated in a gear unit for transmitting drive energy in the drive rods D or D'. Such a gear unit usually is executed as a crank or lever mechanism. The movable annular shield 70 then is linked with the first contact member 20 by means of the control mechanism and the crank or lever mechanism of the gear unit.

List of Reference Signs

[0043]

10	housing
11	insulator
12, 13	metal bodies
14, 15	field control electrodes
16	rim of flexible contact fingers
20	contact member
21	arcing contact
22	nominal contact
23	connection piece
24	contact surface
25	shielding section
30	contact member
31	arcing contact
32	nominal contact
33	head of arcing contact 31
34	contact surface
35	connection
40	insulating nozzle
50	auxiliary nozzle
60	heating channel
61	compression volume
62	piston
63	cylinder

70	annular shield
71	shielded area
5 80	control device
81	longitudinal guide
82	slide block
10 83	guideway
84, 85	stops
15 90	latching mechanism
91	groove
A	axis
20 D, D'	drive rods
G	gear unit
25 M	metal enclosure

Claims

- 30 1. A gas-insulated high-voltage circuit breaker comprising coaxially arranged:
- 35 a contact assembly with two contact members (20, 30) that can be moved relative to one another along an axis (A),
an insulating nozzle (40) which is attached to the first contact member (20) and which coaxially is arranged between an arcing contact (21) and a hollow nominal contact (22) of the first contact member (20), and
40 an axially movable annular shield (70) surrounding the insulating nozzle (40),
characterised in
that a control device (80) of the circuit breaker links the movable annular shield (70) with the first contact member (20),
that during an opening operation the control device (80) forces the annular shield (70) to move together with the first contact member (20) into the fully open position when the annular shield (70) protrudes over an end of the first contact member (20) facing the second contact member (30), and
50 **that** during a closing operation the control device (80) forces the annular shield (70) to move together with the first contact member (20) into the fully closed position when the first contact member (20) protrudes over an end of the an-

- nular shield (70) facing the second contact member (30).
2. The circuit breaker according to claim 1 further comprising a metal enclosure (M) which is filled with the insulating gas and which receives the contact assembly together with two hollow stationary shields (14, 15) that are spaced axially from another and from which the first (14) surrounds the first contact member (20) and the second (15) the second contact member (30), **characterised in that** the annular shield (70) is arranged between the first hollow stationary shield (14) and the nominal contact (22). 5
 3. The circuit breaker according to claim 1 further comprising two hollow stationary shields (14, 15) that are spaced axially from another and from which the first (14) surrounds the first contact member (20) and the second (15) the second contact member (30), **characterised in that** the annular shield (70) is arranged between the nominal contact (22) and the insulating nozzle (40). 10
 4. The circuit breaker according to one of claims 1 to 3, **characterised in that** the control device (80) comprises an axially extended game between the nominal contact (22) and the annular shield (70). 15
 5. The circuit breaker according to claim 4, **characterised in that** the game is sized such that the annular shield (70) protrudes over the first contact member (20) when during the opening operation the arcing contact (21) of the first contact member becomes dielectrically more critical than an arcing contact (31) of the second contact member (30). 20
 6. The circuit breaker according to one of claims 4 or 5, **characterised in that** the game is achieved with a longitudinal guide (81) which comprises a slide block (82) linked with the annular shield (70) and glidingly supported on an axially extended guideway (83) of the nominal contact (22). 25
 7. The circuit breaker according to claim 6, **characterised in that** the guideway (83) is bordered with two stops (84, 85) which are arranged with a distance from another and which border the game between the nominal contact (22) and the annular shield (70), such that the first stop (84) hits the slide block (82) during the opening operation and that the second stop (85) hits the slide block (82) during the closing operation of the circuit breaker. 30
 8. The circuit breaker according to claim 7, **characterised in that** at least one of the two stops (84, 85) is designed as a shock absorber. 35
 9. The circuit breaker according to one of claims 1 to 8, **characterised in that** the annular shield (70) glidingly engages a stationary rim of flexible contact fingers (16) which are hold on the potential of an electrical conducting section (12) defining a current terminal for the first contact member (20). 40
 10. The circuit breaker according to claim 9, **characterised in that** the stationary rim of flexible contact fingers (16) is part of a latching mechanism (90) of the control device (80), which in the fully closed position of the circuit breaker is latched. 45
 11. The circuit breaker according to claim 10, **characterised in that** the latching mechanism (90) further comprises at least a groove (91) or a projection which is inserted in the annular shield (70) and which in the fully closed position receives at least one of the tips of the contact fingers. 50
 12. The circuit breaker according to one of claims 1 to 11, **characterised in that** the first contact member (20) is linked with an operating rod (D). 55
 13. The circuit breaker according to claim 12, **characterised in that** the second contact member (30) is stationary.
 14. The circuit breaker according to claim 12, **characterised in that** a gear unit (G) for causing a movement in opposite directions links the insulating nozzle (40) and a movable arcing contact (31) of the second contact member (30).
 15. A gas-insulated high-voltage circuit breaker comprising coaxially arranged:

a contact assembly with two contact members (20, 30) that can be moved relative to one another along an axis (A),
 an insulating nozzle (40) which is attached to the first contact member (20) and which coaxially is arranged between an arcing contact (21) and a hollow nominal contact (22) of the first contact member (20), and
 an axially movable annular shield (70) surrounding the insulating nozzle (40),
characterised in that the movable annular shield (70) is part of the first contact member (20) and surrounds the hollow nominal contact (22),
that the circuit breaker further comprises two hollow stationary shields (14, 15) that are spaced axially from another and from which the first (14) surrounds the first contact member (20) and the second (15) the second contact member (30), and
that the circuit breaker further comprises a connection (35) which during the whole opening and

the whole closing operation rigidly connects the annular shield (70) and first nominal contact (22).

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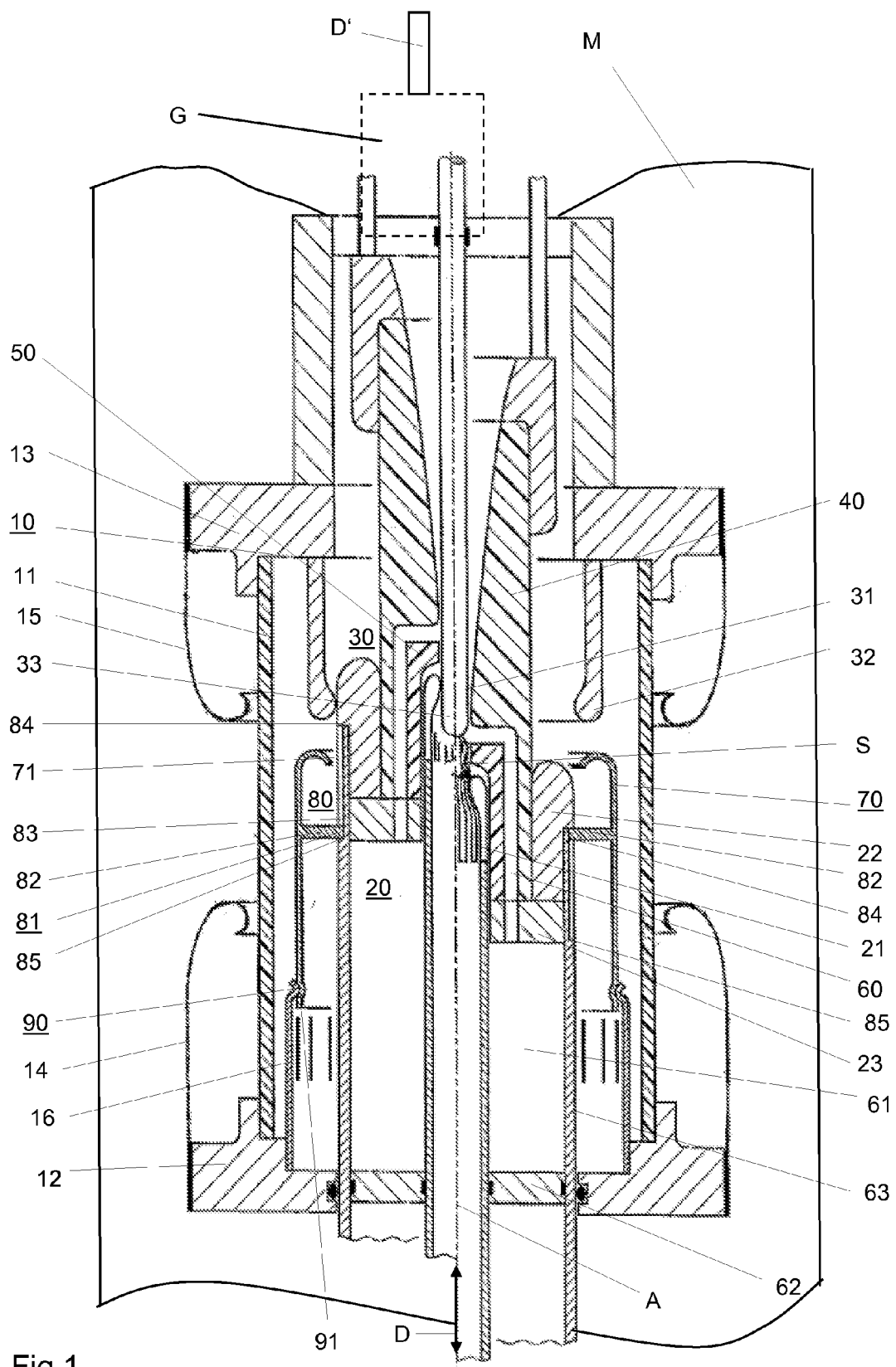
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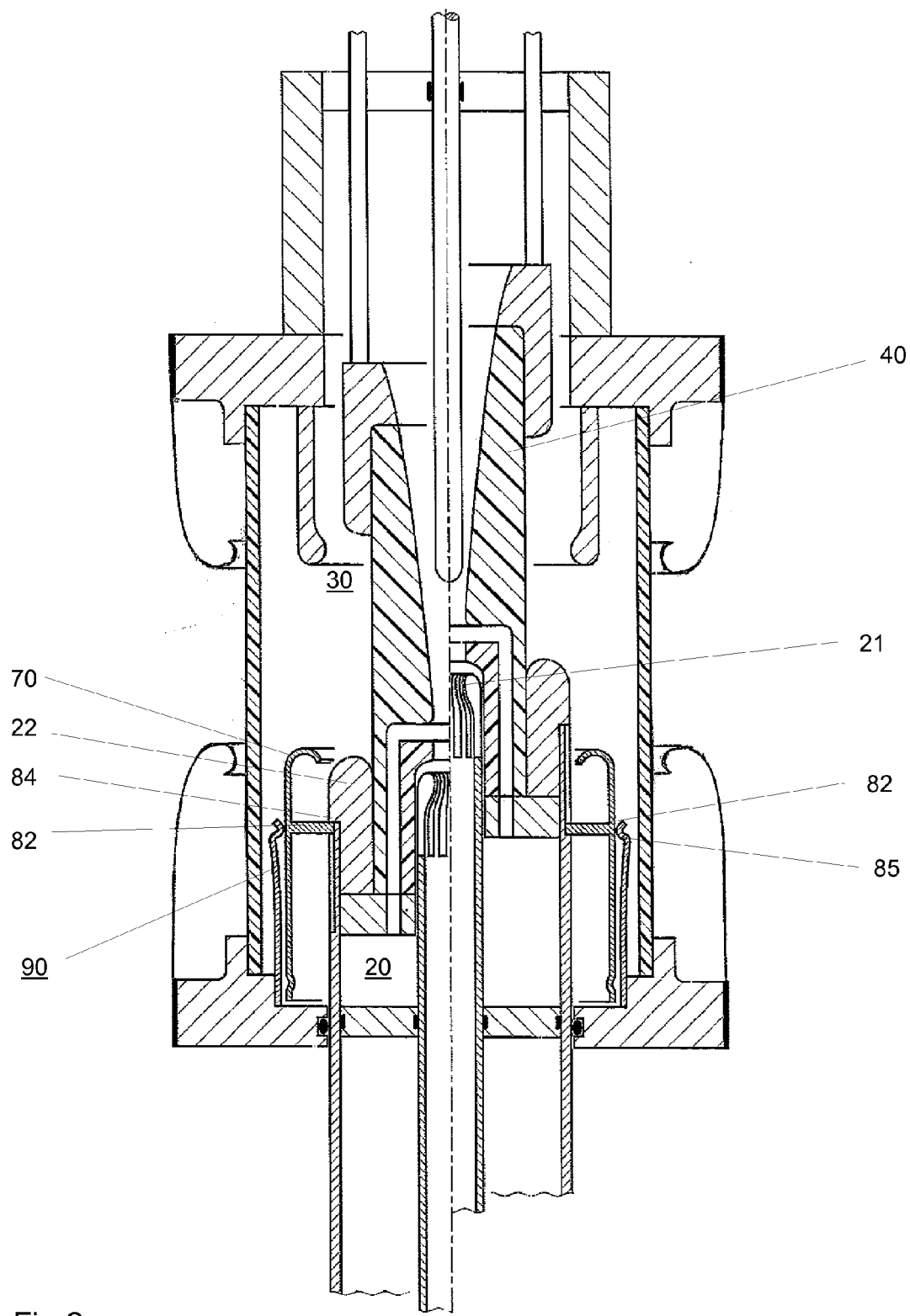


Fig.2

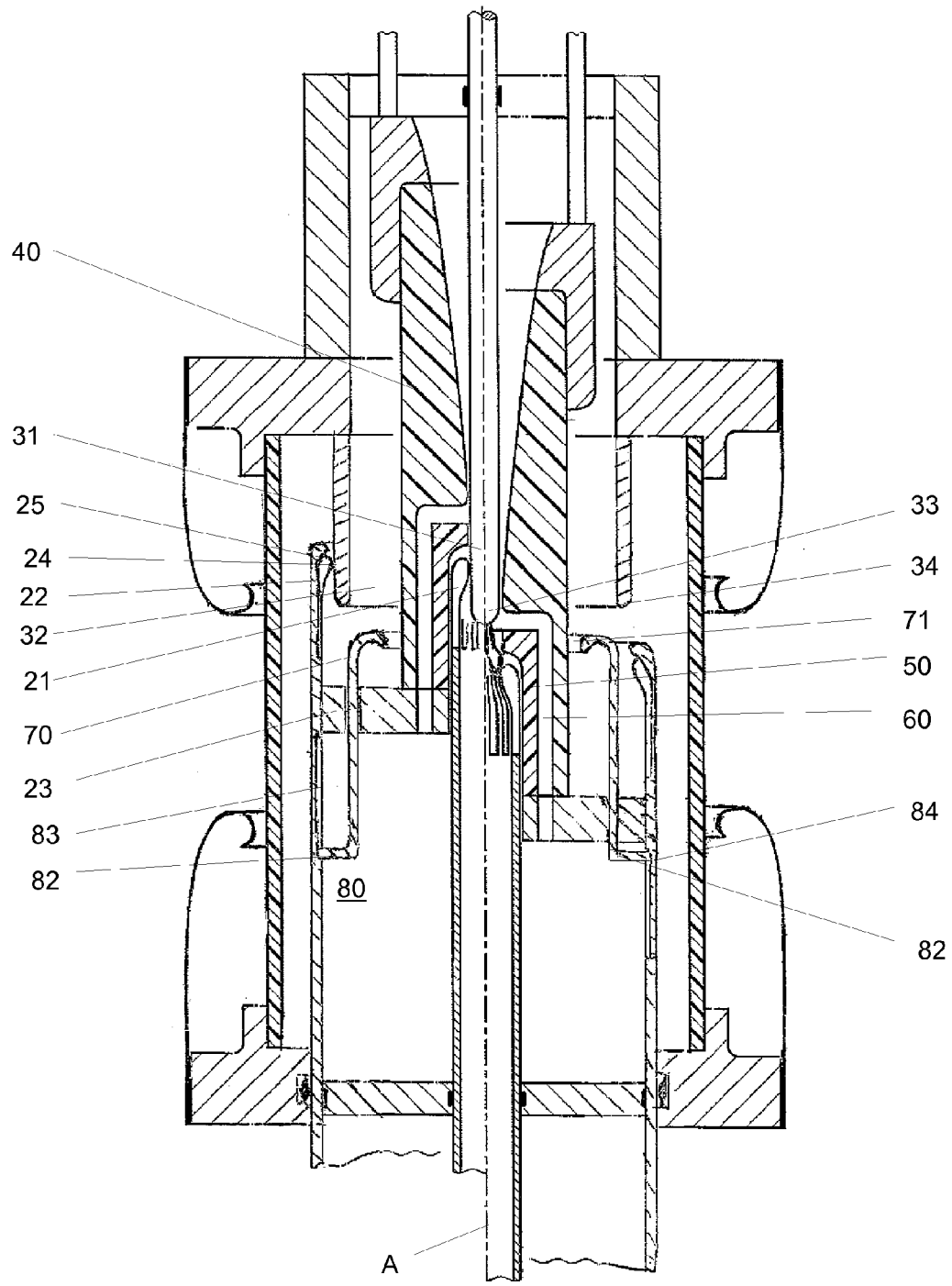


Fig.3

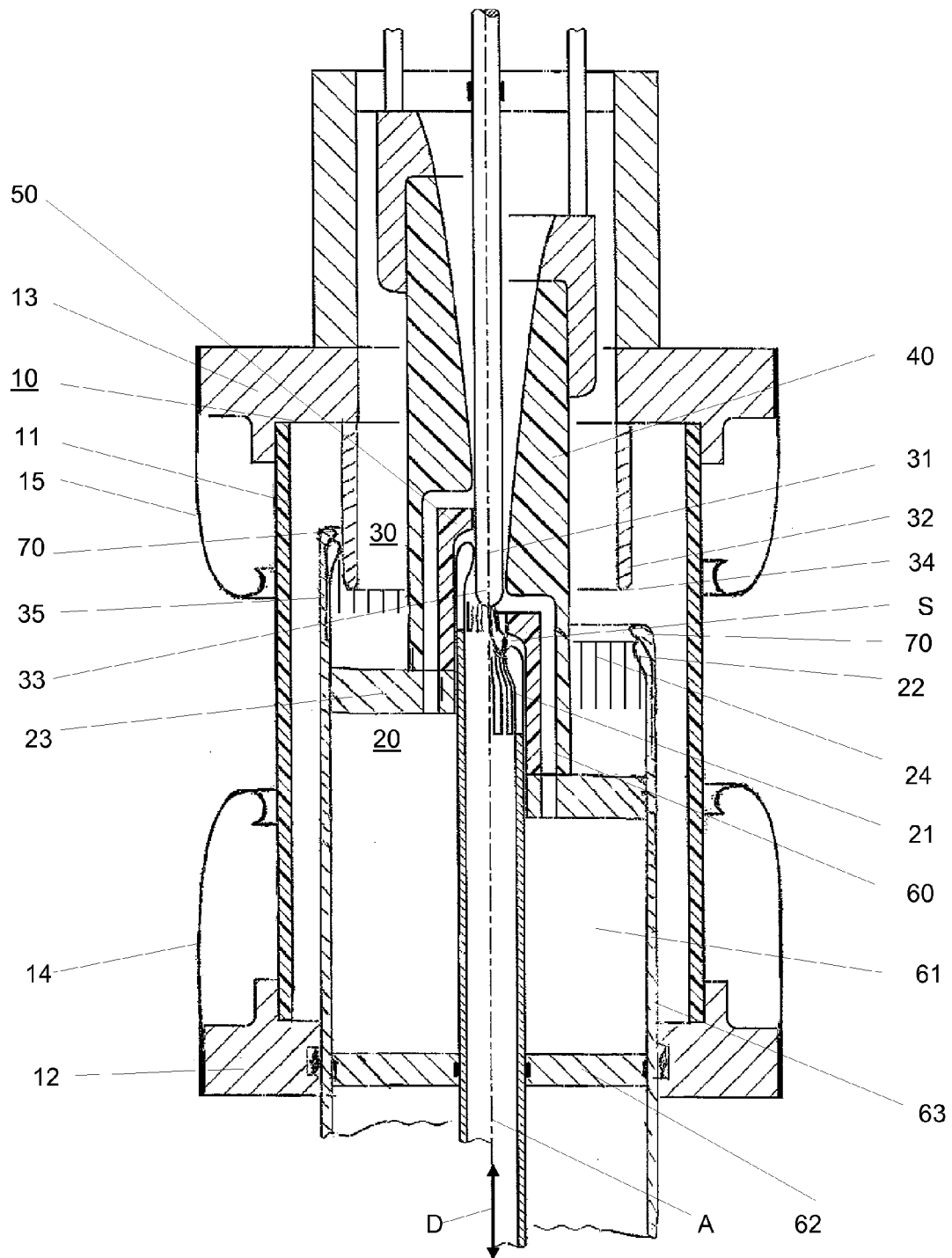


Fig.4



EUROPEAN SEARCH REPORT

Application Number
EP 10 15 7975

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 696 040 A1 (ABB MANAGEMENT AG [CH] ASEA BROWN BOVERI [CH]) 7 February 1996 (1996-02-07) * abstract * * column 3, paragraph 4 - column 4, paragraph 2 *	1-3, 12-14	INV. H01H33/24
A,D	US 6 177 643 B1 (MARIN HEINER [DE] ET AL) 23 January 2001 (2001-01-23) * the whole document *	1	
A	DE 32 37 146 A1 (BBC BROWN BOVERI & CIE [CH] ABB MANAGEMENT AG [CH]) 1 March 1984 (1984-03-01) * figures *	1,4-11	
X	DE 41 03 119 A1 (SIEMENS AG [DE]) 6 August 1992 (1992-08-06) * figure 1 *	15	
A	EP 0 744 759 A1 (SIEMENS AG [DE]) 27 November 1996 (1996-11-27) * column 2, line 23 - line 46 *	15	TECHNICAL FIELDS SEARCHED (IPC) H01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 February 2011	Examiner Socher, Günther
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 [P04C01]



Application Number

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 10 15 7975

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-14

Gas-insulated high-voltage circuit breaker having an insulating nozzle and an axially movable annular shield surrounding the insulating nozzle wherein a control device links the the movable annular shield with the movable contact.

2. claim: 15

Gas-insulated high-voltage circuit breaker having an insulating nozzle and an axially movable annular shield surrounding the insulating nozzle wherein the movable annular shield is part of the movable contact and the circuit breaker further comprises hollow stationary shields.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 7975

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-02-2011

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REFERENCES CITED IN THE DESCRIPTION

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