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(54) Vacuum interrupter for low-, medium-, or high voltage use, for high environmental pressure application

(57) The invention relates to a Vacuum interrupter for low-, medium-, or high-voltage use, for high environmental pressure application, with at least one moving contact and one fixed contact in an insulting ceramic housing.

In order to reduce the needed number of parts in the case of a pressure tight vacuum interrupter or switchgear installation in high pressure environment like in subsea application, the invention is, that the ceramic housing (4) of the vacuum interrupter itself is high pressure tight, in the range of vacuum inside the ceramic housing, and up to 500 Bar outside of ceramic housing.

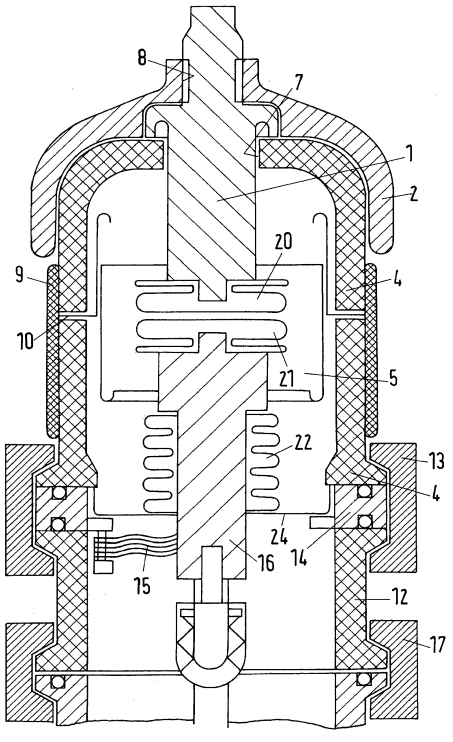

Fig.1

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Description

[0001] The invention relates to a Vacuum interrupter for low-, medium-, or high-voltage use, for high environmental pressure application, with at least one moving contact and one fixed contact in an insulting ceramic housing, according to the preamble of claim 1.

[0002] Vacuum interrupter application for such use in high pressure environment are known for subsea application. There switchgear arrangement for medium voltage use are applied for engines in mineral oil and gas subsea fields. For that, known vacuum switchgears are arranged in pressure tight containments which are not trivial to construct. Such pressure separate containments in which vacuum pole parts are arrangend into, makes the system highly complex.

[0003] So the object of the invention is, to reduce the needed number of parts in the case of a pressure tight vacuum interrupter or switchgear installation in high pressure environment like in subsea application.

[0004] The solution of the problem is the invention, wherein the ceramic housing of the vacuum interrupter itself is high pressure tight, in the range of vacuum inside the ceramic housing, and 500 Bar outside of the ceramic housing.

[0005] So the housing of the vacuum interrupter is pressure tight itself, and need not further external housing for producing pressuretightness against environmental high pressure.

[0006] Preferably the invention is used in medium voltage range.

[0007] A further advantageous embodiment is, that the fixed contact is connected to a fixed contact rod, extended through the ceramic housing of the vacuum interrupter housing at one distal end.

[0008] A further advantageous embodiment is, that the ceramic housing has one integral distal end, and that the fixed contact is connected to a fixed contact rod, extended through the ceramic housing of the vacuum interrupter at one distal end, and fixed at the ceramic housing of the vacuum interrupter by brazing.

[0009] So at the distal end of the vacuum interrupter, the vacuum interrupter has on the fixed contact side a externally ending contact rod, passing through the external metal cap at that side, and passing through the ceramic housing of the vacuum interrupter too.

[0010] The contact rod is there going through the ceramic housing as an end cap or lid, to fix the fixed contact side after brazing to the vacuum interrupter.

[0011] At the other end of the vacuum interrupter, there is a flange at the ceramic housing provided, which takes the connection between the movable side of the vacuum interrupter via a sliding or flexible contact system to the middle part of the flange.

[0012] In a further advantageous embodiment is described, that the distal end of the vacuum interrupter housing at the fixed contact rod side, is strengthend additionally by a metal cap with an opening, through which the fixed contact rod is guided pressuretightend through this opening.

[0013] So the contact rod of the fixed contact of the vacuum interrupter is brazed directly to the distal end of the ceramic housing of the vacuum interrupter.

[0014] This brazing has to be pressuretight. In order to prevent, that the environmental pressure presses the copper parts, for example the fixed contact rod into the vacuum interrupter, the additional metal cap at that side of the vacuum interrupter cares for force distribution.

[0015] Therefore in best mode, the distal end of the vacuum interrupter housing as well as the metal cap are domeshaped.

[0016] In a further advantageous embodiment, the metal cap is fixed pressuretight at the distal end of the ceramic housing of the vacuum interrupter by a liquid sealing material.

[0017] In a further advantageous embodiment is described, that at the moved contact side of the vacuum interrupter, the ceramic housing is closed by a metal cap and that the moving contact rod is gastightly provided with an at least axially flexible bellow, by which the moving contact is allowed to be moved for closing and opening the moving contact to or from the fixed contact.

[0018] So consequently is a further advantageous embodiment, that a cylindrical tube is attached pressuretightly at the ceramic housing of the vacuum interrupter at the moving contact side in such, that this cylindrical body only encloses the push rod of the moving contact and a drive for that pushrod.

[0019] In a further advantageous embodiment, the ceramic housing of the vacuum interrupter is a one part tube, in case of non use of a light arc shielding inside the vacuum interrupter.

[0020] Furthermore is advantageous, if the ceramic housing of the vacuum interrupter is a two part tube, in case of a placement of a shielding element inside the vacuum interrupter, so that the shielding is contacted externally by conducting elements from the shielding to an outer field stearing contact, and that the conducting elements are brazed on the opposing surfaces of the two parts of the ceramic housing of the vacuum interrupter pressuretightly.

[0021] So consequently is a further advantageous embodiment, that the cylindrical tube is attached and fixed pressure tight to the vacuum interrupter housing via a clamp ring, which corresponds with an integral collar or flange ring at both opposing sides of the vacuum interrupter housing and the tube.

[0022] A further advantageous embodiment is, that the cylindrical tube consist of at least two axially attached cylindrical tubes.

[0023] For finally pressuretight positioning of all relevant components, the cylindrical tube is closed at it open end with a closed pressure tightly fixed flange.

[0024] Consequently the cylindrical tube is made of an insulating material.

[0025] For advantageous contacting is described, that

between the flange of the vacuum interrupter housing, and the flange of the attached cylindrical tube is arranged also pressuretightly a contact ring as a contact terminal of the moving contact side, which is electrically connected to the push rod of the moving contact via a sliding contact or a flexible contact band.

[0026] For the use in a multi phases subsea arrangement, it is proposed a medium or high voltage switchgear for subsea application, with a vacuum interrupter arrangement according to one of the aforesaid claims, wherein for the three phase use, an arrangement of at least three vacuum interrupters is arranged in a container, which is filled with incompressible insulating fluid.

[0027] An embodiment of the invention is shown in figure 1.

[0028] The conclusional and basical feature of the invention is, that the housing of the vacuum interrupter is pessuretight itself, within vacuum inside, and high environmental pressure until 500 bar outside. For realizing this, a basical feature is that the insulating ceramic tube provides a brazing flange, to take the fixed contact rod of the vacuum interrupter. This flange is brazed to the ceramic tightly. Additionally an outer metal cap is positioned over that, and brazed also pressuretightly to the flange, which is formed as a collar at the fixed contact rod. A further metal cap is brazed vacuumtight on the ceramic tube, at that side, where the movable contact rod of the moving contact is brazed to a bellow, which is furthermore brazed to the metal cap at that side of the vacuum interrupter, in order to allow the movment of the movable contact rod switching path.

[0029] So at the fixed contact side, the metal cap with the brazed bellow is installed inside a cylindrical tube as an adapter inner part, to avoid high pressure at the part.

[0030] The middle side is a connection to a flange between two ceramic parts, that means the vacuum interrupter housing and the cylindrical tube, and on the bottom side there is the connection to the breaker assembly. To provide enough stiffness at the fixed contact side here a metal cap is installed to take the mechanical force from the fixed copper stem of the vacuum interrupter and to distribute the mechanical stress to the ceramic round shaped part. Between both parts liquid sealing is provided with the advantage the mismatch of both parts can be taken and the sealing against the liquid will be there.

[0031] To get connection between the ceramic and the metal parts here are clamp rings installed.

[0032] Furthermore the ceramic housing can be covered by a rubber material to avoid damage at the outer side of the housing during the subsea installation getting service.

[0033] In detail, the vacuum interrupter housing 4 is made of a insulating ceramic material. The housing could be a one part housing, if no shielding 5 is implemented inside the vacuum interrupter, or made of two parts, if a shielding 5 is implemented. In this case the two parts are brazed together with a contact collar of the shielding 5 between them.

[0034] The distal end of the housing 4 above has an opening 7, through which the fixed contact rod 1 is installed and pressuretightly fixed by brazing. For a better fixation of the contact rod 1, for example made of copper, an integral collar ring is formed at the contact rod 1, in such, that it can be brazed directly on the distal end of the ceramic housing 1 around the opening 7.

[0035] To strengthen the region around that brazed contact rod 1, a metal cap 2 is brazed or fixed with a liquid sealing on top of that, in order to distribute the force which is impacted by the external enviromental pressure.

[0036] Both, the distal end of the ceramic housing 4 of the vacuum interrupter, as well as the metal cap 2 is or are domeshaped.

[0037] The lower part of the vacuum interrupter housing 4 is closed also with a metal cap 24. This metal cap is located in the inner pressuretight region, so that this metal cap has only to be pressure tight against 1 or 2 bar on one side and vacuum on the other side.

[0038] The moved contact piece 21 is fixed to a movable contact rod 16, which is guided vacuum tight through the lower metal cap 24 by a bellow, which is brazed at one side to the movable contact rod 16 and at the other side brazed to the lower metal cap 24.

[0039] In case of the use of a shielding 5, the electrical contact to external is covered after brazing with a rubber manchet, or a manchet made of insulating material. The contact rod is electrically connected to a flexible contact band 15, which is furthermore electrically connected to a contact ring 14.

[0040] This contact ring 14 is placed between two integral flanges, one at the side of the vacuum interrupter housing 4, and one at side of the further cylindrical tube 12. Both opposing flanges, with the contact ring 14 between them, are fixed pressure tight by a clamp ring 13.

[0041] So this region is pressuretight against the environmental pressure.

[0042] Further tubes can be axially attached pressure tight, in order to integrate the drive inside.

[0043] So the contacts 20 and 21 of the vacuum interrupter can be finally electrically contacted to external terminals via the fixed contact rod 1 at one side, for example the fixed contact side, and at the contact ring 14 for example the moving contact side.

[0044] Addional further cylindrical tubes can be attached axially, so far they are needed to implement the drive of the moving contact rod 16.

[0045] For the use in a subsea switchgear, such vacuum interrupters can be installed for one- or three- or more-phases use in a tank, filled with insulating oil.

Position numbering

[0046]

1 fixed contact rod
2 metal cap
4 ceramic housing

5 Shielding
7 opening in the ceramic housing
8 opening in the metal cap
9 rubber cover
10 contacting of the shielding 5
12 cylindrical tube
13 clamp ring
14 contact ring
15 flexible contact band
16 movable contact rod
17 clamp ring
20 fixed contact
21 moving contact
22 Bellow
24 metal cap (lower metal cap)

Claims

1. Vacuum interrupter for low-, medium-, or high voltage use, for high environmental pressure application, with at least one moving contact and one fixed contact in an insulting vacuumtight and at least partly ceramic cylindrical housing,
characterized in
that the ceramic housing (4) of the vacuum interrupter itself is high pressure tight, in the range of vacuum inside the ceramic housing, and up to 500 Bar outside of the ceramic housing.

2. Vacuum interrupter according to claim 1,
characterized in
that the ceramic housing has one integral distal end, and that the fixed contact (20) is connected to a fixed contact rod (1), extended through the ceramic housing (4) of the vacuum interrupter at one distal end, and fixed at the ceramic housing of the vacuum interrupter by brazing.

3. Vacuum interrupter according to claim 2,
characterized in
that the distal end of the vacuum interrupter housing (4) at the fixed contact rod side, is strengthed additionally by a metal cap (2) with an opening (8), through which the fixed contact rod (1) is guided pressuretightend through this opening (8).

4. Vacuum interrupter according to claim 3,
characterized in
that the metal cap is fixed pressuretight at the distal end of the ceramic housing of the vacuum interrupter by a liquid sealing material.

5. Vacuum interrupter according to one of the aforesaid claims,
characterized in
that at the moved contact side of the vacuum interrupter, the ceramic housing (4) is closed by a further metal cap (24), and that the moving contact rod (16) is gastightly provided with an at least axially flexible bellow (22), by which the moving contact (21) is allowed to be moved for closing and opening the moving contact (21) to or from the fixed contact (20).

6. Vacuum interrupter according to one of the aforesaid claims 1 to 5,
characterized in
that the ceramic housing (4) of the vacuum interrupter is a one part tube, in case of non use of a light arc shielding inside the vacuum interrupter.

7. Vacuum interrupter according to one of the aforesaid claims 1 to 5,
characterized in
that the ceramic housing (4) of the vacuum interrupter is a two part tube, in case of a placement of a shielding element inside the vacuum interrupter, so that the shielding is contacted externally by conducting elements from the shielding to an outer field stearing contact, and that the conducting elements are brazed on the opposing surfaces of the two parts of the ceramic housing of the vacuum interrupter pressuretightly.

8. Vacuum interrupter according to one of the aforesaid claims,
characterized in
that a cylindrical tube (12) is attached pressuretightly at the ceramic housing (4) of the vacuum interrupter at the moving contact side in such, that this cylindrical tube (12) only encloses the push rod (16) of the moving contact (21) and a drive for that pushrod (16) pressuretightly.

9. Vacuum interrupter according to claim 5,
characterized in
that the cylindrical tube (12) is attached and fixed pressure tight to the vacuum interrupter housing (4) via a clamp ring (13), which corresponds with an integral collar or flange ring at both opposing sides of the vacuum interrupter housing (4) and sealing elements and the tube (12).

10. Vacuum interrupter according to claim 6,
characterized in
that the cylindrical tube (12) consists of at least two axially attached cylindrical tubes.

11. Vacuum interrupter according to one of the aforesaid claims,
characterized in
that the cylindrical tube (12) is closed at its open end with a closed pressure tightly fixed flange.

12. Vacuum interrupter according to one of the aforesaid claims,

characterized in
that the cylindrical tube (12) is made of an insulating material.

13. Vacuum interrupter according to one of the aforesaid claims,
characterized in
that the between the flange of the vacuum interrupter housing (4), and the flange of the attached cylindrical tube (12) is arranged also pressuretightly a contact ring (14) as a contact terminal of the moving contact side, which is electrically connected to the push rod (16) of the moving contact via a sliding contact or a flexible contact band.

14. Medium or high voltage switchgear for subsea application, with a vacuum interrupter arrangement according to one of the aforesaid claims, wherein for the one or more electrical phases use, an arrangement of at least three vacuum interrupters is arranged in a container, which is filled with incompressible insulating fluid.

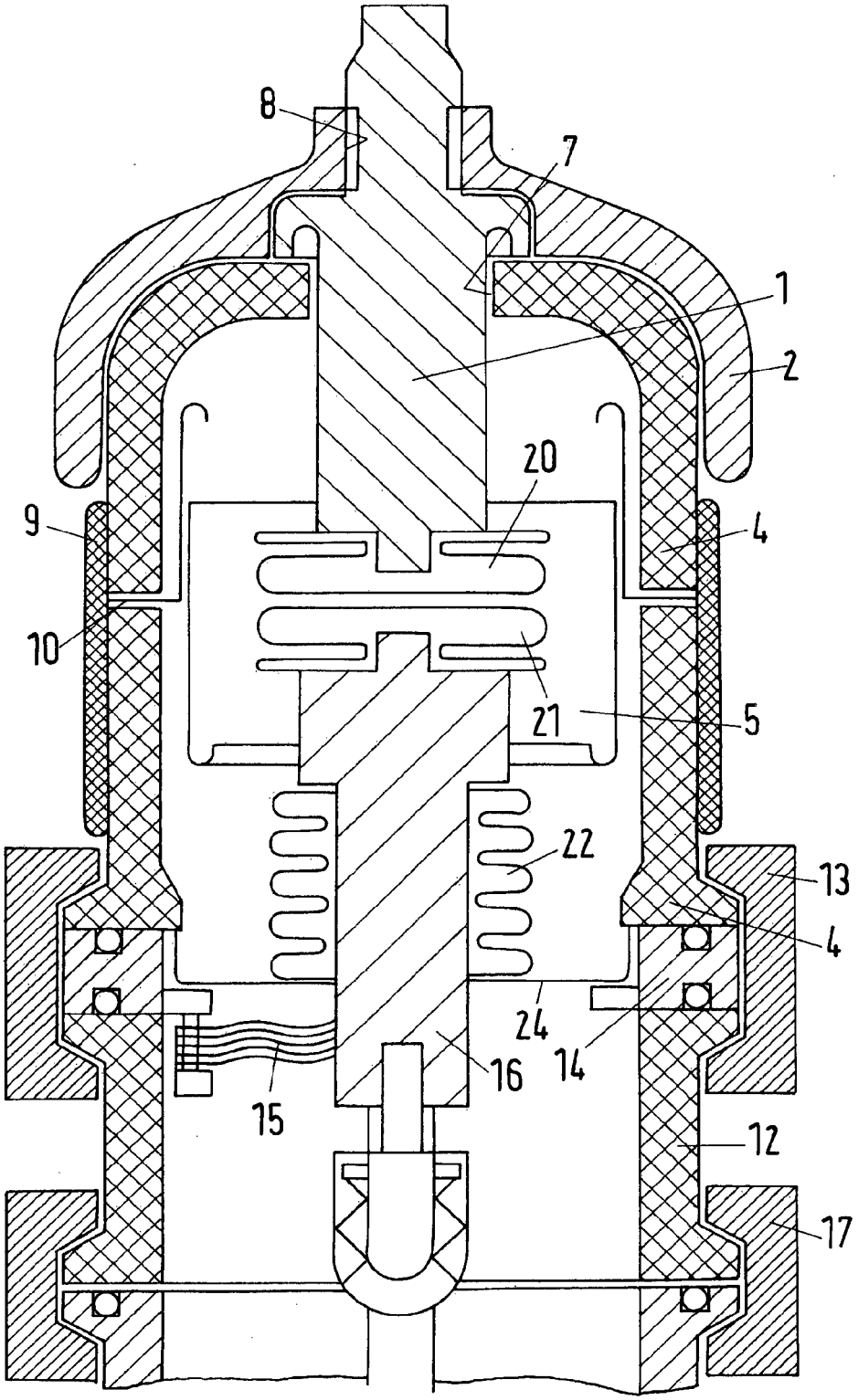

Fig.1

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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 3735

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H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 April 2015	Drabko, Jacek

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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