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(54) MEDIUM VOLTAGE FUSE-LINK

(57) The present invention relates to a field of electrical fuses, especially fuse-links, used to provide an overcurrent protect to electric circuits. The present invention relates more particularly to the electrical fuses used in medium voltage applications.

A goal of the invention is to provide an overcurrent protection in a medium voltage application, especially in a medium voltage direct current application, where a nominal current is relatively small compared to a breaking current.

According to the invention a medium voltage fuse-link comprising a first cap, a second cap, a core with a first end and a second end, wherein on the first end is the first cap, and on the second end there is the second cap, and a fuse element connected to the first cap and the second cap, a first external cap, a second external cap, a fuse tube with a first end and a second end, wherein on the first end is the external first cap, and on the second end there is the external second cap, an arc quenching medium surrounding the fuse element. The first cap is electrically coupled with the first external cap by means of a first connector, and the second cap is electrically coupled with the second external cap by means of a second connector. The first cap, the second cap, the core, the first connector, the second connector, and the fuse element are placed inside the fuse tube. The fuse element is made of a precise resistive wire made of an metal alloy based on copper and nickel.

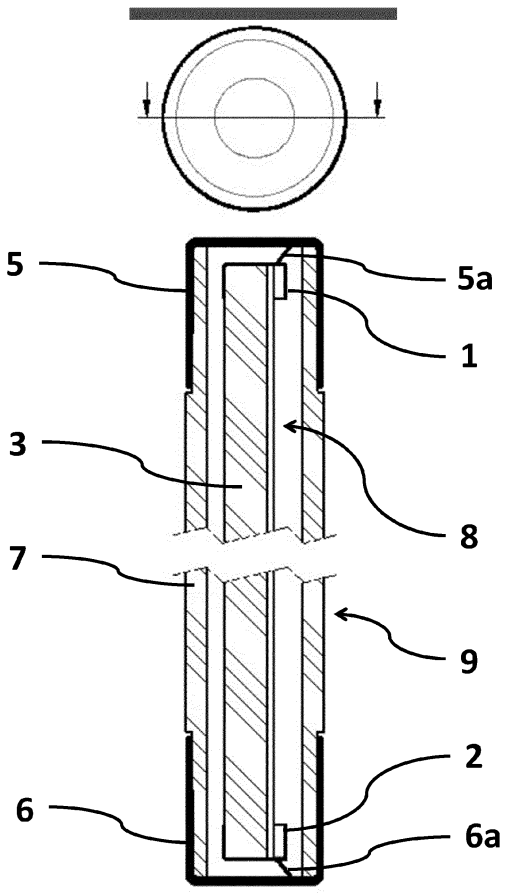

Fig. 1

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Description

[0001] The present invention relates to a field of electrical fuses, especially fuse-links, used to provide an overcurrent protect to electric circuits. The present invention relates more particularly to the electrical fuses used in medium voltage applications.

[0002] Document US 11,476,073 discloses a use of a high-voltage high-power fuse for securing direct current transmission, wherein the direct voltage of the direct current and/or the rated voltage of the high voltage fuse is greater than 4 kV.

[0003] According to the invention a medium voltage fuse-link comprising a first cap, a second cap, a core with a first end and a second end, wherein on the first end is the first cap, and on the second end there is the second cap, and a fuse element connected to the first cap and the second cap, a first external cap, a second external cap, a fuse tube with a first end and a second end, wherein on the first end is the external first cap, and on the second end there is the external second cap, an arc quenching medium surrounding the fuse element. The first cap is electrically coupled with the first external cap by means of a first connector, and the second cap is electrically coupled with the second external cap by means of a second connector. The first cap, the second cap, the core, the first connector, the second connector, and the fuse element are placed inside the fuse tube. The fuse element is made of a precise resistive wire made of an metal alloy based on copper and nickel.

[0004] Preferably the metal alloy comprises 40% to 50% of nickel, preferably 44% of nickel.

[0005] Preferably resistivity of the metal alloy is r=0,00000049 Ω x m +/-10%.

[0006] Preferably a cross-section of the core is a star.

[0007] Preferably the fuse element is wound around the core.

[0008] Preferably the first connector is part of the first cap and/or the second connector is part of the second cap.

[0009] Preferably comprising a name plate placed on an outer side of the fuse tube.

[0010] Preferably is in a shape of a cylinder.

[0011] Preferably the arc quenching medium is a silica sand.

[0012] A goal of the invention is to provide an overcurrent protection in a medium voltage application, especially in a medium voltage direct current application, where a nominal current is relatively small compared to a breaking current.

[0013] The invention has been shown on a figures, on which:

Fig. 1 shows a fuse-link according to preferred embodiment of the invention;

Fig. 2 shows a core of the fuse-link;

Fig. 3-5 shows characteristics of the fuse-link according to the invention.

[0014] A medium voltage fuse-link according to the invention is shown on a fig. 1 and 2. The medium voltage fuse-link comprising a first cap 1, a second cap 2, a core 3, and a fuse element 4. The core 3 has a first end and a second end, wherein on the first end is the first cap 1, and on the second end there is the second cap 2, and a fuse element 4 connected to the first cap 1 and the second cap 2, wherein the fuse element 4 is made of a precise resistive wire made of an metal alloy based on copper and nickel.

[0015] In the preferred embodiment the constantan metal alloy comprises 40% to 50% of nickel, preferably 44% of nickel. Preferably a resistivity of the metal alloy is r=0,00000049 Ω x m +/-10%.

[0016] The fuse element 4 is surrounded by arc quenching medium 8. Silica sand or non-conducting medium may be used.

[0017] For the safety reasons the medium voltage fuse-link also comprises a first external cap 5, a second external cap 6, a first connector 5a, a second connector 6a and a fuse tube 7. The fuse tube 7 has a first end and a second end, wherein on the first end is the external first cap 5, and on the second end there is the external second cap 6. The first cap 1 is electrically coupled with the first external cap 5 by means of the first connector 5a, and the second cap 2 is electrically coupled with the second external cap 6 by means of the second connector 6a. The first cap 1, the second cap 2, the core 3, the first connector 5a, the second connector 6a and the fuse element 4 are placed inside the fuse tube 7. Such design encloses the fuse element 4 within the fuse tube 7 and thus provide a separation from a heat generated by the fuse element 4 during a high current flow. Preferably a name plate 9 is placed on an outer side of the fuse tube 7. In a preferred embodiment the first connector 5a is part of the first cap 1 and/or the second connector 6a is part of the second cap 2.

[0018] It is a purpose of the invention to provide a fuse-link for a medium voltages (approx. 5kV DC) for a low currents (in a rage of 0,1A), where a maximum breaking current is approx. 30kA and a minimum braking current is 4A. A nominal current, in such application, is relatively low compared to a breaking currents. Also a breaking current range is relatively wide. A material for a fuse-link element 4 has been proposed to be a constantan, preferably CuNi44.

[0019] In the exemplary embodiment the fuse element 4, for a purpose of providing desired parameters, has listed parameters:

- A length of the fuse element 4 - 550mm
- A resistivity of a wire used r=0,000 000 49 Ω x m +/-10%,
- The fuse element 4 made of constantan with a 44% of Nickel,

- A diameter of the wire - 0,05mm

[0020] Characteristics of the fuse-link, as described above, are shown on fig. 3-5. Fig. 3 shows a cut-off current characteristic - the highest value that the current reaches during the process of breaking by the fuse-link. The value of this current can be read from the cut-off (let-through) current characteristic. Fig. 4 shows a time current characteristic, where the curve showing average operating time as a function of the prospective current. Fig. 5 shows a pre-arcing time characteristic - the time taken from the initiation of the short-circuit to the element melting is called the pre-arcing time.

[0021] In one embodiment a cross-section of the core 3 is a star, however the person skilled in the art will know that other shapes are also possible.

[0022] In yet another embodiment the fuse element 4 is wound around the core 3.

[0023] The fuse-link is preferably in a shape of a cylinder. A general fuse construction is known in the prior art - for example US 11,476,073 discloses a general information regarding construction details of a typical fuse-link.

1 first cap
2 second cap
3 core
4 fuse element
5 first external cap
5a first connector
6 second external cap
6a second connector
7 fuse tube
8 arc quenching medium
9 name plate

Claims

1. A medium voltage fuse-link comprising:

a first cap (1),
a second cap (2),
a core (3) with a first end and a second end, wherein on the first end is the first cap (1), and on the second end there is the second cap (2), and
a fuse element (4) connected to the first cap (1) and the second cap (2),
a first external cap (5),
a second external cap (6),
a fuse tube (7) with a first end and a second end, wherein on the first end is the external first cap (5), and on the second end there is the external second cap (6),
an arc quenching medium (8) surrounding the fuse element (4),
wherein the first cap (1) is electrically coupled with the first external cap (5) by means of a first connector (5a), and the second cap (2) is electrically coupled with the second external cap (6) by means of a second connector (6a),
wherein the first cap (1), the second cap (2), the core (3), the first connector (5a), the second connector (6a), and the fuse element (4) are placed inside the fuse tube (7), wherein the fuse element (4) is made of a precise resistive wire made of an metal alloy based on copper and nickel.

2. The medium voltage fuse-link according to claim 1, **characterized in that** the metal alloy comprises 40% to 50% of nickel.

3. The medium voltage fuse-link according to claim 2, **characterized in that** metal alloy comprises 44% of nickel.

4. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** resistivity of the metal alloy is r=0,00000049 Ω x m +/-10%.

5. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** a cross-section of the core (3) is a star.

6. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** the fuse element (4) is wound around the core (3).

7. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** the first connector (5a) is part of the first cap (1) and/or the second connector (6a) is part of the second cap (2).

8. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** comprising a name plate (9) placed on an outer side of the fuse tube (7).

9. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** is in a shape of a cylinder.

10. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** the arc quenching medium is a silica sand.

11. The medium voltage fuse-link according to anyone of the previous claims, **characterized in that** the fuse element (4) is configured to work with a nominal current 0,1-4A and where a breaking current is 4-30000A.

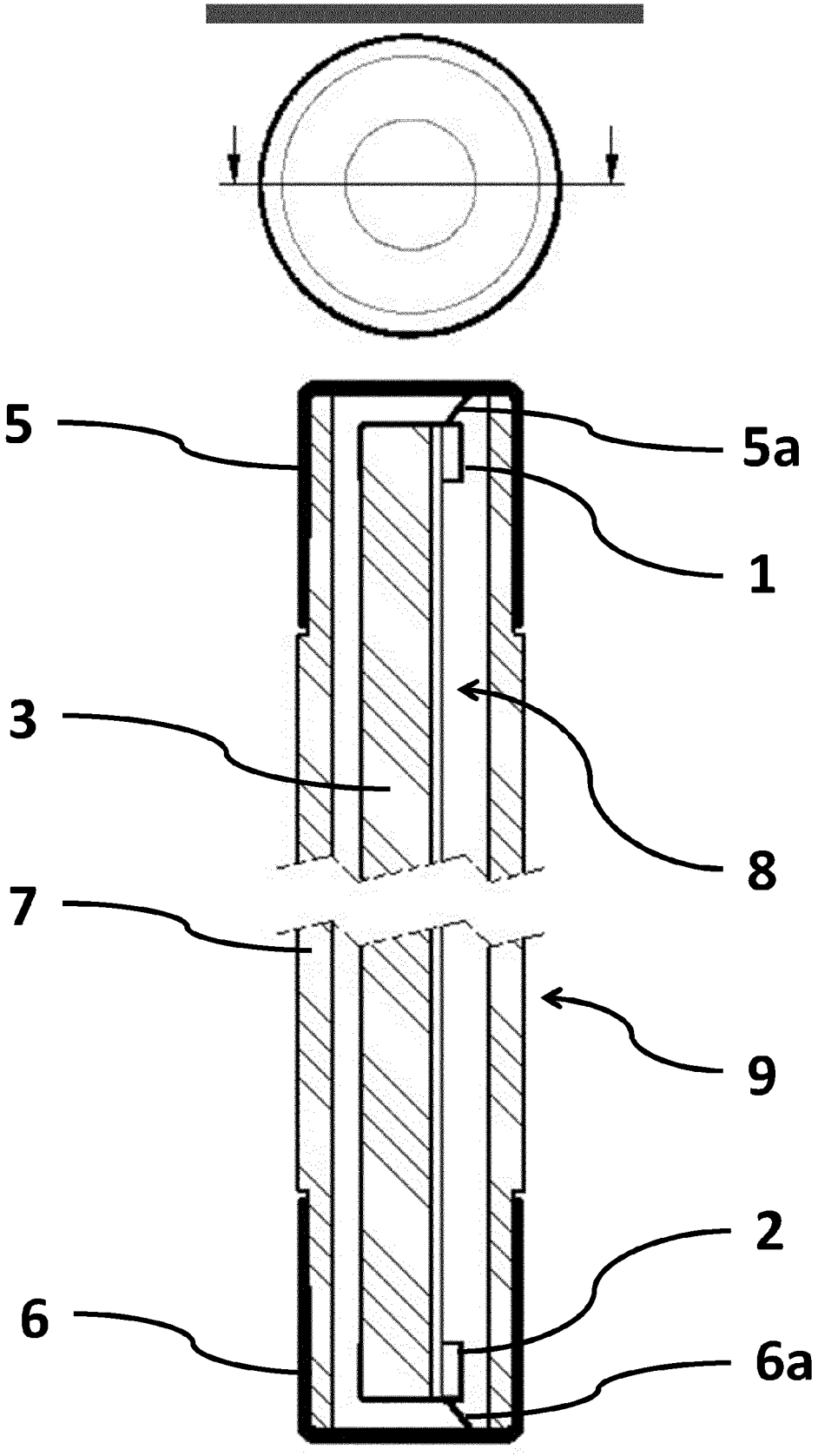

Fig. 1

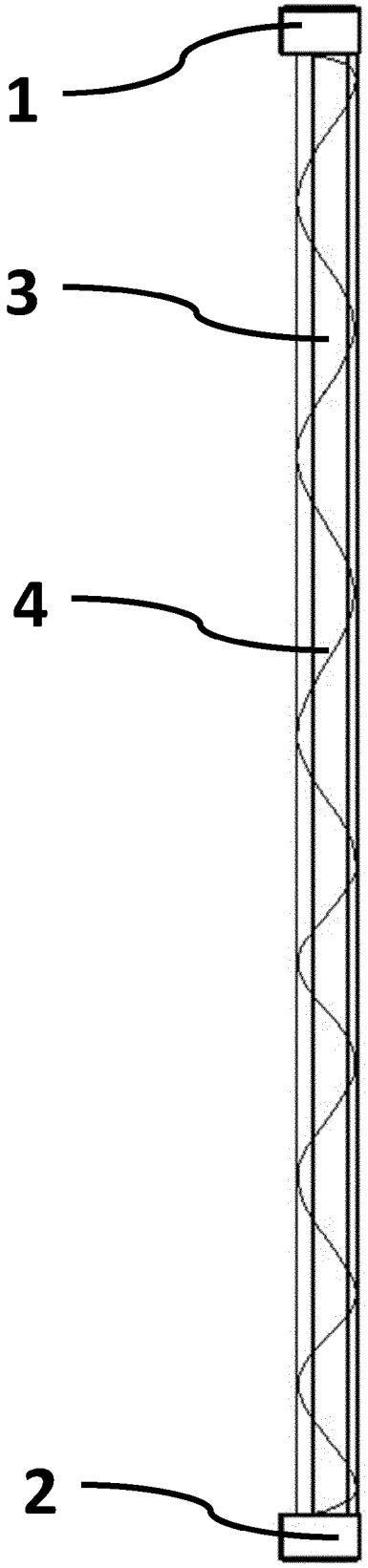

Fig. 2

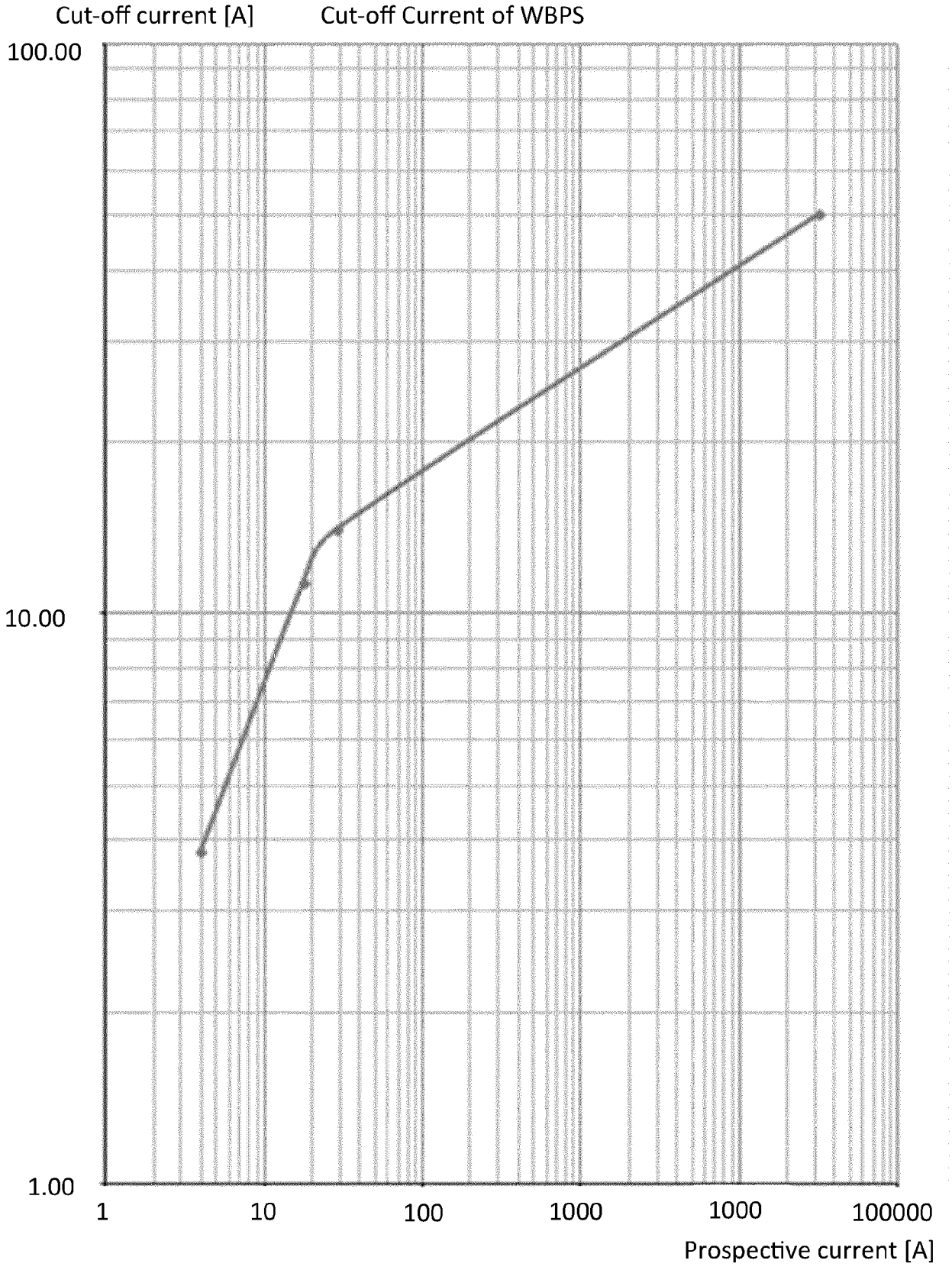
Cut-off current [A]
Cut-off Current of WBPS
100.00
10.00
1.00
1
10
100
1000
1000
100000
Prospective current [A]

Fig. 3

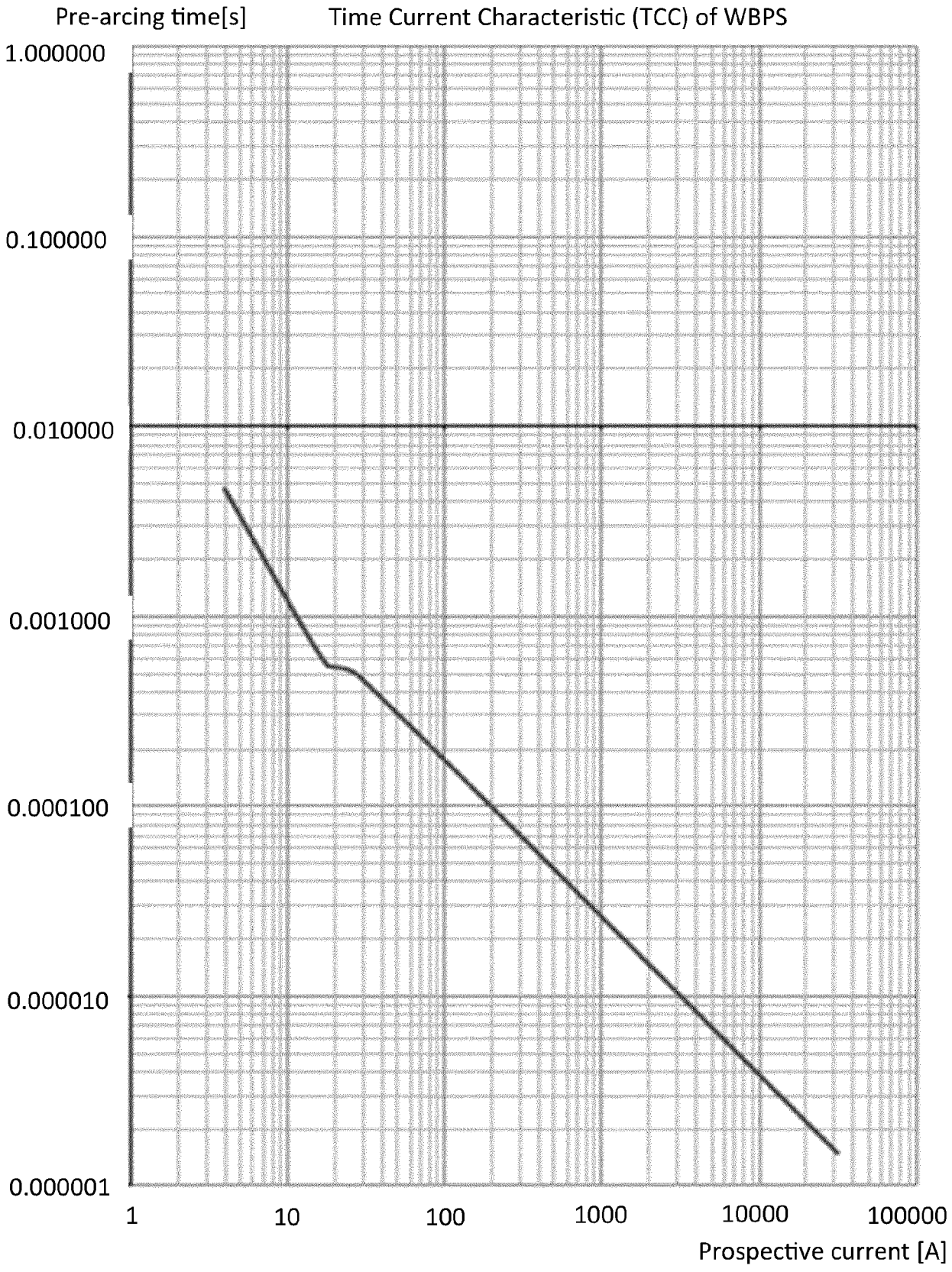
Pre-arcing time[s]
Time Current Characteristic (TCC) of WBPS
1.000000
0.100000
0.010000
0.001000
0.000100
0.000010
0.000001
1
10
100
1000
10000
100000
Prospective current [A]

Fig. 4

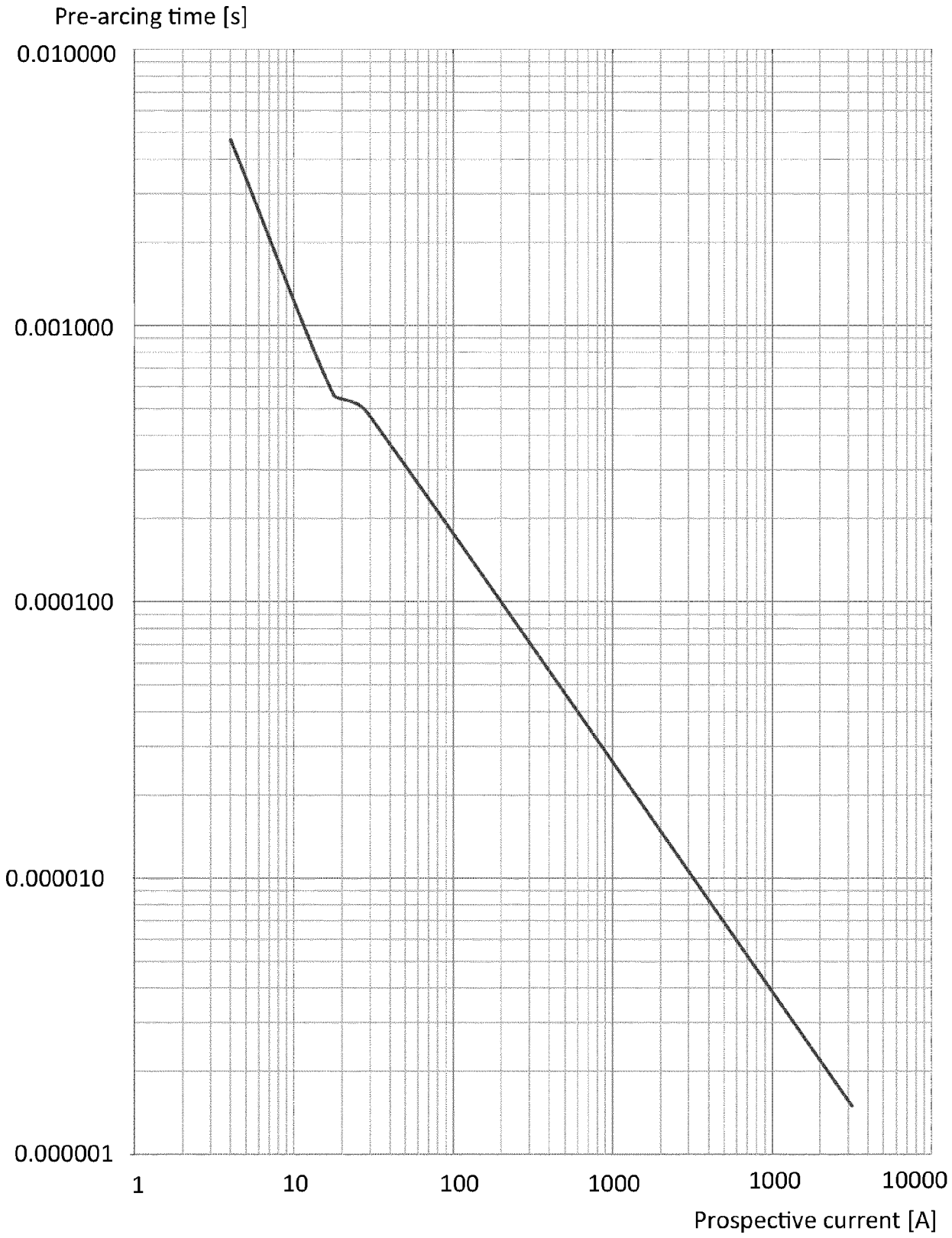
Pre-arcing time [s]
0.010000
0.001000
0.000100
0.000010
0.000001
1
10
100
1000
1000
10000
Prospective current [A]

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 4057

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 March 2024	Bauer, Rodolphe

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

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Munich	11 March 2024	Bauer, Rodolphe

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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