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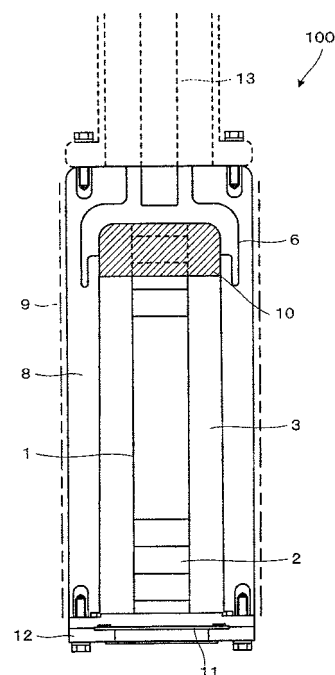
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(54) **ARRESTER**

(57) A surge arrester has: a surge arrester internal element made by stacking a plurality of nonlinear resistors; a cylinder-shaped insulating container housing the surge arrester internal element and housing insulating gas therein; a high-voltage side conductor provided in an end portion of the insulating container in a manner to form an exposed surface exposed to the inside of the insulating container, and electrically connected to the surge arrester internal element; and an insulating resin layer covering at least a boundary portion between the exposed surface of the high-voltage side conductor and an inside surface of the insulating container.

FIG. 1



Description

TECHNICAL FIELD

[0001] An embodiment of the present invention relates to a surge arrester having a nonlinear resistor whose main component is zinc oxide and provided in a power transmission line, a power plant, a substation and so on.

BACKGROUND

[0002] A surge arrester using a zinc oxide element has excellent characteristics such as voltage-current nonlinearity, a discharge tolerated dose characteristic, and chemical stability. In recent years, a high-performance surge arrester in which a protection characteristic is substantially improved is developed, and is applied to protect a gas-insulated switchgear, a transformer, and so on installed in a power plant, a substation, and so on from an abnormal voltage.

[0003] As such a surge arrester, there can be cited a tank-type surge arrester in which sulfur hexafluoride gas excellent in insulation performance is sealed, a porcelain-clad type surge arrester in which nitrogen or air is sealed, a polymer-type surge arrester, and so on.

[0004] The tank-type surge arrester, among the above, has become possible to be formed substantially smaller in size similarly to other switchgears by application of the sulfur hexafluoride gas as an insulating medium, thereby exhibiting a significant effect in reduction of an installation area in substation facilities or the like (for example, see Reference 1).

[0005] On the other hand, under the circumstances of recent increase in global interest in environmental issues, restriction on sulfur hexafluoride which has a global warming coefficient 23900 times as large as that of carbon dioxide is strengthened, and substation equipment using alternative gas and substation equipment not using insulating gas are being studied in individual institutions.

[0006] A configuration of a conventional tank-type surge arrester will be described with reference to Fig. 3. As shown in Fig. 3, a surge arrester internal element 1 in which zinc oxide elements 2 are stacked in series is housed and disposed in a vertically disposed ground tank 5 in which insulation gas 3 composed of sulfur hexafluoride gas is sealed, coaxially with the ground tank 5. One end (upper end portion in Fig. 3) in an axial direction of the surge arrester internal element 1 is connected to a not-shown substation bus bar via a high-voltage side conductor 6 supported by an insulating spacer 4. In the above tank-type surge arrester, a shield 7 for uniformizing voltage allotment related to the zinc oxide element 2 is disposed in a high-voltage side of the surge arrester internal element 1, and a ground potential portion is connected to a low-voltage side of the surge arrester internal element 1.

RELEVANT REFERENCES

Patent Reference

5 **[0007]** Reference 1: JP-A 2001-068308 (KOKAI)

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

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[0008] As described above, it is desirable to refrain from using sulfur hexafluoride gas excellent in insulation characteristic, in view of reducing an environmental load. However, when the sulfur hexafluoride gas is not used, an electric field intensity of each portion becomes so high that there is a problem that a dielectric breakdown occurs at a time of entry of an operation voltage or an abnormal voltage, which highly possibly leads to a system accident.

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[0009] The present invention is made to cope with such conventional circumstances, and its object is to provide a surge arrester capable of reducing an environmental load, of suppressing an electric field of a high electric field portion, and of enduring various electric stresses.

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Means for Solving the Problems

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[0010] A surge arrester in a mode of the present invention has: a surge arrester internal element made by stacking a plurality of nonlinear resistors; a cylinder-shaped insulating container housing the surge arrester internal element and housing insulating gas therein; a high-voltage side conductor provided in an end portion of the insulating container in a manner to form an exposed surface exposed to the inside of the insulating container, and electrically connected to the surge arrester internal element; and an insulating resin layer covering at least a boundary portion between the exposed surface of the high-voltage side conductor and an inside surface of the insulating container.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

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[Fig. 1] Fig. 1 is a vertical cross-sectional view showing a schematic configuration of a surge arrester according to an embodiment.

[Fig. 2] Fig. 2 is a vertical cross-sectional view showing a schematic configuration of a surge arrester according to another embodiment.

[Fig. 3] Fig. 3 is a vertical cross-sectional view showing a schematic configuration of an example of a conventional tank-type surge arrester.

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DETAILED DESCRIPTION OF THE INVENTION

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[0012] Hereinafter, embodiments of the present invention will be described with reference to the drawings.

[0013] Fig. 1 is a vertical cross-sectional view schematically showing a schematic configuration of a surge arrester 100 according to an embodiment of the present invention. As shown in Fig. 1, the surge arrester 100 according to this embodiment has a column-shaped surge arrester internal element 1 configured by stacking a plurality of column-shaped zinc oxide elements 2 being non-linear resistors in series.

[0014] The surge arrester internal element 1 is housed in a center portion of an insulating container 8 formed in a cylinder shape, coaxially with the insulating container 8. Further, inside the insulating container 8 is housed insulating gas 3 which has a lower global warming coefficient as compared with sulfur hexafluoride gas. As the insulating gas 3, any of, for example, nitrogen, carbon dioxide, and dry air, or the like can be used.

[0015] The insulating container 8 is formed of, for example, an insulating resin such as a silicone resin and an epoxy resin. An outer side of the insulating container 8 is coated with a conductive coating material 9, thereby to play a similar role to that of a ground container in a conventional tank-type surge arrester.

[0016] In one end (lower side end portion in Fig. 1) of the insulating container 8 is provided a cover 12 having a pressure discharge device 11. By the cover 12, airtightness of an interior of the insulating container 8 can be held, and even if the surge arrester internal element 1 breaks by accidental overload and an internal pressure in the insulating container 8 rises, gas in the insulating container 8 is discharged by the pressure discharge device 11 thereby reducing rise of the pressure, whereby explosive scattering is prevented.

[0017] On the other hand, in the other end (upper side end portion in Fig. 1) of the insulating container 8 is embedded a high-voltage side conductor 6. The high-voltage side conductor 6 is electrically connected to a GIS (gas-insulated switchgear) connecting conductor 13, and is electrically connected to not-shown opening and closing device and transformer via the GIS connecting conductor 13.

[0018] One end (upper side end portion in Fig. 1) in an axial direction of the surge arrester internal element 1 is electrically connected to the high-voltage side conductor 6. Besides, the surge arrester internal element 1 is electrically connected to the not-shown opening and closing device and transformer via the high-voltage side conductor 6 and the GIS connecting conductor 13. On the other hand, a low-voltage side (lower side end portion in Fig. 1) of the surge arrester internal element 1 penetrates the insulating container 8 airtightly and is electrically connected to a ground potential portion.

[0019] The above-described high-voltage side conductor 6 embedded in the insulating container 8 is electrically connected to an upper end of the surge arrester internal element 1 and is extended toward a lower side in a manner to enclose, with a space, a periphery of the upper end portion of the surge arrester internal element 1. Accordingly, an exposed surface in which the high-

voltage side conductor 6 is exposed is formed in a ceiling surface inside the insulating container 8 and in an upper inner wall surface continued from the ceiling surface. The high-voltage side conductor 6 configured as above also plays a role of controlling voltage allotment along the axial direction of the surge arrester internal element 1.

[0020] In a boundary portion between the exposed surface of the high-voltage side conductor 6 and an inside surface (inner wall) of the insulating container 8, an electric field stress becomes quite high. Thus, it is highly possible that a dielectric breakdown occurs in that portion when a high voltage is applied. In particular, when nitrogen, carbon dioxide, dry air, or the like is used as the insulating gas 3 instead of sulfur hexafluoride gas, such a risk becomes high.

[0021] Thus, in the surge arrester of this embodiment, an insulating resin layer 10 is disposed in a manner to cover at least the boundary portion between the exposed surface of the high-voltage side conductor 6 and the inner wall of the insulating container 8. The insulating resin layer 10 can be formed of, for example, a silicone resin, an epoxy resin, or the like. In the surge arrester 100 shown in Fig. 1, in the upper end portion of the insulating container 8, the insulating resin layer 10 is formed by filling the insulating resin between the insulating container 8 inner wall and the surge arrester internal element 1. Therefore, it is in a state where an outer peripheral surface of a high-voltage side portion of the surge arrester internal element 1 is covered by the insulating resin layer 10.

[0022] However, it suffices if the insulating resin layer 10 is disposed in a manner to cover at least the boundary portion between the exposed surface of the high-voltage side conductor 6 and the inner wall of the insulating container 8, and for example, as in a surge arrester 100a shown in Fig. 2, an insulating resin layer 10a can be disposed in a ring shape along a boundary portion between an exposed surface of a high-voltage side conductor 6 and an inner wall of an insulating container 8. In this case, the insulating resin layer 10a can be formed, for example, by applying an insulating resin along the boundary portion between the exposed surface of the high-voltage side conductor 6 and the inner wall of the insulating container 8.

[0023] Note that in the surge arrester 100a shown in Fig. 2, since portions except the above-described insulating resin layer 10a are configured similarly to those in the surge arrester 100 shown in Fig. 1, the same reference signals are given to the corresponding portions and redundant explanation will be omitted.

[0024] In the surge arrester 100 and the surge arrester 100a configured as above, even when nitrogen, carbon dioxide, or dry air, which has a lower global warming coefficient compared with sulfur hexafluoride gas, is used as the insulating resin gas 3, it is possible to significantly reduce a possibility of an occurrence of the dielectric breakdown in the boundary portion between the exposed surface of the high-voltage side conductor 8 and the inner

wall of the insulating container 8, in the boundary portion the electric field stress becoming quite high when the high voltage is applied. In other words, a dielectric breakdown level in the high electric field portion can be raised. Thereby, it becomes possible to endure various electric stresses, and the surge arrester can be also reduced in size and weight.

[0025] In the above-described surge arrester 100 and surge arrester 100a, when forming the insulating resin layer 100 and the insulating resin layer 10a, zinc oxide varistor powder, which has a high electric field relaxation effect, can be mixed in the insulating resin. When the zinc oxide varistor powder is mixed in the insulating resin as just described, the dielectric breakdown level can be further raised by the electric field relaxation effect.

[0026] As described above, in the surge arrester 100 and the surge arrester 100a according to the embodiment, even if nitrogen, carbon dioxide, or dry air, which has lower global warming coefficient compared with sulfur hexafluoride gas, is used as the insulating gas 3, the dielectric breakdown level in the high electric field portion can be secured and an environmental load can be reduced by not using sulfur hexafluoride gas. Further, reduction in size and weight of the surge arrester can be made, whereby cost reduction of the surge arrester itself, as a matter of course, can be made, and cost reduction of an entire substation to which the surge arrester is applied can be made.

[0027] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiment described herein may be embodiment in a variety of other forms; furthermore, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. A surge arrester comprising:

a surge arrester internal element made by stacking a plurality of nonlinear resistors;
a cylinder-shaped insulating container housing the surge arrester internal element and housing insulating gas therein;
a high-voltage side conductor provided in an end portion of the insulating container in a manner to form an exposed surface exposed to the inside of the insulating container, and electrically connected to the surge arrester internal element; and
an insulating resin layer covering at least a boundary portion between the exposed surface

of the high-voltage side conductor and an inside surface of the insulating container.

2. The surge arrester according to claim 1, wherein the insulating gas housed inside the insulating container is any one of nitrogen, carbon dioxide, and dry air.
3. The surge arrester according to claim 1, wherein zinc oxide varistor powder is mixed in the insulating resin layer.
4. The surge arrester according to claim 2, wherein zinc oxide varistor powder is mixed in the insulating resin layer.
5. The surge arrester according to any one of claims 1-4, wherein the insulating resin layer is formed by filling an insulating resin between the insulating container and a portion in a high-voltage side of the surge arrester internal element.
6. The surge arrester according to any one of claims 1-4, wherein the insulating resin layer is formed in a ring shape along the boundary portion between the exposed surface of the high-voltage side conductor and the inside surface of the insulating container.

FIG. 1

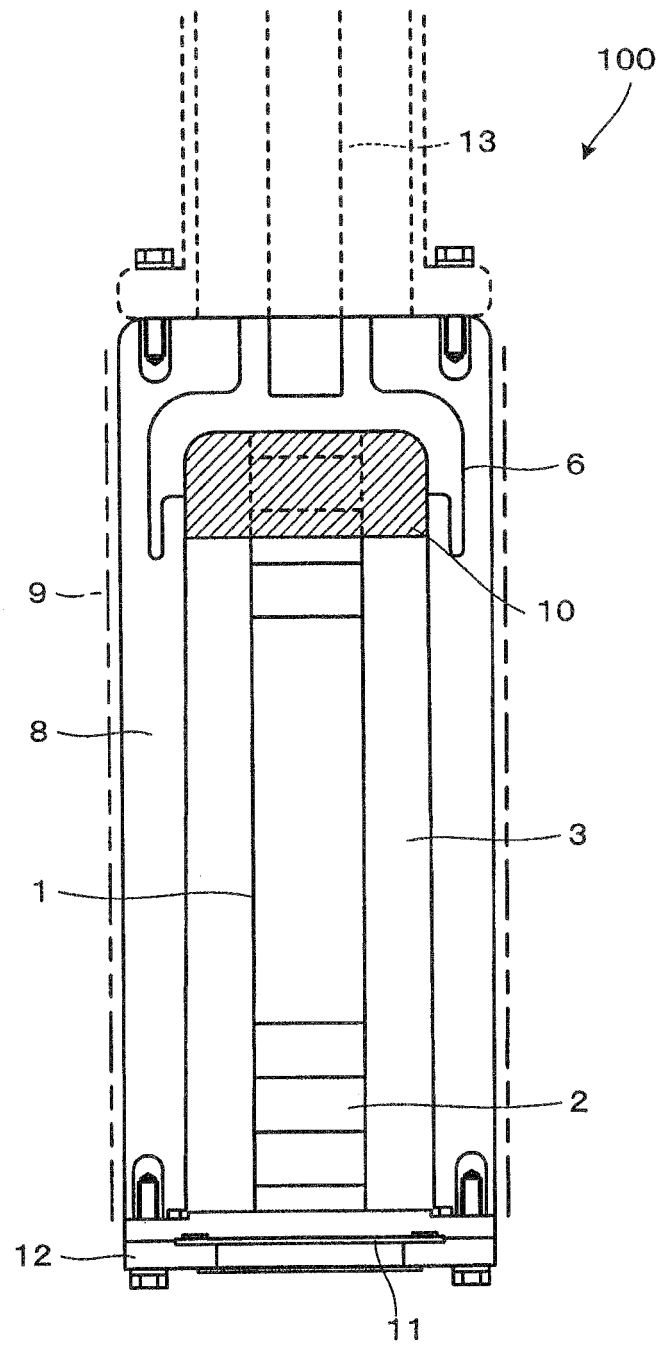


FIG. 2

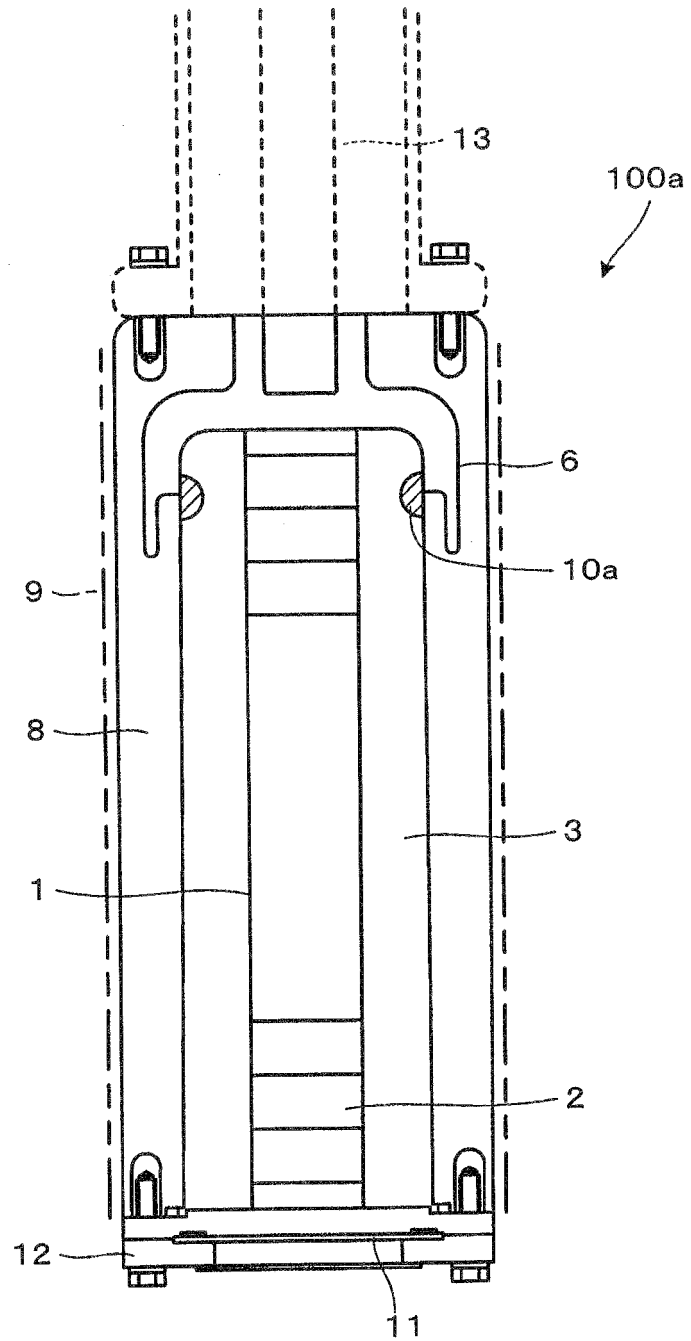
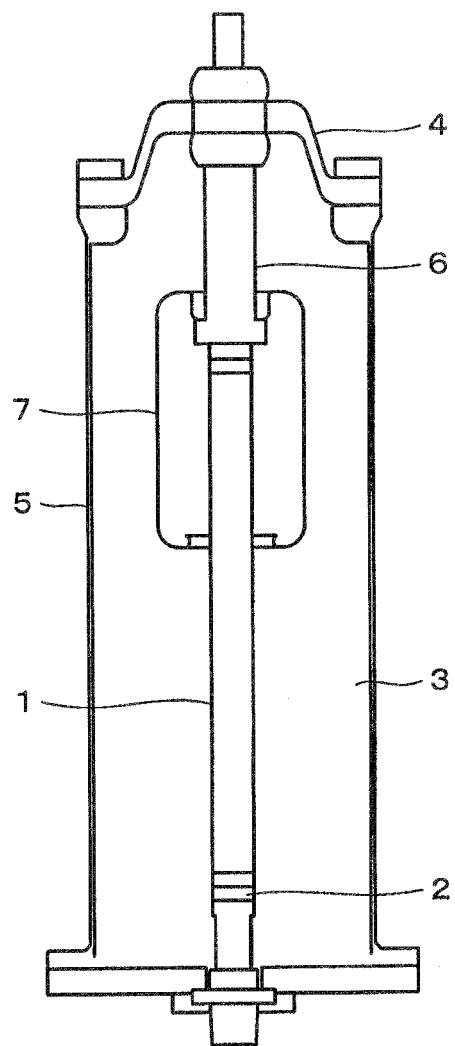


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000053

A. CLASSIFICATION OF SUBJECT MATTER H01C7/12(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) H01C7/12 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011 Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-004687 A (Toshiba Corp.), 07 January 2010 (07.01.2010), entire text; all drawings (Family: none)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 101120/1988(Laid-open No. 024505/1990) (Toko Electric Corp.), 19 February 1990 (19.02.1990), entire text; all drawings (Family: none)	1-6
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 04 April, 2011 (04.04.11)		Date of mailing of the international search report 12 April, 2011 (12.04.11)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000053

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-306136 A (Mitsubishi Electric Corp.), 18 December 2008 (18.12.2008), entire text; all drawings (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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