Claims

1. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone having from 4 to 12 carbon atoms, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

2. Insulation medium according to claim 1, characterized in that the fluoroketone has the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

3. Insulation medium according to any of the preceding claims, characterized in that the fluoroketone has 6 carbon atoms.

4. Insulation medium according to claim 3, characterized in that the fluoroketone is dodecafluoro-2-methylpentan-3-one.

5. Insulation medium according to any of the preceding claims, characterized in that the molar ratio of the fluoroketone in the insulation gas is at least 1%, preferably at least 2%, more preferably at least 5%, more preferably at least 10%, most preferably at least 15%.

~~6. Insulation medium according to any of the preceding~~ claims, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

7. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone having from 4 to 12 carbon atoms and having the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

8. Insulation medium according to claim 7, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

9. Insulation medium according to any of claims 7 to 8, characterized in that the fluoroketone has 6 carbon atoms.

10. Insulation medium according to claim 9, characterized in that the fluoroketone is dodecafluoro-2-methylpentan-3-one.

11. Insulation medium according to any of claims 7 to 10, characterized in that the molar ratio of the fluoroketone in the insulation gas is at least 1%, ~~preferably at least 2%, more preferably at least 5%,~~

~~more preferably at least 10%, most preferably at~~ least 15%.

12. Insulation medium according to any of claims 7 to 11, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

13. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone, characterized in that the fluoroketone has 6 carbon atoms.

14. Insulation medium according to claim 13, characterized in that the fluoroketone has the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

15. Insulation medium according to claim 13 or 14, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

16. Insulation medium according to any of claims 13 to 15, characterized in that the fluoroketone is dodecafluoro-2-methylpentan-3-one.

17. Insulation medium according to any of claims 13 to 16, characterized in that the molar ratio of the ~~fluoroketone in the insulation gas is at least 1%,~~

~~preferably at least 2%, more preferably at least 5%~~, more preferably at least 10%, most preferably at least 15%.

18. Insulation medium according to any of claims 13 to 17, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

19. Use of a fluoroketone according to any of claims 1 to 18 in a dielectric insulation medium.

20. Use of a fluoroketone according to claim 19, characterized in that the insulation medium is used for extinguishing an arc in an electrical switch, in particular in a low voltage switch, a medium voltage switch or a high voltage switch, in particular a circuit breaker.

21. Apparatus for the generation, the distribution or the usage of electrical energy, said apparatus comprising a housing defining an insulating space and an electrical active part arranged in the insulating space, said insulating space comprising an insulation medium, characterized by the dielectric insulation medium according to any of the claims 1 to 18.

22. Apparatus according to any of the preceding claims, the apparatus being a medium or high voltage apparatus.

23. Apparatus according to claim 21 or 22, characterized in that the apparatus is a switchgear, in particular ~~an air-insulated or a gas-insulated metal-~~

~~encapsulated switchgear, or a part or component~~ thereof, in particular a bus bar, a bushing, a cable, a gas-insulated cable, a cable joint, a current transformer, a voltage transformer, and/or a surge arrester.

24. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is a switch, in particular an earthing switch, a disconnector, a load-break switch and/or a circuit breaker.

25. Apparatus according to claim 24, characterized in that the apparatus is a high voltage circuit breaker having a heating chamber for providing a self-blasting effect, and that in a switching operation the fluoroketone is decomposed to fluorocarbon compounds having a lower number of carbon atoms in the heating chamber during a back-heating phase.

26. Apparatus according to claim 25, characterized in that the fluoroketone has 6 carbon atoms, and in particular is dodecafluoro-2-methylpentan-3-one.

27. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is a transformer, in particular a distribution transformer or a power transformer.

28. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is an electrical rotating machine, a generator, a motor, a drive, a semiconducting device, a computing machine, a power ~~electronics device, and/or a component thereof.~~

~~29. Apparatus according to any of claims 21 to 28,~~ characterized in that it further comprises a control unit for controlling individually or in combination a composition, a temperature, an absolute pressure, a partial pressure, a gas density and/or a partial gas density of the insulating medium or at least one of its components, respectively.

30. Apparatus according claim 29, characterized in that the control unit comprises a heater and/or vaporizer for controlling the partial pressure of the fluoroketone and, in particular, for maintaining it above a required partial pressure level.

31. Apparatus according to any of claims 29 to 30, characterized in that the control unit (10a, 10b) comprises a temperature control unit (10a) comprising a heating system for setting the housing (4), or at least a part of the housing (4), of the apparatus to a desired temperature, and/or the control unit (10a, 10b) comprises a fluid handling unit (10b) for dosing a concentration of the fluoroketone and for injecting the resulting insulation medium into the apparatus.

32. Apparatus according to any of claims 21-31, characterized by the apparatus having a reserve volume of liquid fluorketone and/or means for limiting a maximal permissible operating temperature of the desired insulation medium such that the absolute filling pressure is maintained below a given pressure limit of the apparatus.

~~33. Method for dimensioning an electrical apparatus~~ according to any of claims 21 to 31, characterized by the steps of

- determining for the apparatus a permissible electrical field strength of the desired insulation medium and a minimal permissible operating temperature of the desired insulation medium,
- determining from the pressure-reduced breakdown field strength of the desired insulation medium as a function of the molar fraction of the fluorketone, and from the permissible field strength the absolute pressure curve of the insulation medium as a function of the partial pressure of the fluorketone,
- selecting a desired absolute filling pressure of the insulation medium,
- determining from the absolute pressure curve the minimal required partial pressure of the fluorketone, and from the vapour pressure curve the corresponding vaporization temperature of the fluorketone, and
- determining whether the vaporization temperature is above the minimal permissible operating temperature of the desired insulation medium.

34. Method for dimensioning an electrical apparatus as claimed in claim 33, characterized by the further step of, if the vaporization temperature is below the minimal permissible operating temperature of the desired insulation medium, providing a fluid management system, in particular the fluid management ~~system claimed in any of claims 29-32, preferably~~

~~comprising means for heating and/or vaporization~~ and/or fluid reserve ~~management~~ of liquid phase fluorketone, ~~for~~ maintaing the partial pressure above ~~the minimal required partial pressure.~~

Replaced by New Claims 1 to 34.

**Claims**

1. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone having from 4 to 12 carbon atoms, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

2. Insulation medium according to claim 1, characterized in that the fluoroketone has the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

3. Insulation medium according to any of the preceding claims, characterized in that the fluoroketone has from 4 to 10 carbon atoms, more preferably from 4 to 8 carbon atoms, and most preferably 6 carbon atoms.

4. Insulation medium according to claim 3, characterized in that the fluoroketone is dodecafluoro-2-methylpentan-3-one.

5. Insulation medium according to any of the preceding claims, characterized in that the molar ratio of the fluoroketone in the insulation gas is at least 1%, preferably at least 2%, more preferably at least 5%, more preferably at least 10%, most preferably at least 15%.

6. Insulation medium according to any of the preceding claims, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

7. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone having from 4 to 12 carbon atoms and having the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

8. Insulation medium according to claim 7, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

9. Insulation medium according to any of claims 7 to 8, characterized in that the fluoroketone has from 4 to 10 carbon atoms, more preferably from 4 to 8 carbon atoms, and most preferably 6 carbon atoms.

10. Insulation medium according to claim 9, characterized in that the fluoroketone is dodecafluoro-2-methylpentan-3-one.

11. Insulation medium according to any of claims 7 to 10, characterized in that the molar ratio of the fluoroketone in the insulation gas is at least 1%, preferably at least 2%, more preferably at least 5%,

more preferably at least 10%, most preferably at least 15%.

12. Insulation medium according to any of claims 7 to 11, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

13. Dielectric insulation medium comprising an insulation gas, said insulation gas comprising at operational conditions a fluoroketone, characterized in that the fluoroketone has 6 carbon atoms.

14. Insulation medium according to claim 13, characterized in that the fluoroketone has the general structure

R1-CO-R2

wherein R1 and R2 are at least partially fluorinated chains, said chains being independently from each other linear or branched and having from 1 to 10 carbon atoms.

15. Insulation medium according to claim 13 or 14, characterized in that the fluoroketone has a boiling point of at least -5°C at ambient pressure.

16. Insulation medium according to any of claims 13 to 15, characterized in that the fluoroketone is a perfluorinated ketone having the molecular formula $C_6F_{12}O$, and most preferably is dodecafluoro-2-methylpentan-3-one.

17. Insulation medium according to any of claims 13 to 16, characterized in that the molar ratio of the fluoroketone in the insulation gas is at least 1%,

preferably at least 2%, more preferably at least 5%, more preferably at least 10%, most preferably at least 15%.

18. Insulation medium according to any of claims 13 to 17, characterized in that the insulation gas is a gas mixture, which further comprises air or at least one air component, in particular selected from the group consisting of carbon dioxide, oxygen and nitrogen.

19. Use of a fluoroketone according to any of claims 1 to 18 in a dielectric insulation medium.

20. Use of a fluoroketone according to claim 19, characterized in that the insulation medium is used for extinguishing an arc in an electrical switch, in particular in a low voltage switch, a medium voltage switch or a high voltage switch, in particular a circuit breaker.

21. Apparatus for the generation, the distribution or the usage of electrical energy, said apparatus comprising a housing defining an insulating space and an electrical active part arranged in the insulating space, said insulating space comprising an insulation medium, characterized by the dielectric insulation medium according to any of the claims 1 to 18.

22. Apparatus according to any of the preceding claims, the apparatus being a medium or high voltage apparatus.

23. Apparatus according to claim 21 or 22, characterized in that the apparatus is a switchgear, in particular an air-insulated or a gas-insulated metal-

encapsulated switchgear, or a part or component thereof, in particular a bus bar, a bushing, a cable, a gas-insulated cable, a cable joint, a current transformer, a voltage transformer, and/or a surge arrester.

24. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is a switch, in particular an earthing switch, a disconnector, a load-break switch and/or a circuit breaker.

25. Apparatus according to claim 24, characterized in that the apparatus is a high voltage circuit breaker having a heating chamber for providing a self-blasting effect, and that in a switching operation the fluoroketone is decomposed to fluorocarbon compounds having a lower number of carbon atoms in the heating chamber during a back-heating phase.

26. Apparatus according to claim 25, characterized in that the fluoroketone has 6 carbon atoms, and in particular is dodecafluoro-2-methylpentan-3-one.

27. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is a transformer, in particular a distribution transformer or a power transformer.

28. Apparatus according to any of claims 21 to 23, characterized in that the apparatus is an electrical rotating machine, a generator, a motor, a drive, a semiconducting device, a computing machine, a power electronics device, and/or a component thereof.

29. Apparatus according to any of claims 21 to 28, characterized in that it further comprises a control unit for controlling individually or in combination a composition, a temperature, an absolute pressure, a partial pressure, a gas density and/or a partial gas density of the insulating medium or at least one of its components, respectively.

30. Apparatus according claim 29, characterized in that the control unit comprises a heater and/or vaporizer for controlling the partial pressure of the fluoroketone and, in particular, for maintaining it above a required partial pressure level.

31. Apparatus according to any of claims 29 to 30, characterized in that the control unit (10a, 10b) comprises a temperature control unit (10a) comprising a heating system for setting the housing (4), or at least a part of the housing (4), of the apparatus to a desired temperature, and/or the control unit (10a, 10b) comprises a fluid handling unit (10b) for dosing a concentration of the fluoroketone and for injecting the resulting insulation medium into the apparatus.

32. Apparatus according to any of claims 21-31, characterized by the apparatus having a reserve volume of liquid fluorketone and/or means for limiting a maximal permissible operating temperature of the desired insulation medium such that the absolute filling pressure is maintained below a given pressure limit of the apparatus.

33. Method for dimensioning an electrical apparatus according to any of claims 21 to 31, characterized by the steps of

- determining for the apparatus a permissible electrical field strength of the desired insulation medium and a minimal permissible operating temperature of the desired insulation medium,
- determining from the pressure-reduced breakdown field strength of the desired insulation medium as a function of the molar fraction of the fluorketone, and from the permissible field strength the absolute pressure curve of the insulation medium as a function of the partial pressure of the fluorketone,
- selecting a desired absolute filling pressure of the insulation medium,
- determining from the absolute pressure curve the minimal required partial pressure of the fluorketone, and from the vapour pressure curve the corresponding vaporization temperature of the fluorketone, and
- determining whether the vaporization temperature is above the minimal permissible operating temperature of the desired insulation medium.

34. Method for dimensioning an electrical apparatus as claimed in claim 33, characterized by the further step of, if the vaporization temperature is below the minimal permissible operating temperature of the desired insulation medium, providing a fluid management system, in particular the fluid management system claimed in any of claims 29-32, preferably

comprising means for heating and/or vaporization and/or fluid reserve management of liquid phase fluorketone, for maintaing the partial pressure above the minimal required partial pressure.