

(19)



(11)

EP 1 320 860 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
18.07.2007 Bulletin 2007/29

(51) Int Cl.:
H01H 33/36 (2006.01) H01H 3/28 (2006.01)

(21) Application number: **01961538.4**

(86) International application number:
PCT/SE2001/001819

(22) Date of filing: **27.08.2001**

(87) International publication number:
WO 2002/019360 (07.03.2002 Gazette 2002/10)

(54) **CIRCUIT BREAKER**

UNTERBRECHERSCHALTER

DISJONCTEUR

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

- **HERMANSSON, Lars**
S-723 55 Västerås (SE)
- **ROININEN, Tomas**
S-772 70 Saxdalen (SE)
- **VALDEMARSSON, Stefan**
S-531 98 Lioköping (SE)

(30) Priority: **28.08.2000 SE 0003030**

(43) Date of publication of application:
25.06.2003 Bulletin 2003/26

(74) Representative: **Dahlstrand, Björn**
ABB Group Services Center AB
Legal & Compliance/Intellectual Property
721 78 Västerås (SE)

(73) Proprietor: **ABB AB**
721 83 Västerås (SE)

(72) Inventors:
• **THURESSON, Per Olof**
S-772 40 Grängesberg (SE)

(56) References cited:
WO-A1-00/05735 WO-A1-00/36621
DE-A1- 3 224 165

EP 1 320 860 B1

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

Technical field

[0001] The present invention relates in a first aspect to a circuit breaker of the type described in the preamble to claim 1. The breaker is thus actuated by an electric motor. In second, third, fourth and fifth aspects the invention relates to an electric plant provided with such a circuit breaker, to the use of such a circuit breaker, to a method of disconnecting an electric current and to a method of manufacturing a circuit breaker, respectively.

[0002] Circuit breakers of this type are used in electric plants such as switchgear stations in order to disconnect the current when necessary. A circuit breaker shall be able to disconnect and connect normal load currents but, most importantly, it must be able to very rapidly break the short-circuiting currents that arise in the event of a fault in the system. The main components of a circuit breaker are breaker chamber and actuating means. Disconnection and connection of the current is effected by contacts in the breaker chamber, one of the contacts usually being stationary and the other movable. The movable contact is brought into contact with or disconnected from the stationary contact by means of the actuating means which comprises the motor and means connected thereto for transmitting movement. The breaker chamber may be of various types such as vacuum breaker, SF₆-circuit breaker or oil-minimum breaker. The circuit breakers in accordance with the invention is intended for medium and high voltage, i.e. from about 1 kV up to several hundred kV.

Background art

[0003] Traditionally the actuating means for a circuit breaker usually comprises Off and On springs having sufficient stored energy to perform the breaking and closing procedures. Tripping may occur automatically or upon manual operation. The function of the On spring is to close the breaker and place the Off spring under tension. The Off spring comes into operation upon breaking. The On spring is tensioned by an electric motor. However, a spring-actuated circuit breaker has a number of drawbacks.

[0004] To eliminate the drawbacks associated with the traditional spring-actuated breakers the use of an electric motor as drive means has been proposed instead. WO 00/105735 thus describes a circuit breaker, primarily for high-voltage applications, in which the movable contact is connected to an electric motor by a means for transmitting movement.

[0005] The breaker chamber, i.e. the space where the stationary and the movable contacts are brought into or out of contact with each other is hermetically sealed from the surroundings by a gas-tight housing, normally in the form of a pin insulator of porcelain, and contains a breaking medium, e.g. SF₆-gas. The sealed space also con-

tains the means for transmitting movement, which is connected to the movable contact to actuate the latter, the means for transmitting movement also being arranged in the porcelain, as described in WO 99/60591. The space comprising the breaker chamber and the space in which the actuating means is arranged are termed the apparatus chamber in the present application, and the housing surrounding the latter is termed the apparatus housing.

[0006] The actuating movement that is transmitted from the electric motor to the means for transmitting movement includes a movable mechanical element, such as a shaft, having to pass through a wall in towards the sealed apparatus chamber. This places great demands on the sealing at the shaft bushing. Since the apparatus chamber must be completely gas-tight some form of tightly fitting mechanical contact sealing is required. This entails considerable friction losses. Since the actuating movement when the breaker is switched off is extremely brief, in the order of 40-60 ms, the power requirement during actuation is relatively great. The greater the power required, the larger must the electric motor and the static current changer arranged between the motor and the current source supplying the current to the motor be dimensioned. The cost of these thus also increases. However, to provide a competitive circuit breaker driven by an electric motor it is important to limit the cost of these components.

[0007] DE 3224165 shows an arrangement to be already known in which the movable contact is driven by an electric motor. The motor is arranged on the inside and the outside of the gas-tight housing in which the movable contact of the breaker is arranged. In this case the rotor of the motor is arranged inside the housing and its stator on the outside of the housing. Such an embodiment results in an extremely special construction in which the whole unit must be designed and suited to this embodiment. This reduces the possibility of using standard components for the circuit breaker and its peripherals.

[0008] Another drawback with the motor described in DE 3224165 is that a wall exists between stator and rotor. The wall must be relatively thick to effectively withstand the pressure inside the housing and ensure that no gas diffuses out. The gap will therefore be large, thus considerably reducing the efficiency of the motor.

Description of the invention

[0009] Against this background the object of the invention is to reduce the power losses in a circuit breaker driven by an electric motor and to achieve greater security against gas leakage when solving the above-mentioned problems.

[0010] This object is achieved in accordance with the invention by a circuit breaker of the type described in the preamble of claim 1, having the special features defined in the characterizing part of the claim.

[0011] Thanks to the entire motor being arranged in

the same gas-tight housing that surrounds the contacts, the problem described above concerning sealing around the shaft that transmits the motor movement to the movable contact, and the risk of leakage, are eliminated. The only bushing that must be hermetically sealed is the electric cable supplying current to the motor. Since this does not move the seal is completely problem free and causes no power loss. The circuit breaker in accordance with the invention thus enables the power loss to be reduced or eliminated and the motor and converter to be made smaller. The above-mentioned problems related to previously known technology are thus solved.

[0012] In accordance with a preferred embodiment of the invention the first housing is made of insulating material and in accordance with another preferred embodiment of the invention the housing surrounding the motor is also made of insulating material. It is particularly advantageous for the apparatus housing and the second housing, i.e. the housing in which the motor is arranged, to be integrated with each other so that a common aggregate housing is formed. In practise this results in both the contacts, the means transmitting movement and the motor, can all be arranged in the porcelain of the pin insulator.

[0013] Although various types of electric motors can be used within the scope of the invention, in most cases a rotating electric motor would be the most appropriate alternative. This therefore constitutes yet another preferred embodiment of the circuit breaker in accordance with the invention. In this embodiment the means for transmitting movement comprises means for converting movement that convert rotary movement of the rotor to translation movement in the movable contact.

[0014] In accordance with yet another preferred embodiment, the circuit breaker of the invention comprises a plurality of breaker poles, preferably three, in which the means for transmitting movement belonging to each breaker pole is mechanically connected to the movable part of a motor common to all the breaker poles. The second chamber, i.e. the one in which the motor is arranged, thus communicates with the apparatus chamber of each breaker pole. This is an expedient application of the concept of the invention in the case of multi-pole breaking. The whole aggregate with all poles and their means for transmitting movement, and the motor, are thus housed in a common, sealed space.

[0015] The circuit breaker in accordance with the invention is particularly suitable for breaking high-voltage current. A breaker for such an application therefore constitutes a preferred embodiment of the invention. The advantages of the breaker are particularly interesting for voltages in the range of 72 to 420 kV.

[0016] The above preferred embodiments of the circuit breaker in accordance with the invention are defined in the claims dependent on claim 1.

[0017] An electric plant in accordance with a second aspect of the invention, uses of the circuit breaker in accordance with a third aspect, a method of breaking an

electric current in accordance with a fourth aspect, and a method for manufacturing a circuit breaker in accordance with a fifth aspect are defined in claims 6, 7, 8, 9 and 10, respectively.

5 **[0018]** The electric plant, the use, and the methods in accordance with the invention thus involve advantages equivalent to those explained with respect to the circuit breaker in accordance with the invention.

10 **[0019]** The invention will be described in more detail in the following detailed description of preferred embodiments thereof with reference to the accompanying drawings.

Brief description of the drawings

15

[0020]

Figure 1 illustrates schematically an electric circuit breaker.

20

Figure 2 is a longitudinal section through the actuating means and motor for a circuit breaker in accordance with a first embodiment of the invention.

25

Figure 3 is a longitudinal section through the actuating means and motor for a circuit breaker in accordance with a second embodiment of the invention.

30

Figure 4 is a longitudinal section through the actuating means and motor for a circuit breaker in accordance with a third embodiment of the invention.

35

Figure 5 illustrates an embodiment of the invention as applied to a three-pole circuit breaker.

40

Figure 6 is a diagram showing a part of a switchgear station in accordance with the invention.

45

Description of preferred embodiments

50

[0021] Figure 1 illustrates schematically the principle of an electric circuit breaker. This consists of a breaking chamber 1 and an actuating means 2 comprising an actuating rod 3. A stationary contact 4 and a movable contact 5 are arranged in the breaking chamber. Each of the contacts is electrically connected to a cable. Normally the contacts 4, 5 are in contact with each other and current is conducted from one cable to the other cable through the breaker. When the current is to be disconnected, for some reason, e.g. because of a fault, the mobile contact 5 rapidly draws short-circuiting currents away from the stationary contact 4. An electric arc then initially arises between the contacts and is extinguished soon after the contacts have moved apart. When the current is then to be connected, the movable contact 5 is once more moved into contact with the stationary contact 4. Initiation of disconnection and connection may be performed manually or automatically. Switching the breaker on and off is effected via the actuating rod 3 which is joined to the movable contact and to the motor 6. This

55

basic structure of a circuit breaker is common to various types and may, of course, have various appearances. A larger number of components normally found in a breaker have been omitted in the figure in order to explain the principle of its operation.

[0022] The breaking chamber 1 is hermetically sealed from the surroundings by means of a housing enclosing the chamber. The invention is shown as applied to an SF₆-circuit breaker and the breaking chamber 1 is thus filled with SF₆ gas.

[0023] Figure 2 illustrates a first example of the actuating means 2 for a circuit breaker having a basic structure similar to that described with reference to Figure 1. The actuating means 2 comprises an electric motor 6 surrounded by a cover 7. The motor is suitably a three-phase permanent-magnet alternating-current motor. One end of the cover is secured to a mounting plate 8, suitably supported by a stand, by means of attachment bolts through holes in the plate 8. A hollow pillar 9 of insulating material, such as porcelain or plastic material, extends upwards in the figure from the side opposite to the motor. The insulation pillar 9 is provided externally with flanges 10 to provide an extended creepage distance. The actuating rod 3 is arranged inside the insulation pillar. The breaking chamber is also arranged in the upper end of the insulation pillar, not shown, and its movable contact is rigidly joined to the actuating rod 3. The actuating rod 3, insulation pillar 9 and motor are all coaxial with each other. The insulation pillar surrounds a space 31 enclosing the means for transmitting movement 3, 17 which transmits movement from the motor 6 to the movable contact 5 and which also comprises the actual breaking chamber 1. SF₆ gas is thus present in this chamber 31, termed the apparatus chamber in the present application.

[0024] A conversion mechanism is arranged for converting rotary movement of the rotor 13 of the motor to translation movement of the actuating rod 3 in order to open or close the breaker as described with reference to Figure 1. The conversion mechanism will be described in more detail in the following.

[0025] The rotor 13 is journaled in the motor housing 11 by means of a bearing 14, 15 at each end of the rotor. The stator 12 of the motor is secured to the motor housing 11 and the motor housing is secured to the mounting plate 8. The rotor 13 has a central boring 30 extending axially through most of its length. The mounting plate 8 has an opening coaxial with the motor shaft, in which a nut 16 is journaled for rotation in a double-operating angular contact ball bearing 18. The outer ring 19 of the bearing 18 is secured to the mounting plate 8 by means of bolts arranged in borings 20 through a flange on the outer ring. The inner ring 21 of the bearing 18 is also joined to the rotor 13 and unable to turn in relation thereto.

[0026] A screw 17 extends through the nut, i.e. a rod provided with screw threading. The screw threads of the nut 16 and the screw 17 are in engagement with each other. Relative movement between them thus causes the

screw to be displaced axially in relation to the nut. On its end facing away from the motor, i.e. the upper end in the figure, the screw 17 is connected to the actuating rod 3 of the breaker since the upper end of the screw extends in a boring 23 in the lower end 24 of the actuating rod 3. The connection is secured by means of a pin 25 extending diametrically through the ends of the screw and the operating rod.

[0027] A guiding sleeve 26 surrounding the screw 17 extends from the mounting plate 8. The guiding sleeve is provided with axially running guides 27 arranged diametrically opposite each other. The pin 25 extends out through each guide 27 and is provided at each end with a locking washer 28. The width of the guides 27 corresponds to the diameter of the pin 25. The screw 17 is thus connected to the guiding sleeve 26 and unable to turn in relation thereto. The guiding sleeve 26 is also prevented from turning since it is secured to the mounting plate 8 by means of bolts through the borings 29. The guiding sleeve 26 has an inner diameter such that the actuating rod 3 can be inserted therein with little clearance.

[0028] When, thus, the nut 16 is axially fixed by its bearing and the screw 17 is secured against turning by means of the arrangement described above, a rotary movement of the nut will cause the screw to be displaced axially.

[0029] Figure 2 shows the actuating part of the circuit breaker when in its normal, closed position.

[0030] When the circuit breaker is to be activated in order to disconnect the current, the motor 6 is started so that its rotor 13 is caused to rotate clockwise seen from above in the figure. This forces downward displacement of the screw so that the movable contact 5 (see Figure 1) is drawn away from the stationary contact. The length of the central boring 30 is such as to allow sufficient displacement of the screw to complete disconnection. During the breaking process the lower part of the actuating rod 3 will slide downwards inside the guiding sleeve 26.

[0031] When disconnection is complete the motor is stopped and in this position the lower end of the screw 17 is close to the bottom of the boring 30. The pin 26 is then situated at the lower end of the guides 27. When the breaker is then to be restored, the motor is started with opposite rotation so that the screw 17 with the actuating rod is displaced upwardly until the movable contact 5 once more encounters the stationary contact, whereupon the parts of the arrangement assume the position shown in Figure 2.

[0032] The breaking process must occur extremely quickly. It is therefore necessary to have a high speed of rotation for the motor since the pitch of the screw must not be too great. Considerable acceleration and deceleration forces therefore also occur. It is therefore important that the mass of those components which are subjected to forces of inertia is as little as possible. The actuating rod 3 is therefore hollow.

[0033] The screw has a number of thread entries. This permits large pitch of the threads without them being

overloaded. Thus, with a pitch of 3 mm/turn a translation movement of 3 mm for each revolution of the motor is achieved for the breaker. With eight entries and correspondingly greater pitch the translation movement will be 24 mm/turn and with 12 entries it will be 36 mm/turn. With a stroke length of 120 mm for the breaking movement, 3.33 revolutions of the motor are required for the breaking movement in the case of 12 thread entries.

[0034] The cover 7 surrounding the motor 6 constitutes a second gas-tight housing, thus forming a second gas-tight chamber 32 surrounding the motor 6. The cable 33 supplying the motor with current upon operation is passed through the cover 7 in gas-tight manner. Since the chamber 32 surrounding the motor is also gas-tight, no seal is required where the movement-transmitting means passes through the mounting plate 8. Power losses caused by sealing friction are thus eliminated.

[0035] The movement-transmitting means shown in the figure is only intended as an example. The screw-nut arrangement may be vice versa, for instance, the screw being joined to the motor and the nut to the actuating rod 3 of the movable contact 5. This has the advantage that the moment of inertia to be accelerated by the motor will be less than in the embodiment illustrated. Many other mechanisms for converting the rotary movement of the motor to translation movement of the movable contact are naturally feasible within the scope of the invention. The invention is also applicable to a linear motor, in which case no conversion of the movement is necessary.

[0036] The cable 33 supplying the motor with current is connected via a converter to a current source (not shown), such as capacitors, batteries or a power net, or a combination thereof. However, these components do not form any central aspect of the present application and are therefore not shown in the drawings or described in further detail.

[0037] Figure 3 shows a second embodiment of the breaker claimed. The design in Figure 3 differs from that in Figure 2 only in that the cover 7 which surrounds the motor is replaced with enclosure of only the rotor 13 of the motor, but is otherwise the same. In this embodiment the actual motor housing 11 is hermetically sealed to the mounting plate 8 by means of a connection rim 34. At the opposite end of the motor 6 a lid 35 is sealingly secured to the motor housing 11. The rotor 13 will therefore be sealed inside a chamber formed by the mounting plate 8 connection rim 34, motor housing 11 and lid 35. No sealing out to the apparatus chamber 31 exists, as described with reference to the embodiment shown in Figure 2. The cable 33 supplying the motor with current is connected to a current source (not shown).

[0038] Figure 4 shows a third embodiment of the invention. In this embodiment the electric motor has been moved up inside the insulation pillar 9. The insulation pillar thus constitutes an aggregate housing surrounding the space 31 which is housed in the whole aggregate comprising contacts, actuating means and motor. To maintain the requisite insulation distance the insulation

pillar 9 must be extended by a distance corresponding to the length of the motor.

[0039] Figure 5 illustrates the invention as applied in a three-pole circuit breaker where the three breaker poles 101 are intended to be connected one to each phase of a three-phase transmission or distribution network. Each breaker pole 101 is filled with a breaker medium in the form of SF₆ gas and comprises a pin insulator 102 supporting a breaking chamber isolator 103. A stationary contact 104 and a movable contact 106 are provided in each breaking chamber isolator 103. The stationary contact 104 is connected to the electric network via a first connection flange 105. The movable contact 106 is also connected to the electric network, via a sliding contact 109 and a second connection flange 107. The breaker poles 101 are mounted on a hollow beam 108 so that the breaking medium can flow freely between the beam 108 and each breaker pole 101. At each end of the beam 108, respectively, is a first end piece 110 and a second end piece 11, with tight sealing. The beam 108, end pieces 110, 111 and the three poles 101 thus constitute a common enclosure for all the breaker poles that surrounds a volume 112 filled with breaking medium.

[0040] The movable contacts 106 are connected mechanically via a mechanical system to a motor 113 arranged on the short side of the beam 108. The motor 113 drives all three breaker poles 101 and influences a shaft 114 with a turning force. Besides the shaft 114, the mechanical system also comprises a coupling 115 for each breaker pole and an actuating rod 116. The shaft 114 runs inside the beam 108 in the longitudinal direction of the beam 108 and is there rotatably journaled in bearing brackets 117. In each breaker pole 101 the upper end of the actuating rod 116 is arranged at the movable contact 106. At its lower end the rod 116 is arranged at the coupling 115 that converts a rotary movement of the shaft 114 to a translation movement of the rod 116. The majority of the mechanical system is thus located inside the enclosure and is thus protected from external influence, both mechanical (impact, etc.) and chemical (corrosion).

[0041] The motor 113 is arranged in a space 119 which is hermetically sealed to the surroundings by a housing 120. The shaft 114 that is joined to the rotor of the motor 113 extends without sealing between the inner space 112 of the beam and the outer space 119 in which the motor 113 is arranged. The spaces 112 and 119 thus communicate with each other.

[0042] Figure 6 shows an electric plant which includes part of an electrical switchgear station. An incoming cable 200 is connected to a busbar 202 via a transformer 206 and a first breaker 201. User cables 203 run from the busbar to respective loads 204 via respective breakers 205. Each of the breakers 201 and 205 is constructed in accordance with the circuit breaker according to the invention.

Claims

1. A circuit breaker, preferably for medium and high voltage, comprising at least one movable contact (5; 106) and one means (16, 17; 114, 116) for transmitting movement which is connected to the movable contact (5; 106), said contact and said means for transmitting movement being arranged in a gas-tight chamber (31; 112) surrounded by a gas-tight housing (9; 102), and said breaker also comprising an electric motor (6; 113) joined to the means for transmitting movement (16, 17; 114, 116), **characterized in that** the electric motor is entirely enclosed in said gas-tight housing.
2. A circuit breaker as claimed in claim 1, **characterized in that** the housing (9; 102) is at least partially made of insulating material.
3. A circuit breaker as claimed in claim 1 or claim 2, **characterized in that** the motor (6; 113) is a rotating electric motor having a rotor (13) connected to the means for transmitting movement (16, 17; 114, 116) and **in that** the means for transmitting movement comprises means (16, 17; 115) for converting rotary movement of the rotor 13 to translation movement in the movable contact (5; 106).
4. A circuit breaker as claimed in any one of claims 1-3, **characterized in that** the breaker comprises a plurality of breaker poles (101), preferably three breaker poles (101), and **in that** the means for transmitting movement (114, 116) belonging to each breaker pole is mechanically connected to a motor (113) common to all the breaker poles.
5. A circuit breaker as claimed in any one of claims 1-4, **characterized in that** the breaker is arranged for breaking electric current in the high-voltage area, preferably in the area 72 to 420 kV.
6. An electric plant (200-205) comprising at least one electric circuit breaker (201, 205), **characterized in that** at least one of the electric circuit breakers (201, 205) is of the type defined in any one of claims 1-5.
7. The use of a circuit breaker as claimed in any one of claims 1-5 for breaking electric current in a transmission network.
8. The use of a circuit breaker as claimed in any one of claims 1-5 for breaking electric current in a distribution network.
9. A method for breaking electric current, **characterized in that** the current is broken by means of a circuit breaker as claimed in any one of claims 1-5.

10. A method of manufacturing a circuit breaker as claimed in any one of claims 1-5, **characterized by** arranging the motor inside said gas-tight housing.

Patentansprüche

1. Unterbrecherschalter, vorzugsweise für Mittel- und Hochspannung, umfassend mindestens einen beweglichen Kontakt (5; 106) und ein Mittel (16, 17; 114, 116) zum Übertragen der Bewegung, welches mit dem beweglichen Kontakt (5; 106) verbunden ist, wobei der Kontakt und die Mittel zum Übertragen der Bewegung in einer gasdichten Kammer (31; 112) angeordnet sind, die von einem gasdichten Gehäuse (9; 102) umgeben ist, und wobei der Unterbrecher auch einen elektrischen Motor (6; 113) umfasst, der mit dem Mittel zum Übertragen der Bewegung (16, 17; 114, 116) verbunden ist, **gekennzeichnet dadurch, dass** der elektrische Motor vollkommen in dem gasdichten Gehäuse eingeschlossen ist.
2. Unterbrecherschalter, wie in Anspruch 1 beansprucht, **gekennzeichnet dadurch, dass** das Gehäuse (9; 102) zumindest teilweise aus isolierendem Material gemacht ist.
3. Unterbrecherschalter wie in Anspruch 1 oder 2 beansprucht, **gekennzeichnet dadurch, dass** der Motor (6; 113) ein rotierender Elektromotor ist, aufweisend einen Rotor (13), der mit dem Mittel zum Übertragen der Bewegung (16, 17; 114, 116) verbunden ist, und dadurch, dass das Mittel zum Übertragen der Bewegung Mittel (16, 17; 115), zum Wandeln der Rotationsbewegung des Rotors (13), in Translationsbewegung in dem beweglichen Kontakt (5; 106) einschließt.
4. Unterbrecherschalter, wie in irgendeinem der Ansprüche 1-3 beansprucht, **gekennzeichnet dadurch, dass** der Unterbrecher eine Vielzahl von Unterbrecherpolen (101), vorzugsweise drei Unterbrecherpole (101), einschließt, und dadurch dass das Mittel zum Übertragen der Bewegung (114, 116), das zu jedem Unterbrecherpol gehört, mechanisch mit einem Motor (113) verbunden ist, der allen Unterbrecherpolen gemeinsam ist.
5. Unterbrecherschalter wie in irgendeinem der Ansprüche 1-4 beansprucht, **gekennzeichnet dadurch, dass** der Unterbrecher angeordnet ist, um elektrischen Strom in dem Hochspannungsbereich, vorzugsweise in dem Bereich von 72 bis 420 kV, zu unterbrechen.
6. Elektrische Anlage (200-205) umfassend mindestens einen elektrischen Unterbrecherschalter (201, 205), **gekennzeichnet dadurch, dass** mindestens

einer der Unterbrecherschalter (201, 205) von dem Typ ist, der in irgendeinem der Ansprüche 1-5 definiert wurde.

7. Verwendung eines Unterbrecherschalters, wie in irgendeinem der Ansprüche 1-5 beansprucht, zum Unterbrechen von elektrischem Strom in einem Übertragungsnetzwerk. 5
8. Verwendung eines Unterbrecherschalters, wie in irgendeinem der Ansprüche 1-5 beansprucht, zum Unterbrechen von elektrischem Strom in einem Übertragungsnetzwerk. 10
9. Verfahren zum Unterbrechen von elektrischem Strom, **gekennzeichnet dadurch, dass** der Strom mittels eines Unterbrecherschalters, wie in irgendeinem der Ansprüche 1-5 beansprucht, unterbrochen wird. 15
10. Verfahren zur Herstellung eines Unterbrecherschalters, wie in irgendeinem der Ansprüche 1-5 beansprucht, **gekennzeichnet durch** Anordnen des Motors innerhalb des gasdichten Gehäuses. 20

Revendications

1. Disjoncteur de circuit, de préférence pour moyenne et haute tension, comprenant au moins un contact mobile (5 ; 106) et des moyens (16, 17 ; 114, 116) de transmission de mouvement qui sont reliés au contact mobile (5 ; 106), le contact et les moyens de transmission de mouvement étant installés dans une chambre étanche aux gaz (31 ; 112) entourée par une enveloppe étanche aux gaz (9 ; 102), et le disjoncteur comprenant également un moteur électrique (6 ; 113) réuni aux moyens de transmission de mouvement (16, 17 ; 114, 116), **caractérisé en ce que** le moteur électrique est entièrement enfermé dans l'enveloppe étanche aux gaz. 25
2. Disjoncteur de circuit selon la revendication 1, **caractérisé en ce que** l'enveloppe (9 ; 102) est au moins partiellement constituée d'un matériau isolant. 30
3. Disjoncteur de circuit selon la revendication 1 ou la revendication 2, **caractérisé en ce que** le moteur (6 ; 113) est un moteur électrique rotatif ayant un rotor (13) couplé aux moyens de transmission de mouvement (16, 17 ; 114, 116) et **en ce que** les moyens de transmission de mouvement comprennent des moyens (16, 17 ; 115) pour convertir le mouvement de rotation du rotor (13) en un mouvement de translation du contact mobile (5 ; 106). 35
4. Disjoncteur de circuit selon l'une quelconque des re- 40

vendications 1 à 3, **caractérisé en ce que** le disjoncteur comprend une pluralité de pôles de disjoncteur (101), de préférence trois pôles de disjoncteur (101), et **en ce que** les moyens de transmission de mouvement (114, 116) appartenant à chaque pôle de disjoncteur sont connectés mécaniquement à un moteur (113) commun à tous les pôles du disjoncteur. 45

5. Disjoncteur de circuit selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le disjoncteur est conçu pour couper le courant électrique dans la plage des hautes tensions, de préférence dans la plage de 72 à 420 kV. 50
6. Installation électrique (200 - 205) comprenant au moins un disjoncteur de circuit électrique (201, 205), **caractérisé en ce qu'**au moins l'un des disjoncteurs de circuits électriques (201, 205) est du type défini dans l'une quelconque des revendications 1 à 5. 55
7. Utilisation d'un disjoncteur de circuit selon l'une quelconque des revendications 1 à 5 pour couper le courant électrique dans un réseau de transmission. 60
8. Utilisation d'un disjoncteur de circuit selon l'une quelconque des revendications 1 à 5 pour couper le courant électrique dans un réseau de distribution. 65
9. Procédé de coupure de courant électrique, **caractérisé en ce que** le courant est coupé au moyen d'un disjoncteur de circuit selon l'une quelconque des revendications 1 à 5. 70
10. Procédé de fabrication d'un disjoncteur de circuit selon l'une quelconque des revendications 1 à 5, **caractérisé par le fait que** l'on met le moteur à l'intérieur de l'enveloppe étanche aux gaz. 75

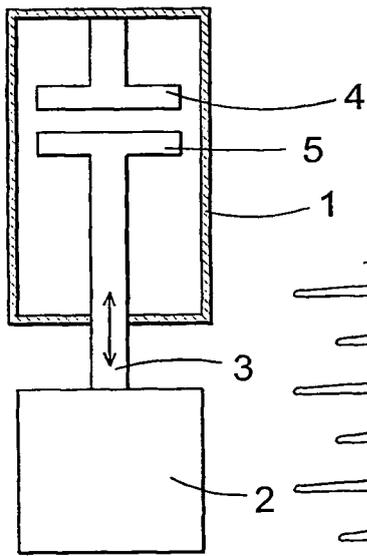


Fig. 1

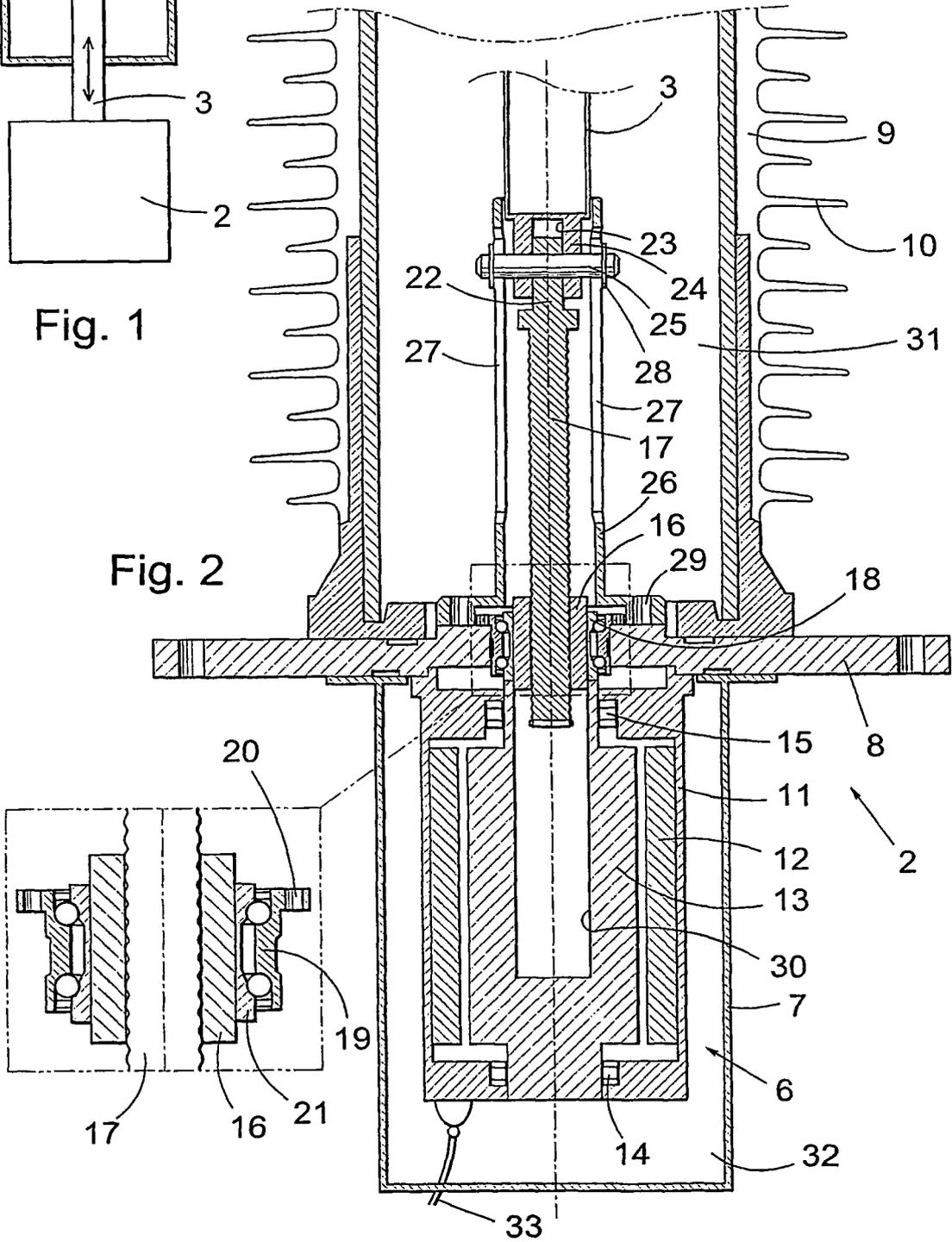
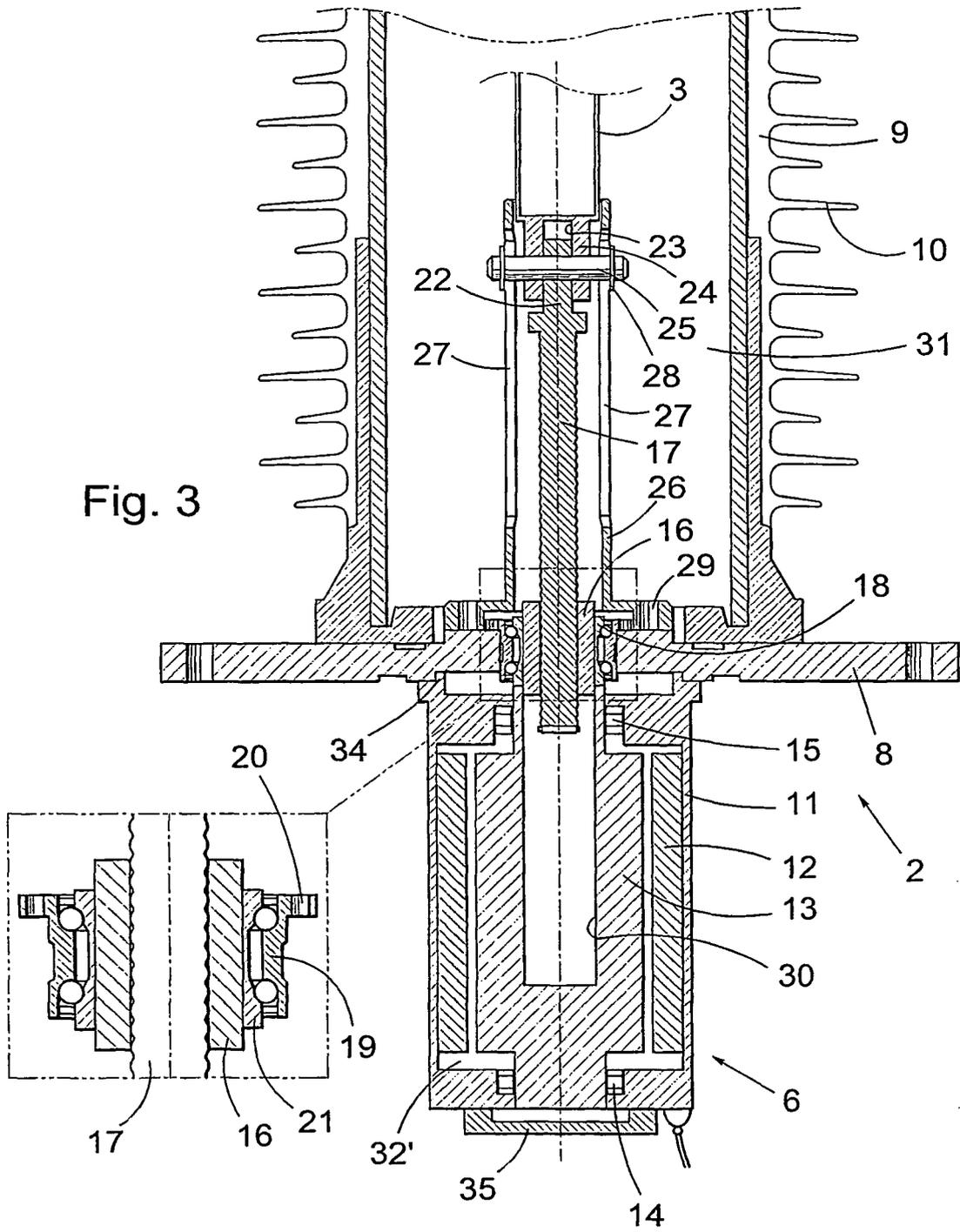
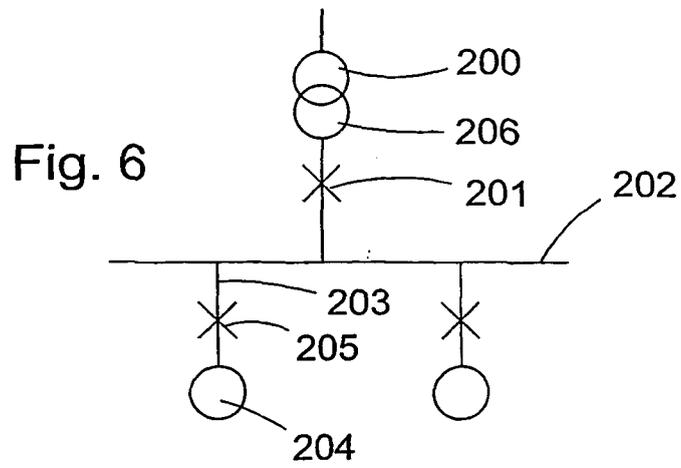
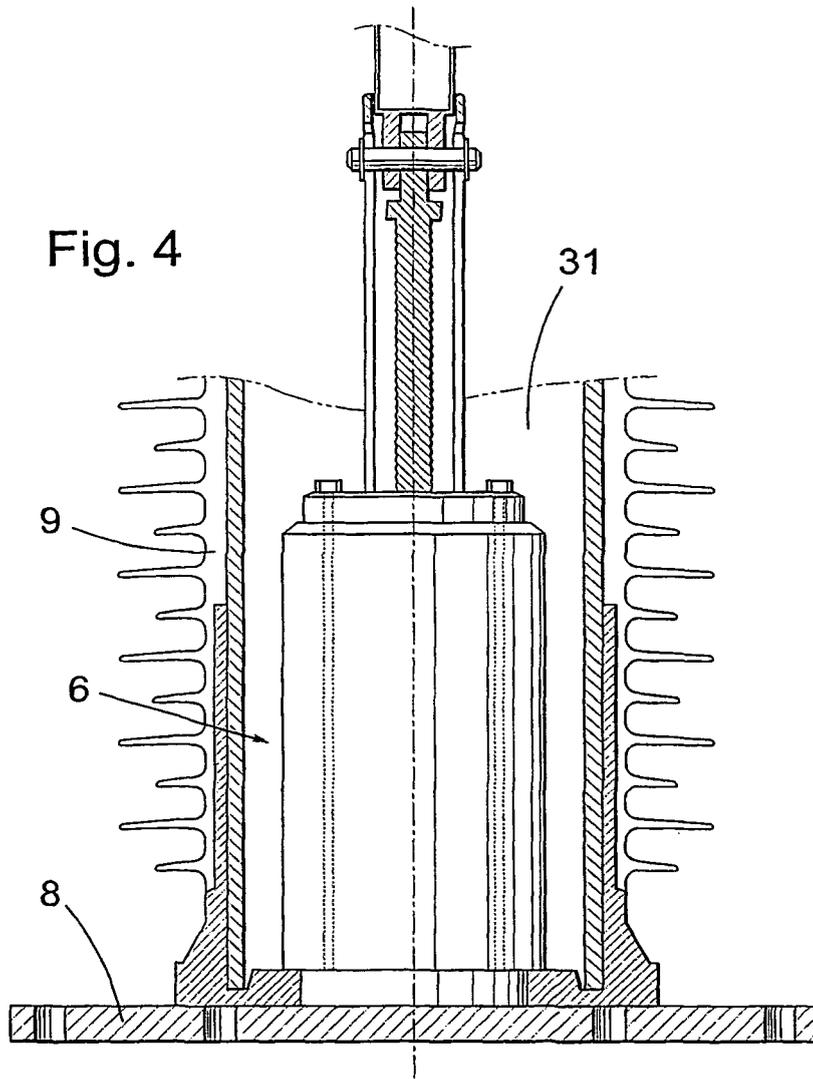


Fig. 2





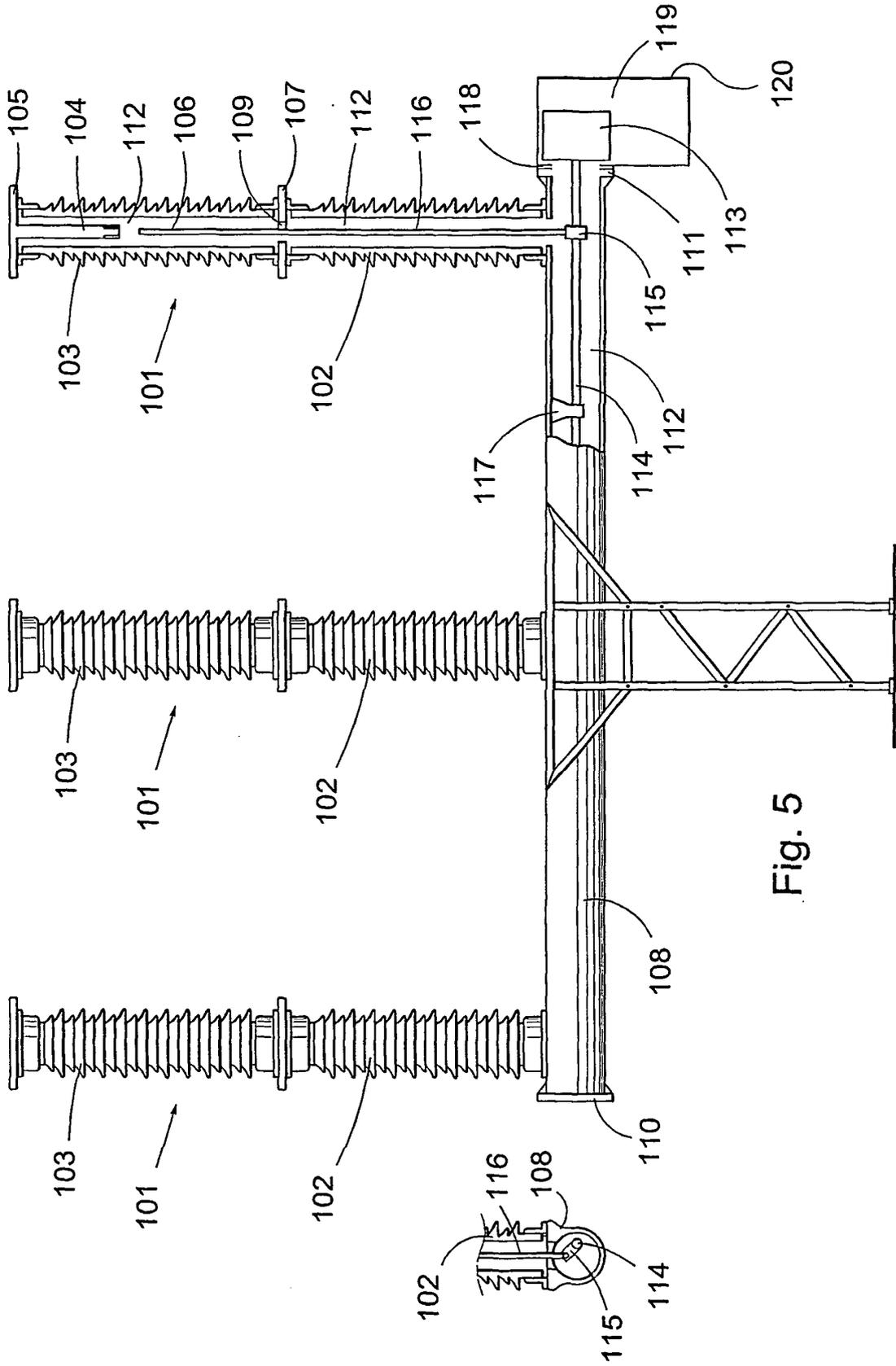


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 00105735 A [0004]
- WO 9960591 A [0005]
- DE 3224165 [0007] [0008]