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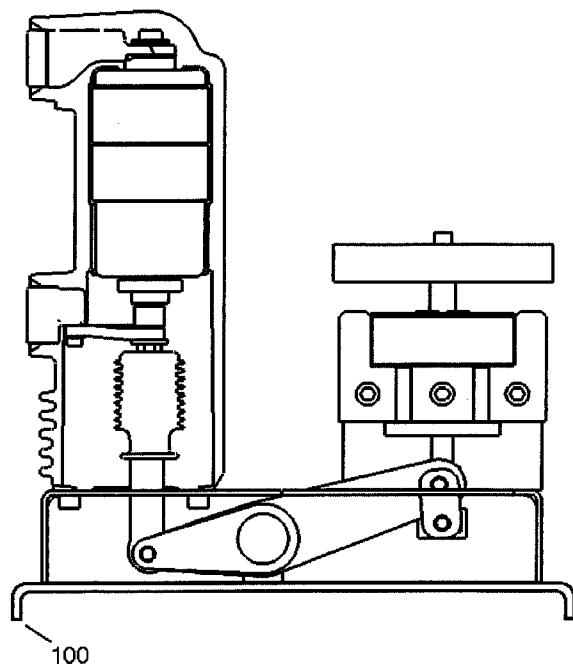
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[Continued on next page]

(54) **Title:** MEDIUM VOLTAGE CIRCUIT BREAKER ARRANGEMENT



**Fig. 7**

(57) **Abstract:** Medium voltage circuit breaker arrangement comprising at least one pole part housing (1a - 1c) for accommodating a pair of coaxially arranged electrical contacts (9a, 9b), wherein - one electrical contact (9b) of the pair of electrical contacts (9a,9b) is axially movable via a jackshaft arrangement (10) which is accommodated in a recasted sheet metal housing (4), and driven by an actuator unit (2), wherein - the sheet metal housing (4) is only designed to form a suspension construction for the at least one pole part housing (1a - 1c) and the jackshaft arrangement (10) and the corresponding actuator unit (2) forming a module, wherein - an additional housing part (11; 13; 15) is provided for covering at least the actuator unit (2) of the module in order to define the outer geometrical dimensions of the circuit breaker arrangement.

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## Medium Voltage Circuit Breaker Arrangement

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### Field of the invention

The present invention relates to a medium voltage circuit breaker arrangement comprising at least one pole part housing for accommodating a pair of coaxially arranged electrical contacts, wherein one electrical contact of the pair of electrical contacts is axially moveable via a jackshaft arrangement, which is accommodated in a recasted sheet metal housing and is driven by an actuator unit.

Circuit breakers of that kind are widely used for medium voltage applications in the range between 1 and 72 kV of a high current level for interruption of electrical circuitries of power grids.

These special circuit breakers interrupt the current by creating and extinguishing the arc in a closed vacuum chamber. Modern vacuum circuit breakers attend to have a longer life expectancy than conventional air circuit breakers. Nevertheless, the present invention is not only applicable to vacuum circuit breakers but also to air circuit breakers or modern SF6 circuit breakers.

Generally, a medium voltage circuit breaker consists mainly of one or several pole parts, at least one actuator unit and a gear and/or shaft assembly for transmission of the operation force from the actuator unit to the at least one pole part. The number of the pole parts corresponds to the number of phases of the power grid. All these parts

are usually accommodated in a common housing. The housing is an integral part of the circuit breaker which cannot be assembled without the housing.

5 The article "The magnetically actuated circuit breaker reality" (ABB wide paper, ABB power T & D Company, 1999, pages 1-8) discloses such a circuit breaker with a common housing. The same housing is used for accommodating an actuator unit together with a jackshaft arrangement coupled thereon. Separate pole parts have own housings which are usually consist of moulded plastics insulating material. The pole part housings are detachably connected on the common housing by screws. The  
10 common housing for the actuator unit and the jackshaft arrangement consists of a recasted sheet metal housing. The common housing realizes a mechanical connection between the actuator unit and the pole parts which is relatively rigid in order to avoid loss of drive energy. The common housing defines the outer dimensions of the circuit breaker arrangement in order to ensure an attachment interface in a switch board.  
15 Therefore, the common housing is normally made of sheet metals. The material is relatively thick to achieve the desired rigidity. In case the common housing of a circuit breaker is made of plastic material, it will be difficult to obtain the required rigidity without additional steel parts. Different types of switch boards and applications often require dedicated types of circuit breakers that are different from the very beginning of  
20 their production, as they are basing on different housings. This makes an automatic assembly more difficult. A further disadvantage of the state of the art is that a high variance of large and heavy housings represents a logistic problem, especially considering world-wide sourcing.

25 The patent document EP 0 898 780 B1 discloses a magnetically actuated circuit breaker for medium voltage applications. A single electromagnetic actuator drives a common jackshaft assembly. The jackshaft assembly couples the actuator force to the moving electrical contacts of each pole part containing vacuum interrupter inserts of a pair of electrical contact parts switchable through insulated push rods.

30

Each pole part has an own housing which is screwed on a mounting surface of a housing which only contains the jackshaft assembly. The housing of the jackshaft assembly consists of a recasted sheet metal forming a box which is underside opened

in order to gain access to the jackshaft assembly. However, the housing of the actuator unit is not connected to the housing of the jackshaft assembly.

5 It is an object of the present invention to provide a housing arrangement for a medium voltage circuit breaker which is easy to manufacture and allows an easy mounting of the several parts at one hand and, moreover, which defines a geometrical mounting interface for easily adapting to various different applications.

### 10 Summary of the invention

According to the invention a special sheet metal housing is designed for a suspension construction for the at least one pole part housing and the jackshaft arrangement and the corresponding actuator unit in order to form an universal module, wherein an  
15 additional housing part is provided for covering at least the actuator unit of the module.

Both housings in combination define the outer geometrical dimensions of the circuit breaker arrangement. The nucleus of the present invention is the separation of the suspension or supporting function at one hand and the housing function for defining the  
20 outer geometrical dimensions at the other hand. The mechanical connection of the at least one pole part and the actuator unit shall be realized by a very compact and rigid housing part made of sheet metal. This connection, together with the at least one pole part and the actuator unit with its jackshaft arrangement for transmission, forms a kind of core circuit breaker arrangement. The outer dimensions can then be realized by an  
25 add-on part that can be made relatively light and thin, e. g. from plastics material. This add-on part can also provide the area for further components of the circuit breaker arrangement, e. g. energy storage means, control or auxiliary switching means.

A advantageous embodiment is given by that, that the circuit breaker has a base  
30 frame, connected to earth contact, pole parts, mechanical coupling means and an actuator, and that the base frame is coupled with mechanical adaption interface, in that way, that the base frame can be adapted to three different uses, that are  
- Air-insulated switchgear

- Gas- insulated switchgear
- Outdoor switchgear.

By this feature it is possible to manufacture a basic switchgear for different application, which is adaptable mechanically by changing the mechanical interface.

5 So one common unit can be manufactured for different uses.

According to another additional aspect of the invention, the separate housing part could be connected to the sheet metal housing via clip connection means. This inter housing connection does not require a strong attachment since the additional housing part  
10 mainly serves as a cover.

Preferably, the sheet metal housing consists of a bended U-shaped sheet metal part with separate side cover parts for covering the open sides of the U-shaped sheet metal in order to form a box-shaped housing arrangement containing the jackshaft  
15 arrangement. Both side cover parts should consist of the same sheet material than the U-shaped sheet metal part in order to allow a permanent joint by bracing or welding.

In a preferred embodiment the housing arrangement according to the present invention on a mounting surface of the U-shaped sheet metal part a pair of L-shaped holding  
20 plates are arranged. The L-shaped holding plates provide a detachable connection to the common actuator unit and they are adjacent arranged to an intermediate opening for coupling the driveshaft of the actuator unit to the jackshaft arrangement for transmission the operating force to the at least pole part. The common actuator unit can be realized as single-coil or a double-coil electromagnetic actuator which as small  
25 geometrical dimensions.

Preferably, on said mounting surface of the U-shaped sheet metal part three pole part housings are connected by screw connecting means in order to provide a three-pole circuit breaker. Of course, different numbers of pole parts are possible in view of the  
30 present invention.

The foregoing and other aspects of the invention will become apparent following the detailed description of the invention when considered in conjunction with the enclosed drawings.

5

Brief description of the drawings

Figure 1 is a perspective view to a medium voltage circuit breaker arrangement comprising three pole parts,

10

Figure 2 is a longitudinal section through the circuit breaker according to Figure 1,

Figure 3 is another perspective view to the circuit breaker according to Figure 1, completed with an additional housing part,

15

Figure 4 is a schematic longitudinal section view to a first preferred application of the circuit breaker arrangement, and

Figure 5 is a schematic longitudinal section view to a second preferred application of the circuit breaker arrangement.

20

Figure 6 is a perspective view to a medium voltage circuit breaker arrangement where the drive unit is mechanical, spring-driven actuator.

25

Figure 7 mechanical interface

Detailed description of the drawings

30

According to Figure 1 a medium voltage circuit breaker arrangement comprises three pole part housings 1a-1c for accommodating – not shown – electrical switching means which are operated by a common actuator unit 2. The actuator unit 2 is realized as a

single-coil electromagnetic actuator. The pole part housings 1a-1c as well as the actuator unit 2 are mounted on a mounting surface 3 of a sheet metal housing 4.

5 The sheet metal housing 4 is designed to form a support construction for the pole part housings 1a-1c which are directly attached to the mounting surface 3 by screw means. Furthermore, the sheet metal housing accommodates the – not shown – jackshaft arrangement for the actuator unit 2 which is also detachably connected to the sheet metal housing 4 by screw means. The three pole part housings 1a-1c of each pole part and the common drive unit 2 are mounted on the mounting surface 3 of a U-shaped  
10 sheet metal part 5, realizing a rigid body of the circuit breaker arrangement.

In order to form a box-shaped housing for accommodating the – not shown – jackshaft arrangement the U-shaped sheet metal part 5 comprises two opposite side cover parts 6, which consist of the same material than the U-shaped metal part 5 in order to attach  
15 them one to another by welding. On the mounting surface 3 of the U-shaped sheet metal part 5 a pair of L-shaped holding plates 7a and 7b are arranged adjacent to an intermediate opening 8 for coupling the actuator unit 2 to the – not shown – inner jackshaft arrangement.

20 According to Figure 2 the circuit breaker arrangement comprises the pole part housing 1 for accommodating a pair of coaxially arranged electrical contacts 9a and 9b, wherein the lower electrical contact 9b is axially moveable via a jackshaft arrangement 10. The jackshaft arrangement 10 is accommodated in a recasted sheet metal housing 4. The jackshaft arrangement 10 is driven by the actuator unit 2 and it is pivot-mounted inside  
25 the sheet metal housing 4, which form a box-shaped housing around the jackshaft arrangement 10. In contrast, the pole part housings 1 (exemplary) are mounted on the top of the sheet metal housing 4, realizing the rigid body of the circuit breaker arrangement. The jackshaft arrangement 10 inside the sheet metal housing 4 enables the transfer of drive force from the actuator unit 2 to the electrical poles inside the  
30 respective pole part housings 1.

According to Figure 3 the sheet metal housing 4 which is designed as a kind of suspension construction for the pole part housings 1a-1c is completed with an

additional housing part 11. The additional housing part 11 covers the (not shown) actuator unit 2 and defines the outer geometrical dimensions of the circuit breaker arrangement. Said additional housing part 11 is connected to the sheet metal housing 4 via clip connection means and consist of a relatively thin sheet metal material. Thus, the additional housing part 11 provides an additional volume for accommodating further attaching parts 12 at the circuit breaker arrangement.

Figure 5 shows a possible application of the circuit breaker arrangement as described above. An actuator unit 2 which is designed as a single coil magnetic actuator is installed inside a circuit breaker compartment 13. The sheet metal housing 4 together with the pole part housings 1 (exemplary), the jackshaft arrangement 10 and the corresponding actuator unit 2 form a module. The module is installed in a gas insulated switch board. Thus, the module that is usually intended for an air-insulated circuit breaker as shown in Figure 3 can also be used inside the circuit breaker compartment 13 of a gas-insulated medium voltage switch board. In that case the compartment 13 has to be classified as the additional housing part in view of the present invention. The main advantage is again standardisation as the state of the art foresees quite different circuit breakers for air- and gas insulated switch boards.

The fact that the actuator unit 2 is generally maintenance-free enables the approach to place the actuator unit 2 in a volume with restricted access. Additional components that require only an electrical connection to the actuator unit 2 like energy storage and control can also be placed outside the circuit breaker compartment 13. The position of the actuator unit 2 can preferably be traced magnetically. The function of the auxiliary switches can likewise be realized by the – not shown – control means.

According to Figure 5 the same module comprising the sheet metal housing 4 with the three pole part housings 1a-1c, the – not shown – jackshaft arrangement and the actuator unit 2 can be used in outdoor applications like dead tank breakers 14 and so called “kiosk switch gear” as shown. In this case, the outdoor enclosure 15 that is available anyway serves as the additional housing part according to the present invention. Compared to existing prior art solutions, a double housing can be avoided.

Figure 6 shows the module with a mechanical, spring-driven actuator 16 as the drive unit.

5 Furthermore, the module solution according to the present invention is also possible as a separate product. With additional components like energy storage, control or auxiliary switches that are mounted directly to the module a completely type and routine tested circuit breaker without housing is possible and advantageous for many applications.

10 The special solution according to the invention is at first quite effective as only a few and small parts are being used which are easy to assemble. The module can be used for different types of circuit breakers as standardisation advantage results. This concept has a further advantage when the assembly is automated as the variance of the product appears relatively late in the production process.

15 Figure 7 shows finally the use of the adaptive mechanical interface 100 located at the base frame, by which it is possible to use one common construction for different mechanical connection to

- AIS
- GIS
- 20 - Outdoor

Switches.

25

**Reference list**

	1	pole part housing
	2	actuator unit
5	3	mounting surface
	4	sheet metal housing
	5	sheet metal part
	6	side cover part
	7	holding plate
10	8	intermediate opening
	9	electrical contact
	10	jackshaft arrangement
	11	additional housing part
	12	attaching parts
15	13	circuit breaker compartment
	14	dead tank breaker
	15	outdoor enclosure
	16	spring driven actuator unit
	100	mechanical interface
20		

### Patent Claims

1. Medium voltage circuit breaker arrangement comprising at least one pole part housing (1a – 1c) for accommodating a pair of coaxially arranged electrical contacts (9a,9b), wherein one electrical contact (9b) of the pair of electrical contacts (9a,9b) is axially movable via a jackshaft arrangement (10) which is accommodated in a recasted sheet metal housing (4), and driven by an actuator unit (2),  
**characterized in that** the sheet metal housing (4) is only designed to form a suspension construction for the at least one pole part housing (1a – 1c), the jackshaft arrangement (10) and the corresponding actuator unit (2) forming a module, wherein an additional housing part (11; 13; 15) is provided for covering at least the actuator unit (2) of the module in order to define the outer geometrical dimensions of the circuit breaker arrangement.
2. Medium voltage circuit breaker arrangement according to Claim 1,  
**characterized in that** the circuit breaker has a base frame, connected to earth contact, pole parts, mechanical coupling means and an actuator, and that the base frame is coupled with mechanical adaption interface, in that way, that the base frame can be adapted to three different uses, that are
- Air-insulted switchgear
  - Gas- insulated switchgear
  - Outdoor switchgear.
3. Medium voltage circuit breaker arrangement according to Claim 1 or 2,  
**characterized in that** the additional housing part (11; 13; 15) is connected to the sheet metal housing (4) via clip connection means.
4. Medium voltage circuit breaker arrangement according to Claim 1 or 2,  
**characterized in that** the additional housing part (11; 13; 15) consists of a thin sheet metal material or a plastic sheet material.

5. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** the additional housing part (11; 13; 15) provides an additional volume for accommodating further attaching parts (12).
- 5 6. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** the sheet metal housing (4) consists of a bended U-shaped sheet metal part (5) with two side cover parts (6) for providing a box-shaped housing arrangement containing the jackshaft arrangement (10).
- 10 7. Medium voltage circuit breaker arrangement according to Claim 6, **characterized in that** both side cover parts (6) consist of the same sheet material than the U-shaped sheet metal part (5) attached one to another by brazing or welding.
8. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** on a mounting surface (3) of the U-shaped sheet metal part (5) a pair of L-shaped holding plates (7a, 7b) for detachable connecting the common actuator unit (2) are arranged adjacent to an intermediate opening (8) for coupling the actuator unit (2) to the jackshaft arrangement (10).
- 15 8. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** on a mounting surface (3) of the U-shaped sheet metal part (5) three pole part housings (1a-1c) are detachable connected by screw connecting means.
- 20 9. Medium voltage circuit breaker arrangement according to Claim 8, **characterized in that** on a mounting surface (3) of the U-shaped sheet metal part (5) three pole part housings (1a-1c) are detachable connected by screw connecting means.
- 25 10. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** the common actuator unit (2) is realized as a single-coil or a double-coil electromagnetic actuator.
11. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** the actuator unit (2) is a mechanical, spring-driven actuator (16).
- 30 11. Medium voltage circuit breaker arrangement according to Claim 1 or 2, **characterized in that** the actuator unit (2) is a mechanical, spring-driven actuator (16).
12. Gas-insulated switchboard comprising a medium voltage circuit breaker arrangement according to one of the preceding Claims 1 to 11.

13. Air-insulated switchboard comprising a medium voltage circuit breaker arrangement according to one of the preceding Claims 1 to 11.
- 5 14. Dead tank breaker for outdoor use comprising a medium voltage circuit breaker arrangement according to one of the preceding Claims 1 to 11.

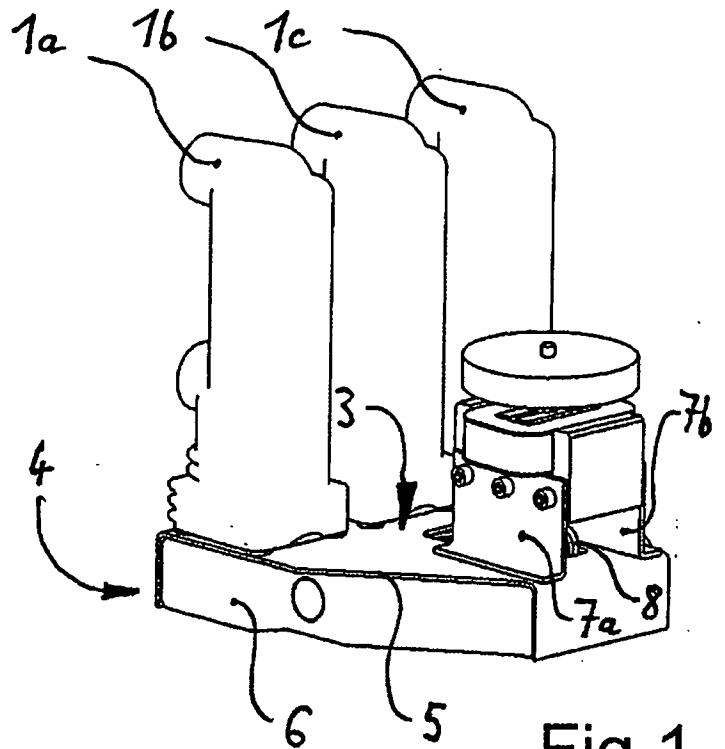


Fig. 1

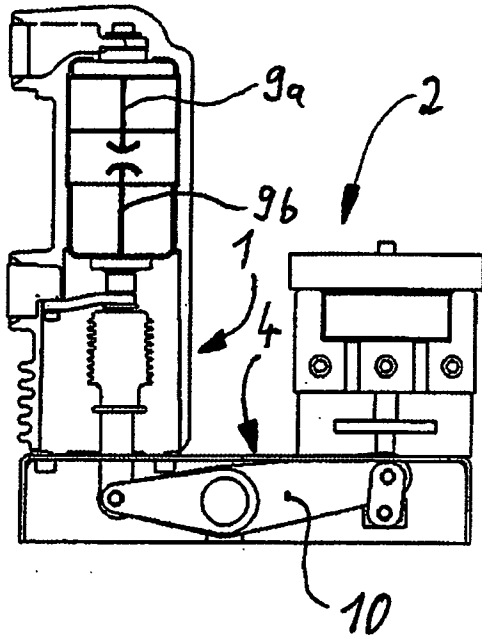


Fig. 2

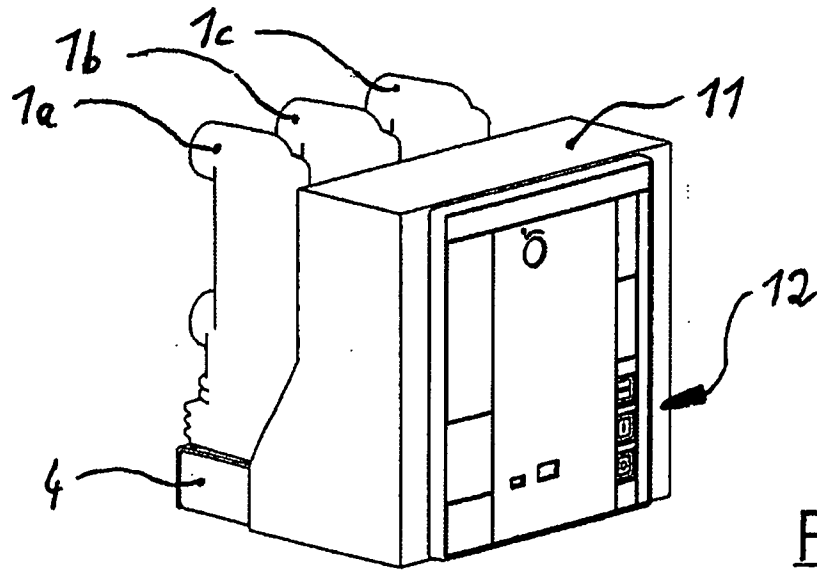


Fig. 3

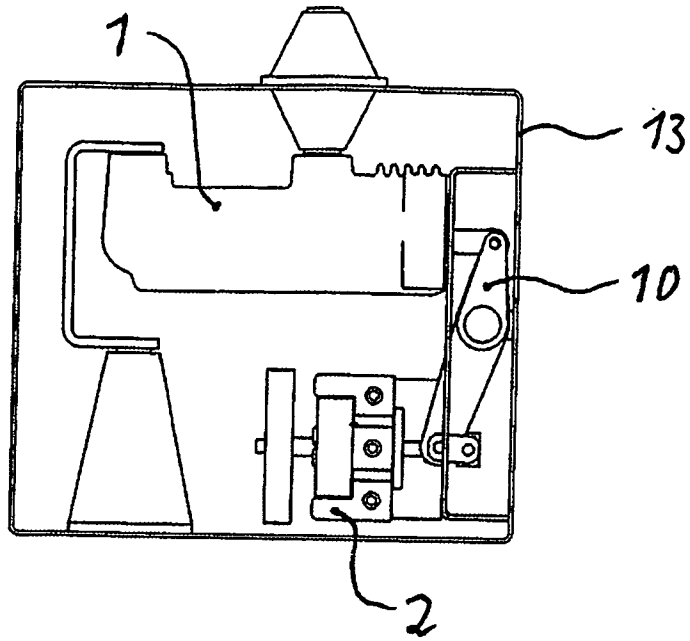


Fig. 4

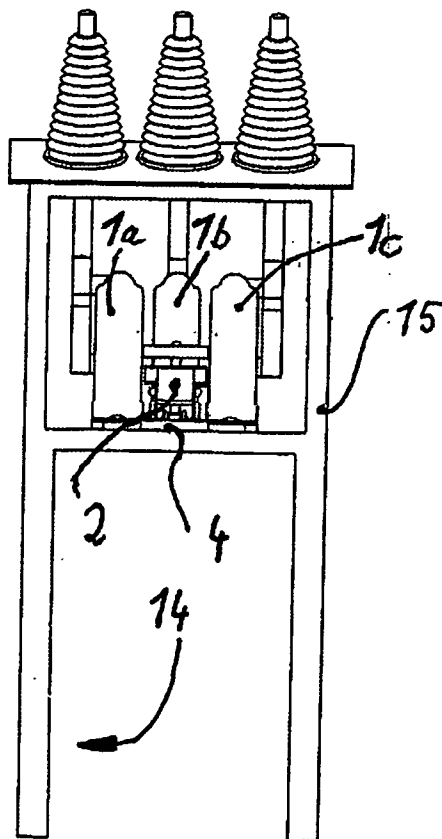


Fig. 5

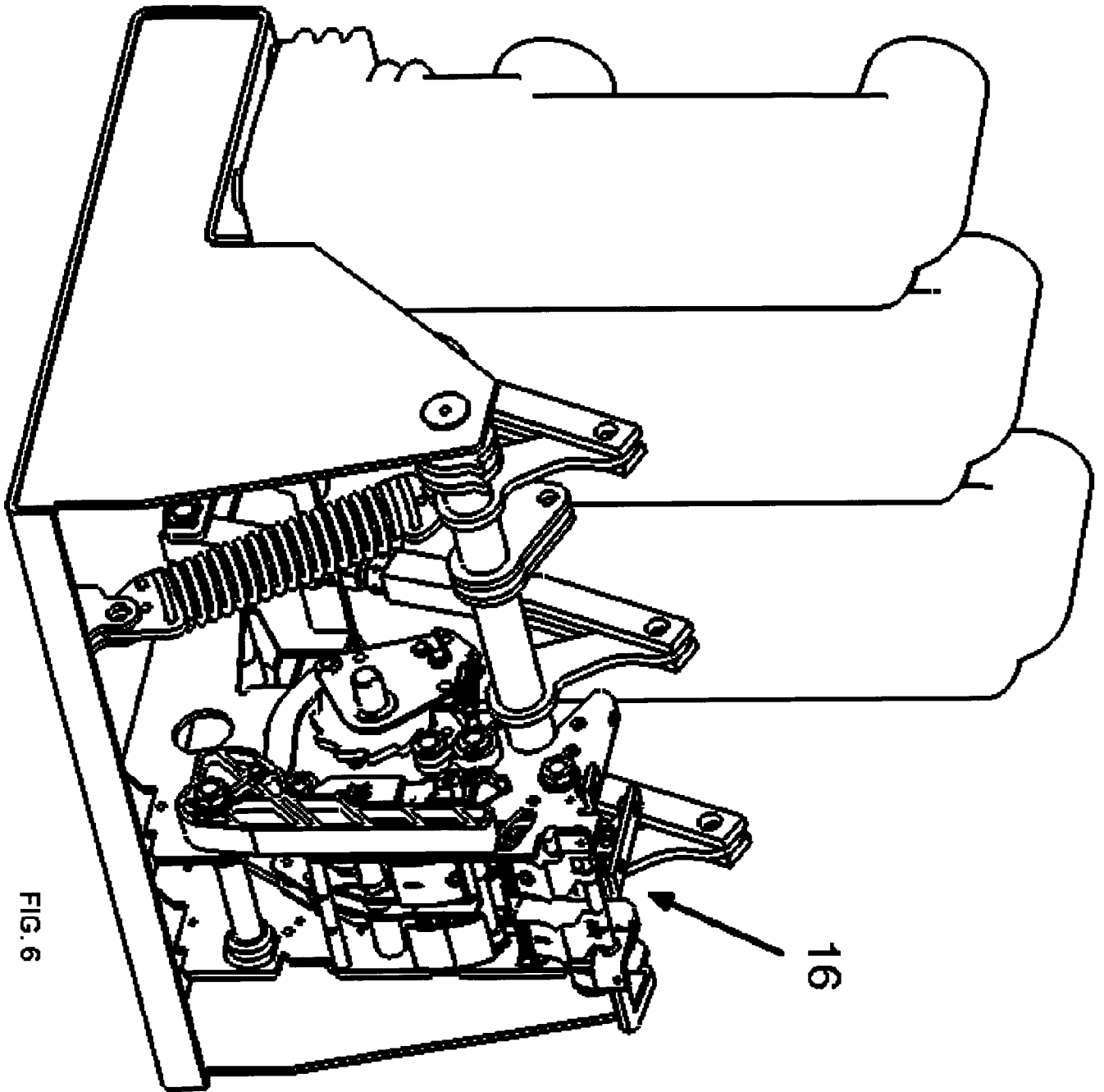
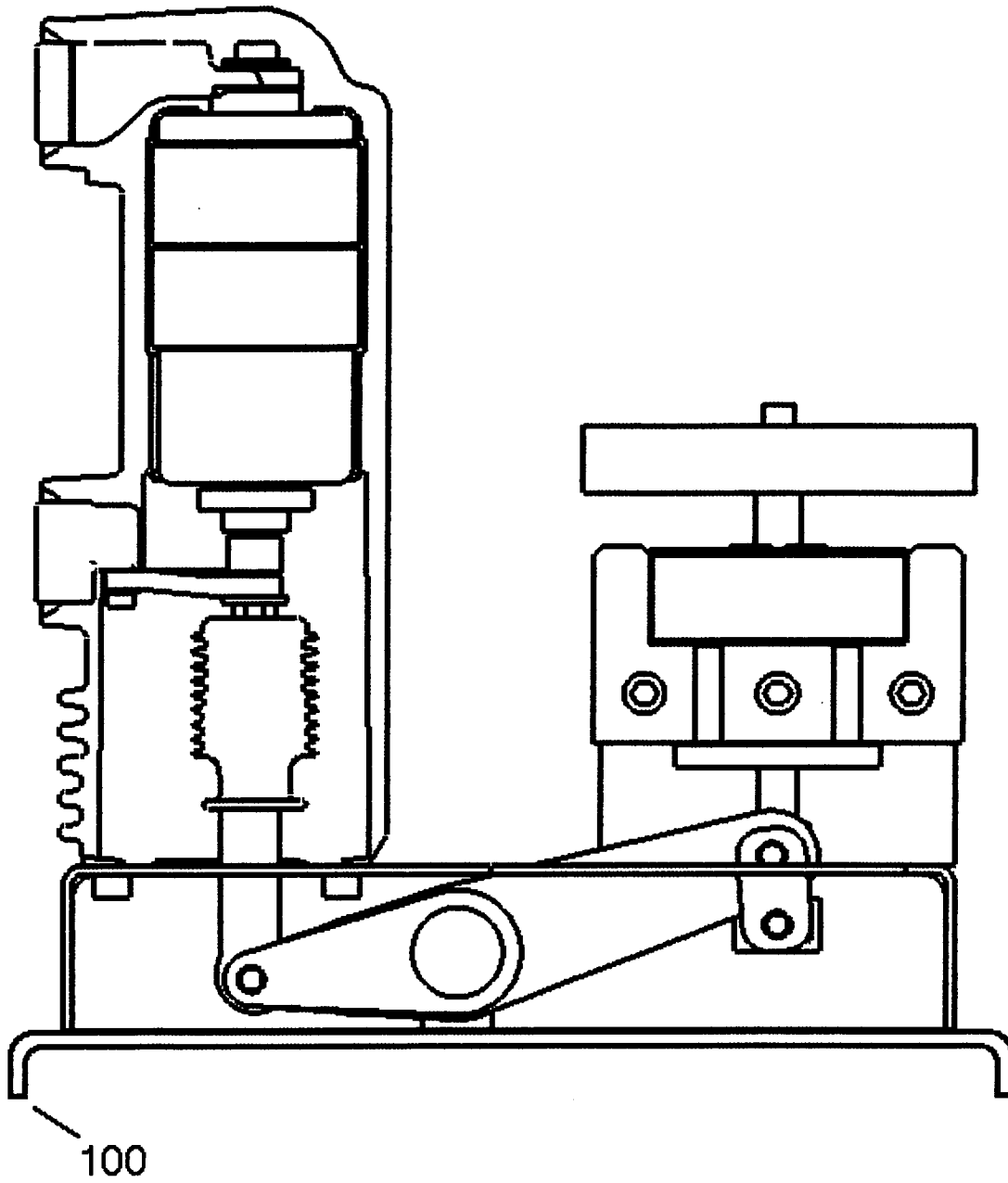


FIG. 6



**Fig. 7**

# INTERNATIONAL SEARCH REPORT

International application No PCT/EP2010/006992
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**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. H01H33/66  
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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A	cited in the application paragraphs [0020], [0021]; figure 1	1,3-5, 8-14
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Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search

2 February 2011

Date of mailing of the international search report

09/02/2011

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Esmiol, Marc-Olivier

INTERNATIONAL SEARCH REPORT

International application No  
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International application No PCT/EP2010/006992
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