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(54) **THREE-PHASE GAS-INSULATED CIRCUIT BREAKER**

(57) The invention relates to a three-phase gas-insulated circuit breaker comprising a longitudinally extending enclosure (1) defining an axis (2) and three longitudinally, parallel to the axis (2) extending interrupters

(3) arranged distant to each other within the enclosure (1) and comprising a radially extending cross-section having a length (6) and a width (7), whereby the length (6) is at least 10% greater than the width (7).

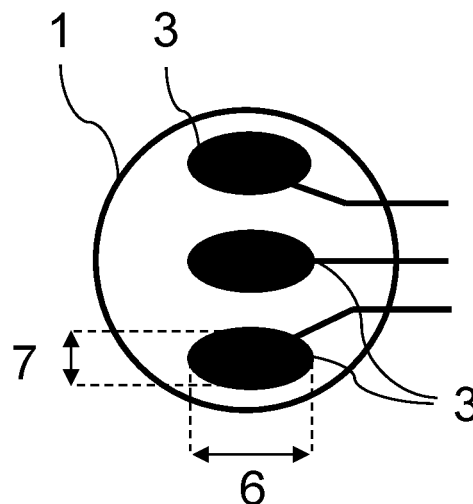


FIG. 2a

Description

Technical Field

[0001] The invention relates to a three-phase gas-insulated circuit breaker comprising a longitudinally extending enclosure defining an axis and three longitudinally, parallel to the axis extending interrupters arranged distant to each other within the enclosure and comprising a radially extending cross-section having a length and a width.

Background Art

[0002] Gas-insulated high-voltage switchgear, GIS, is a compact metal encapsulated switchgear comprising high-voltage components such as high voltage circuit-breakers, disconnectors, earthing switches, and/or current or voltages transformers, which can be safely operated in confined spaces. Gas insulated switchgear is playing an increasingly important role in modern industry.

[0003] The gas insulated circuit breaker usually includes a plurality of interrupters, one for each phase, filled with an insulating gas such as SF₆ or alternatives, and often further elements such as a spring mechanism for operating the interrupters. The interrupters of the three phases are usually installed within a tank as enclosure in a linear or triangle manner. While such triangle arrangement increases open space between the interrupters, a dimension of the interrupters is limited as an electric field of the interrupters interferes with connections of the interrupters.

Summary of invention

[0004] It is therefore an object of the invention to provide a three-phase gas-insulated circuit breaker allowing a simple mechanical connection but providing greater interrupting capabilities compared to prior art implementations.

[0005] The object of the invention is solved by the features of the independent claims. Preferred implementations are detailed in the dependent claims.

[0006] Thus, the object is solved by a three-phase gas-insulated circuit breaker comprising

a longitudinally extending enclosure defining an axis and
three longitudinally, parallel to the axis extending interrupters arranged distant to each other within the preferably same enclosure and comprising a radially extending preferably inner cross-section having a length and a width, whereby
the length is at least 10% greater than the width.

[0007] A key point of the invention is therefore that the interrupters do not comprise, in an exemplary implementation, a circular cross-section but rather for example an

oval or elliptic cross section. Such way more insulating gas can be accommodated within the interrupter such that exhaust performance is improved and interrupter capability is increased.

5 [0008] The three-phase gas-insulated circuit breaker is preferably provided as a high voltage three-phase gas-insulated circuit breaker. The term high voltage relates to voltages that exceeds 1 kV. A high voltage preferably concerns nominal voltages in the range from above 72 kV to 800 kV, like 145 kV, 170 kV, 245 kV or 420 kV. The interrupter may comprise a puffer-type cylinder, a self-blast chamber, a pressure collecting space, a compression space, or puffer volume, an expansion space. The circuit breaker may comprise an operating mechanism such as a spring mechanism.

[0009] The three-phase gas-insulated circuit breaker preferably comprises an insulating gas which can be any suitable gas that enables to adequately extinguish an electric arc formed between contact elements of the interrupter during a current interruption operation, such as, but not limited, to an inert gas as, for example, sulphur hexafluoride SF₆. Specifically, the insulating gas used can be SF₆ gas or any other dielectric insulation medium, may be a dielectric insulation gas or arc quenching gas.

25 [0010] The enclosure preferably comprises a tube-like, cylinder-like or cylindric shape, with closed opposite base areas. On top of one base area the spring mechanism and/or operating mechanism can be attached for operating at least one moving contact of the interrupter. Opposite longitudinal ends of the interrupter can be connected to terminals reaching through lateral areas for electrically connecting the interrupter. The enclosure may therefore comprise lateral openings closed with barrier insulators through which the terminals reach through.

35 [0011] Preferably, a length of an outer cross-section of the interrupter is equally greater than a respective width as the cross-section. Thus, a length of the outer cross-section may be as well at least 10% greater than the width of the outer cross-section. The term length and width preferably refer to a maximum respective radial extension of the interrupter, for example may relate to a major axis as length and minor axis as width. Further, the length and width preferably extend orthogonal to the axis. In this respect the term that the length is at least 10% greater than the width means in particular that that the interrupter does not comprise a circular diameter. Rather, the interrupter may comprise the shape, in radial extension, of a rectangle or rectangle-like with rounded edges.

50 [0012] According to a preferred implementation the length is at least 20%, 25%, 50%, 75%, 100% or 150% greater than the width. Besides that other ratios are possible, as long as the length is greater than the width. Preferably, the interrupter comprises an inner and/or outer width of 190 or 250 mm. Such way, in case the length is 100% greater than the width, the respective length may be 380 or 500 mm. The greater the length in respect to the width, the more insulating gas can be accommodated

inside the interrupter and the higher ratings can be handled by the interrupter.

[0013] In another preferred implementation the cross-section comprises an oval or elliptic shape, or an egg-like shape. Such wise the interrupter may comprise a tube-like or cylinder-like shape. In this respect, a major axis of the oval or elliptic shape may correspond to the length, while a minor axis may correspond to the width. Thus, the major axis of an oval or elliptic shape preferably constitutes its longest diameter, for example a line segment that runs through a centre and both foci, with ends at the two most widely separated points of the perimeter. The minor axis may equally constitute a line segment that is at right angles with the major axis

[0014] In a further preferred implementation the interrupters are arranged in parallel in respect to the length. Such way required distances due to electric fields can be best achieved. Beside that other arrangements are possible within the enclosure.

[0015] Generally, the length can be at least 10% greater than the width along the complete longitudinal extension of the interrupter. However, according to a further preferred implementation the length is greater than the width along at least 50%, 75% or 100% of the longitudinal extension of the interrupter. This means that along a part of the longitudinal extension the length may not be greater than the width, for example may be equal to the width.

[0016] In another preferred implementation the length and the width differ at at least one longitudinal end of the interrupter and the length and the width are equal in an area between the two opposite longitudinal ends of the interrupter. Thus, the interrupter may comprise a mix of different ratios between the length and the width, for example having the same length and width at a centre, while the length and width differ at a respective longitudinal end of the interrupter.

[0017] Such implementation is advantageous as a main part of an exhaust is usually located at the longitudinal end of the interrupter. In this respect it is in particular preferred according to a further preferred implementation that the interrupter comprises at the at least one longitudinal end an oval or elliptic cross-section and the area between the two opposite longitudinal ends comprises a circular cross-section.

[0018] In another preferred implementation the interrupters are arranged in equal distances. Such implementation is advantageous as it allows a simple mechanical connection to the operating respectively spring mechanism and/or equal distribution of electrical fields. Thereby a minimum distance respectively space between the interrupters is defined by said electrical field.

[0019] According to a further preferred implementation the interrupters are arranged, in particular radially, in a linear row. With a such implementation before mentioned advantages increase further, in particular allowing an easy electrical connection to the interrupters. In another preferred implementation a middle interrupter extends along the axis. Such way the middle interrupter of a row

of interrupters is aligned with the axis.

[0020] According to a further preferred implementation the interrupters are arranged, in particular radially, in a triangle in particular around the axis. A triangle arrangement increases the space between the interrupters, thus allowing higher electrical fields respectively voltages.

[0021] In another preferred implementation each interrupter comprises a longitudinally extending fixed contact carrier and a longitudinally extending moving contact carrier arranged in a longitudinal extension. The moving contact carrier is preferably arranged on top of the fixed contact carrier and/or is operatively connected to the operating respectively spring mechanism. The fixed contact carrier may comprise an axially extending fixed arcing contact and the moving contact carrier may comprise a movable moving arcing contact configured for electrically connecting the fixed contact in an arcing region. The interrupter may further comprise a buffer cylinder including a channel directed to the arcing region and a nozzle for blowing during a breaking operation the insulating gas to the arcing region.

[0022] According to a further preferred implementation the enclosure and/or the interrupters are filled with an insulating gas. The insulating gas, also referred to as arc-extinguishing gas, can be any suitable gas that enables to adequately extinguish an electric arc formed within the interrupter respectively between arcing contacts of the fixed contact carrier and the moving contact carrier during a current interruption operation, such as, but not limited, to an inert gas as, for example, sulphur hexafluoride SF₆. Thereby, the arc between arcing contacts develops in the arcing region. Specifically, the arc-extinguishing gas used in the circuit breaker can be SF₆ gas or any other dielectric insulation medium and in particular can be a dielectric insulation gas or arc quenching gas. Such dielectric insulation medium can for example encompass media comprising an organofluorine compound.

[0023] The object of the invention is further solved by a method for manufacturing a three-phase gas-insulated circuit breaker, comprising the steps of

manufacturing a longitudinally extending enclosure having an axis, and
manufacturing three longitudinally extending interrupters for being arranged parallel to the axis and distant to each other within the preferably same enclosure and comprising a radially extending preferably inner cross-section having a length and a width, whereby
the length is at least 10% greater than the width.

[0024] The method preferably comprises the step of inserting the interrupters into the enclosure. With such method it becomes possible to manufacture a three-phase gas-insulated circuit breaker which can accommodate within the interrupter more insulating gas such that exhaust performance is improved and interrupter capability is increased.

[0025] Further implementations and advantages of the method can be derived by the person skilled in the art from the three-phase gas-insulated circuit breaker as described before.

Brief description of drawings

[0026] These and other aspects of the invention will be apparent from and elucidated with reference to the implementations described hereinafter.

[0027] In the drawings:

- Fig. 1a shows a prior art three-phase enclosed gas-insulated circuit breaker in a sectional top view,
- Fig. 1b shows the three-phase enclosed gas-insulated circuit breaker of Fig. 1a in a sectional side view,
- Fig. 2a shows an enclosure of the three-phase enclosed gas-insulated circuit breaker in sectional top view according to a preferred implementation,
- Fig. 2b shows an enclosure of the three-phase enclosed gas-insulated circuit breaker in sectional top view according to another preferred implementation, and
- Fig. 2c shows an enclosure of the three-phase enclosed gas-insulated circuit breaker in sectional top view according to even another preferred implementation.

Description of implementations

[0028] Fig. 1a shows a prior art three-phase enclosed gas-insulated circuit breaker in a sectional top view, while Fig. 1b shows the three-phase enclosed gas-insulated circuit breaker of Fig. 1a in a sectional side view.

[0029] The three-phase enclosed gas-insulated circuit breaker comprises a tube-like enclosure 1, which extends in a longitudinally manner thereby defining an axis 2. The enclosure 1 is closed on a bottom and on a top, whereby an operating respectively spring mechanism is arranged on the top, only partially shown. The operating respectively spring mechanism switches three interrupters 3 arranged within the enclosure 1. Said three interrupters 3 extend in a longitudinal manner parallel to the axis 2 and are arranged distant to each other in a linear row. Such wise Fig. 1a as side view only shows the first interrupter 3 of the row of interrupters 3. The interrupters 3 and the enclosure 1 are filled with an insulating gas such as SF₆ or an alternative arch quenching gas.

[0030] The interrupters 3 each comprise a longitudinally extending fixed contact carrier 4 and a longitudinally extending moving contact carrier 5, which are arranged

in longitudinal extension. The fixed contact carrier 4 comprises a not shown fixed contact and the moving contact carrier 5 comprise a not shown moving contact, which is operatively connected to the operating respectively spring mechanism. Both the fixed contact carrier 4 respectively the fixed contact and the moving contact carrier 5 respectively the moving contact are each connected to a respective terminal 6 extending radially. The terminals 6 extends through a barrier insulation laterally out of the enclosure 2 for connecting the interrupter to, for example, a power grid.

[0031] Figs. 2a to 2c each show the enclosure 1 of the three-phase enclosed gas-insulated circuit breaker as described before in sectional top view according to a preferred implementation. The three implementations only differ in placement of the three interrupters 3 within the enclosure 1. While in Figs 1a and 1b the interrupters 3 comprise a circular outer cross-section respectively shape having a diameter of 190 to 215 mm, the interrupters 3 shown in Figs. 2a to 2c comprise a shape that is not circular. Said cross-section defines a length 6 and a width 7.

[0032] Thereby, the length 6 is at least 10% greater than the width 7. Specifically, as can be derived from Figs. 2a to 2c, the length 6 is twice the width 7 respectively 100% greater. More specifically, the inner and/or outer cross-section comprises an oval or elliptic shape. Thus, the major axis as length 6 is twice as long as the minor axis as width 7. With the proposed shape more insulating gas can be accommodated within the interrupters 3 compared to a circular interrupter shape as known from prior art. In even other words, the proposed shape comprises a greater volume for housing the insulating gas compared to a circular interrupter shape as known from prior art.

[0033] In Fig. 2a the interrupters 3 are arranged in a linear row thereby allowing a simple mechanical connection to the operating respectively spring mechanism. The middle interrupter 3 extends along the axis 2. Around the interrupters 3 the electrical field is indicated, whereby the interrupters 3 are sufficiently spaced apart from each other such that no voltage flash over as indicated occurs.

[0034] Figs. 2b and 2c show to further implementations where the interrupters 3 are arranged in a triangle thereby offering more space between the interrupters 3 compared to the implementation of Fig. 2 in a row. While not illustrated, the interrupters 3 are preferably arranged in equal distances to each other around the axis 2.

[0035] The interrupters 3 may comprise the oval or elliptic shape along the complete longitudinal extension of the respective interrupter 3. While not shown in Figs. 2 to 2c, both opposite longitudinal ends of the interrupters 3 comprise the oval or elliptic cross-section, while a middle area between the two opposite longitudinal ends comprises a rounded cross-section.

[0036] Such way at least 50% or 75% of the longitudinal extension of the interrupters 3 comprise the proposed the oval or elliptic cross-section. In other words the interrupter 3 comprises a mix between a circular shape in a

centre and an oval shape to the ends, where a main part of an exhaust is located.

[0037] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed implementations. Other variations to be disclosed implementations can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting scope.

Reference signs list

[0038]

- 1 enclosure
- 2 axis
- 3 interrupter
- 4 fixed contact carrier
- 5 moving contact carrier
- 6 length
- 7 width

Claims

1. Three-phase gas-insulated circuit breaker comprising

a longitudinally extending enclosure (1) defining an axis (2) and three longitudinally, parallel to the axis (2) extending interrupters (3) arranged distant to each other within the enclosure (1) and comprising a radially extending cross-section having a length (6) and a width (7), whereby the length (6) is at least 10% greater than the width (7).

2. Three-phase gas-insulated circuit breaker according to the previous claim, whereby the length (6) is at least 20%, 25%, 50%, 75%, 100% or 150% greater than the width (7).
3. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby the cross-section comprises an oval or elliptic shape.
4. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby the interrupt-

ers (3) are arranged in parallel in respect to the length (6).

5. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby the length (6) is greater than the width (7) along at least 50%, 75% or 100% of the longitudinal extension of the interrupter.
6. Three-phase gas-insulated circuit breaker according to any of the first three claims, whereby the length (6) and the width (7) differ at at least one longitudinal end of the interrupter (3) and the length (6) and the width (7) are equal in an area between the two opposite longitudinal ends of the interrupter (3).
7. Three-phase gas-insulated circuit breaker according to the previous claim, whereby the interrupter (3) comprises at the at least one longitudinal end an oval or elliptic cross-section and the area between the two opposite longitudinal ends comprises a circular cross-section.
8. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby the interrupters (3) are arranged in equal distances.
9. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby the interrupters (3) are arranged in a linear row.
10. Three-phase gas-insulated circuit breaker according to the previous claim, whereby a middle interrupter (3) extends along the axis.
11. Three-phase gas-insulated circuit breaker according to any of the first seven claims, whereby the interrupters (3) are arranged in a triangle in particular around the axis (2).
12. Three-phase gas-insulated circuit breaker according to any of the previous claims, whereby each interrupter (3) comprises a longitudinally extending fixed contact carrier (4) and a longitudinally extending moving contact carrier (5) arranged in a longitudinal extension.
13. Three-phase gas-insulated circuit breaker according to any of the previous claims, wherein the enclosure (1) and/or the interrupters (3) are filled with an insulating gas.
14. Method for manufacturing a three-phase gas-insulated circuit breaker, comprising the steps of
 - manufacturing a longitudinally extending enclosure (1) defining an axis (2), and
 - manufacturing three longitudinally extending in-

interrupters (3) for being arranged parallel to the axis (2) and distant to each other within the enclosure (1) and comprising a radially extending cross-section having a length (6) and a width (7), whereby the length (6) is at least 10% greater than the width (7)

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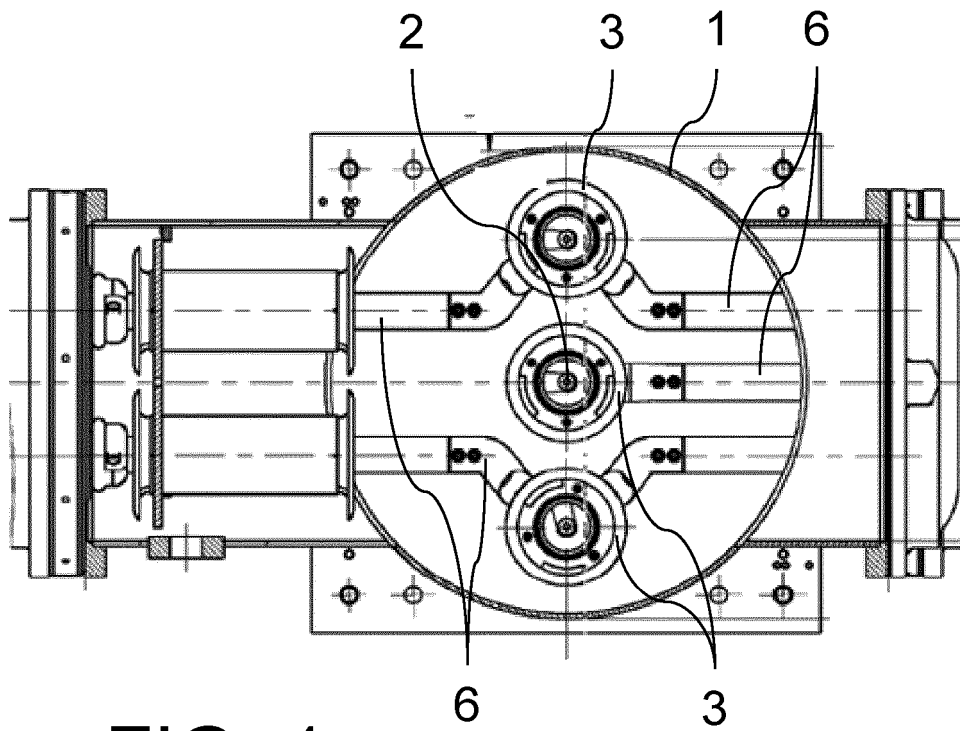


FIG. 1a

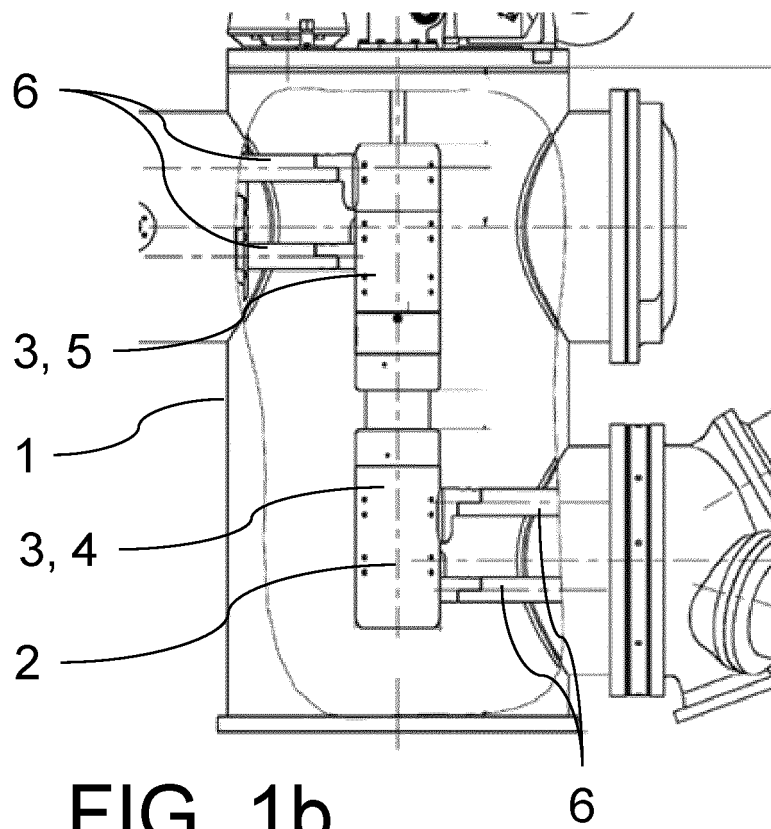


FIG. 1b

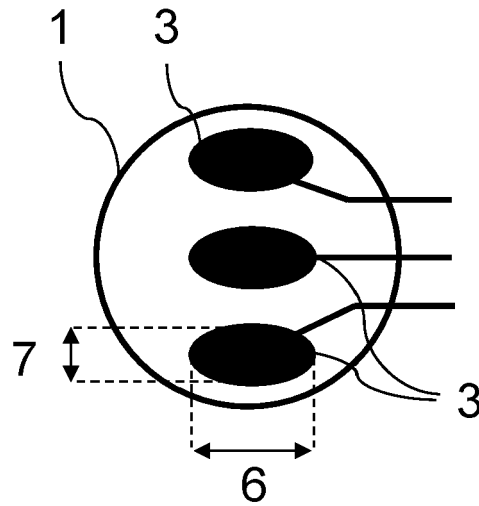


FIG. 2a

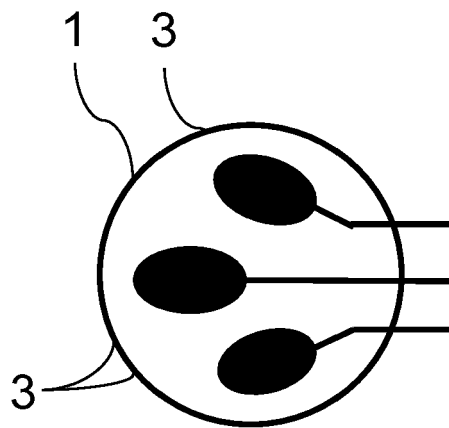


FIG. 2b

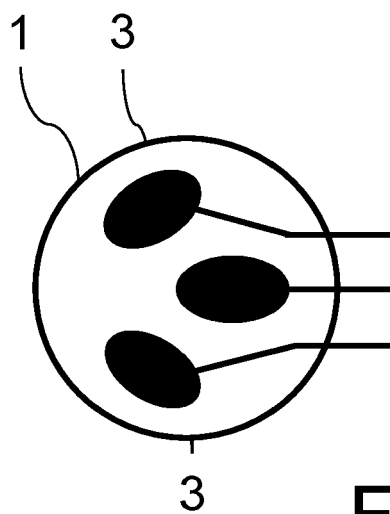


FIG. 2c



EUROPEAN SEARCH REPORT

Application Number

EP 22 15 9120

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			TECHNICAL FIELDS SEARCHED (IPC)
			H01H

The present search report has been drawn up for all claims

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EPO FORM 1503 03.82 (P04C01)

Place of search

Munich

Date of completion of the search

11 August 2022

Examiner

Arenz, Rainer

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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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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