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(54) Arc chamber for medium and/or high voltage circuit breakers

(57) An arc chamber for medium and/or high-voltage circuit-breaker, comprising at least one fixed contact and at least one moving contact and a dielectric fluid for quenching electric arcs, the particularity of which is the fact that the said interruption chamber consists of a plurality of disks housing at least one first active filter.

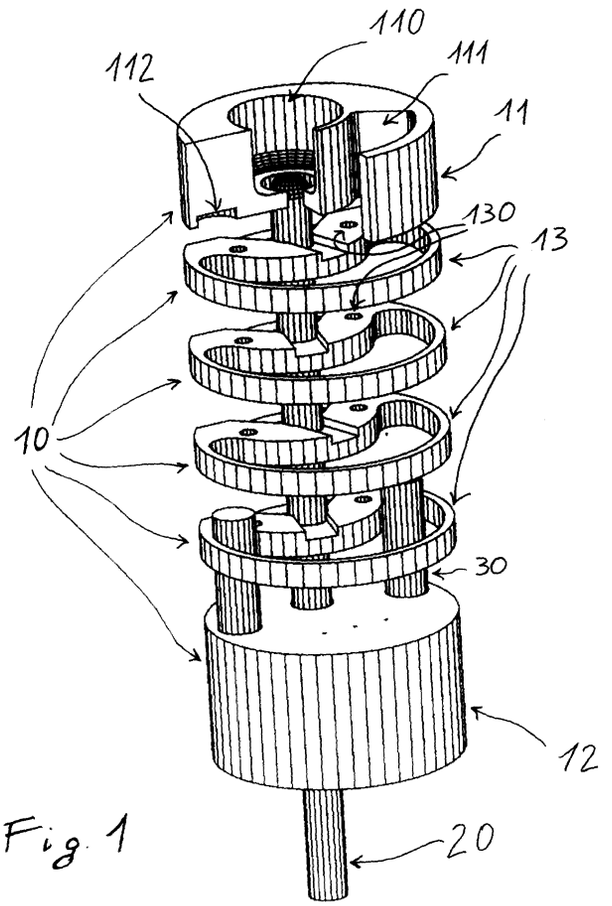

Fig. 1

EP 1 113 474 A1

Description

[0001] The present invention relates to an arc chamber for medium and/or high voltage circuit breakers which contains, as electric arc quenching means, a fluorinated dielectric fluid, in particular a perfluoropolyether (PFPE).

[0002] It is known that medium- and high-voltage circuit breakers comprise an insulating casing in which there is an interruption chamber with interruption mechanisms constituted by at least one fixed contact and at least one moving contact. Opening/closure manoeuvres of the circuit breaker are performed by engaging/disengaging the fixed contacts with respect to the moving contacts by using known actuation devices.

[0003] Generally, during opening the mutual separation of the moving contact and of the fixed contact is accompanied by the generation of an electric arc between the two contacts; these arcs are quenched by using known kinds of dielectric fluid whose use, in the current state of the art, entails various drawbacks and disadvantages.

[0004] For example, one of the most common fluids used to quench the electric arc in medium and/or high-voltage circuit breakers is constituted by a mineral oil: mineral oils, however, in addition to being dangerously flammable, can sometimes lead to unacceptable drawbacks, such as the generation of hydrogen, methane and carbon residuals.

[0005] Many applications commonly use gaseous substances such as nitrogen, noble gases, compressed air, sulphur hexafluoride (SF_6) and mixtures thereof. With these substances it is indispensable to use devices for monitoring the pressure of the gas used and for replenishing it in order to maintain the dielectric performance of the system.

[0006] Another drawback is due to the fact that both when using gaseous fluids and when using liquid fluids it is necessary to adopt particular refinements and to use safety systems in order to avoid and/or indicate any losses and leaks of said fluid. In this case, the losses and consequent leaks of the fluid might in fact cause malfunctions of the circuit breaker and environmental contamination problems. This obviously affects the constructive complexity of the circuit breaker and its overall reliability.

[0007] It is also known in the technical literature to use non-flammable liquids, such as for example mixtures of chlorofluorocarbons (CFC) or of perfluorocarbons (PFC); these liquids are highly limited in their use because in the presence of electric arcs they undergo a decomposition, which produces reactive and toxic by-products. Since these reactive substances are unacceptable from the point of view of environmental impact, they require the adoption of disposal procedures typical of toxic waste.

[0008] It is also known to use, as arc quenching media, particular fluorinated fluids of the perfluoropolyether (PFPE) family. The decomposition of said fluids, following an electric arc, brings about the formation of reactive gaseous substances, a proportion of which remain dissolved in the liquid contained in the arc chamber. Consequently, the said reactive species attack the arc contacts, as well as the construction materials of the chamber itself, eventually reducing the lifespan of the circuit breaker.

[0009] The aim of the present invention is to provide a medium and/or high voltage circuit breaker, which is intrinsically safe, i.e. which does not use as arc quenching medium flammable fluids and in which the production of potentially hazardous substances is reduced.

[0010] Within the scope of this aim, an object of the present invention is to provide a medium and high voltage circuit breaker, which does not require frequent maintenance interventions.

[0011] A further object of the present invention is to provide a medium and high voltage circuit breaker which does not require complex monitoring systems of the status of the arc quenching fluid.

[0012] This aim, these objects and others which will become apparent hereinafter are achieved by an arc chamber of suitable design according to the invention.

[0013] The arc chamber of the invention, for medium and/or high voltage circuit breakers, comprises at least one fixed contact and at least one moving contact and a dielectric fluid, said dielectric fluid being a perfluoropolyether. The arc chamber of the invention further comprises a plurality of disks housing at least one first active filter being suitable for neutralising the chemically reactive species that originate from the decomposition and/or recombination of the dielectric fluid following an electric arc.

[0014] The arc chamber thus conceived is intrinsically safe since it does not contain flammable products. Also, the action of chemically reactive species is limited or even avoided by the proper location of active filters inside the chamber.

[0015] Further characteristics and advantages of the invention will become apparent from the description of preferred but not exclusive embodiments of the arc chamber according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic exploded view of the are chamber according to the present invention;
figure 2 is a schematic view of one of the intermediate disk forming the arc chamber according to the present invention.

[0016] With reference to the above figures, the arc chamber according to the invention comprises, in a general embodiment, a moving contact 30 and a fixed contact (not shown in the figures). The arc chamber further comprises a plurality of disks 10 which house at least one active filter 30. The said active filter is suitable for

neutralising the chemically reactive species that originate form the decomposition and/or recombination of the dielectric fluid following an electric arc. The arc chamber preferably contains two of said active filters.

[0017] The dielectric fluid used in the arc chamber according to the invention is a perfluoropolyether (PFPE), preferably of the family having the following chemical formula:

endcap-O-(C_3F_6O)n-(CF_2O)m-endcap; (a)
or
endcap-O-(C_2F_4O)n-(CF_2O)m-endcap. (b)

[0018] The endcaps can be constituted by HCF_2 (one or both) or CF_3 (preferably no more than one). In particular, the presence of the HCF_2 endcap (hydrogen-endcapped perfluoropolyether) is highly important for environmental impact, since it makes the molecule reactive in the upper atmosphere and therefore does not contribute to the greenhouse effect. In general, perfluoropolyethers can be chosen from a wide range of molecular weights; for example, for molecular weight 2,000 it is possible to have m and n equal to approximately 11, or m and n can be chosen in a ratio of 1:3.

[0019] The plurality of disks 10 can be commonly made by injection moulding of, for example, a fiber reinforced epoxy resin or, alternatively, PTFE.

[0020] Advantageously, the disks contain a hole 131 for housing the moving contact 20.

[0021] A preferred embodiment of the arc chamber according to the invention will be now described with reference to figure 1, in which an exploded view of the arc chamber according to the present invention is given. Obviously, when the arc chamber is assembled the various disks are in contact with each other.

[0022] In this embodiment, the arc chamber comprises an upper disk 11, a lower disk 12 and at least one intermediate disk 13. In the embodiment of figure 1, four intermediate disks 13 are present. Two active filters 30, in the form of cylinder bars, are located in a void area of the intermediate disks 13 and are protected against electric arcs.

[0023] The upper disk 11 contains a cavity 110 to house the fixed contact (not shown in figure 1), a main duct 111 enabling in a larger extent the escape of the said gaseous products, and a housing 112 in order to maintain in a stable fixed position the cylinder bars of active filter 30.

[0024] Corresponding housing 112 (not shown in figure 1) are also present in the lower disk 12.

[0025] Through holes 130 are present in the intermediate disks 13 and have corresponding housing in the upper 11 and lower 12 disks. The function of said through holes and corresponding housing is to house bars made of an insulating material (for example polyamide) that enable a correct mounting and relative positioning of the upper 11, intermediate 13 and lower 12 disks.

[0026] Figure 2 shows a more detailed description of one of the intermediate disks 13. The disk 13 has a hole 131 to house and allow movement of the mobile contact. The diameter of said hole is slightly larger (of a few millimetres) than the diameter of the mobile contact. The electric arc during the interruption phase takes place in the cylindrical canal determined by the superimposition of holes 131 of the various disks 13.

[0027] The gaseous products produced from the recombination of the plasma arc escape through an horizontal discharge canal 132 on one side, and compress the fluid volume on the opposite side of the disk. This side of the disk preferably has a surface 133 inclined of a few degrees, and an the horizontal surface 134.

[0028] The gaseous products, after flowing across the horizontal discharge canal 132, escape from the fluid mass through the vertical discharge canal 136, to the top of the interruption chamber and indeed the top of the interrupter itself. Preferably, as shown in figure 1, the horizontal discharge canals 132 on each disk are symmetrically shifted in respect to each other, thus allowing for an evenly escape of the gaseous products into the discharge canal 136.

[0029] The cylindrical bars of active filter are suitably located in the protected housings 135 and 135 allowing for free circulation of the gaseous products. The two holes 130 enable an easy mounting and proper positioning of the disks as already described in figure 1.

[0030] The active filter 30 is preferably made of a composite material constituted of chemically active materials having a granular shape and an acid resistant binding material, permeable to the said chemically reactive gaseous substances. For example said composite material can be made of fluorinated resin and soda lime.

[0031] The arc chamber thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept. All the details may furthermore be replaced with other technically equivalent elements.

[0032] In practice, the materials used, so long as they are compatible with the specific use, as well as the dimensions, may be any according to the requirements and the state of the art.

Claims

1. Arc chamber for high and/or medium voltage circuit breakers, containing at least one fixed contact and at least one moving contact and a dielectric fluid for quenching electric arcs, characterised in that said dielectric fluid is a perfluoropolyether and in that the said arc chamber comprises a plurality of disks housing at least one first active filter being suitable for neutralising the chemically reactive species that originate from the decomposition/recombination of the dielectric fluid following an electric arc.

2. An arc chamber according to claim 1 characterised in that the said disks contains a hole for housing the moving contact.

3. An arc chamber according to claim 1 or 2, characterised in that disks house two active filters.

4. An arc chamber according to any of the preceding claims characterised in that it comprises an upper disk, a lower disk and at least one intermediate disk.

5. An arc chamber according to claim 4 characterised in that it comprises a plurality of intermediate disks.

6. An arc chamber according to claim 4 or 5, characterised in that the active filters are located in a void area of the intermediate disks protected against electric arcs.

7. An arc chamber according to any of claims from 4 to 6 characterised in that the intermediate disks have an horizontal discharge canal to allow for the escape of the gaseous species.

8. An arc chamber according to claim 7, characterised in that the horizontal discharge canal on each disk are symmetrically shifted in respect to each other.

9. An arc chamber according to any of claims from 4 to 8, characterised in that the said intermediate disks contain holes that allow for the insertion of insulated bars.

10. An arc chamber according to claim 9, characterised in that the upper and lower disks contain seats of the required shape and size for said filters and also for the said insulated bars.

11. An arc chamber according to one or more of the preceding claims characterised in that the said active filters consist of a composite material made of a fluorinated resin and soda lime.

12. A circuit breaker for medium and high voltages comprising an arc chamber according to any of the preceding claims.

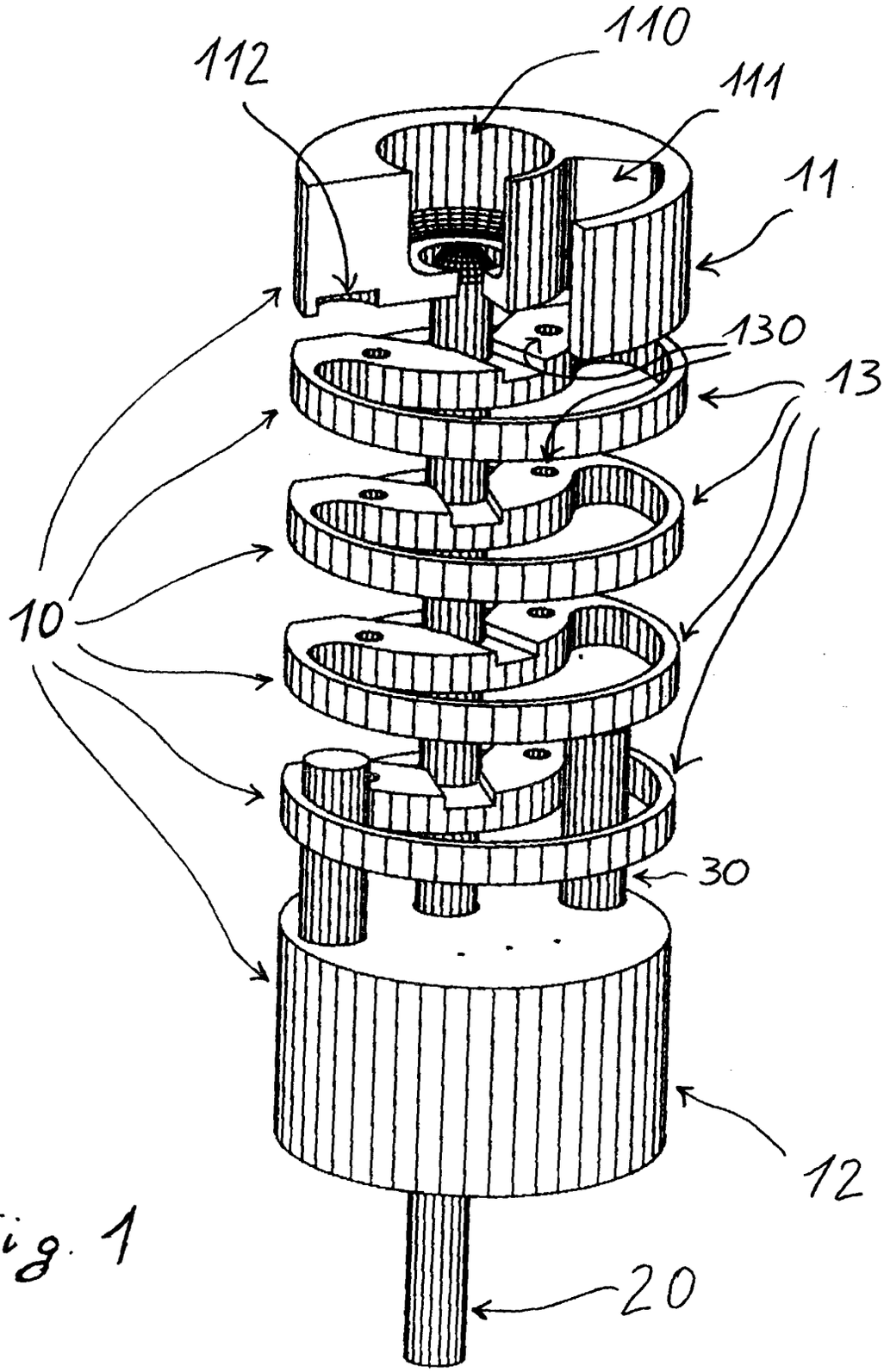

Fig. 1

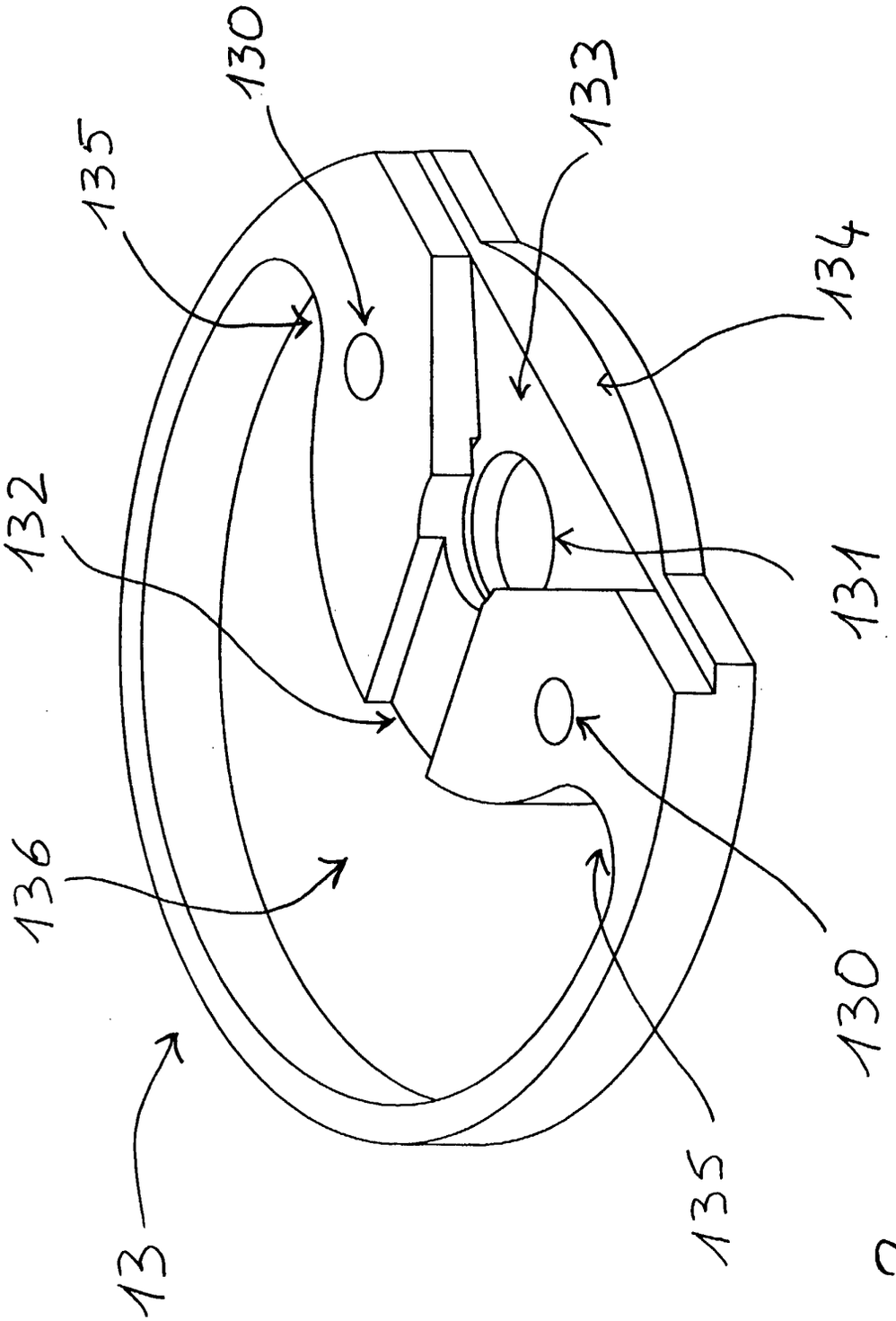

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 20 4619

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 052 555 A (MEARS WHITNEY H ET AL) 4 October 1977 (1977-10-04) * abstract *	1-12	H01H33/22
A	US 4 831 220 A (NOACK DIETER ET AL) 16 May 1989 (1989-05-16) * abstract; figures 1,2 *	1-12	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	10 May 2000	Mausser, T

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 20 4619

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
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10-05-2000

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