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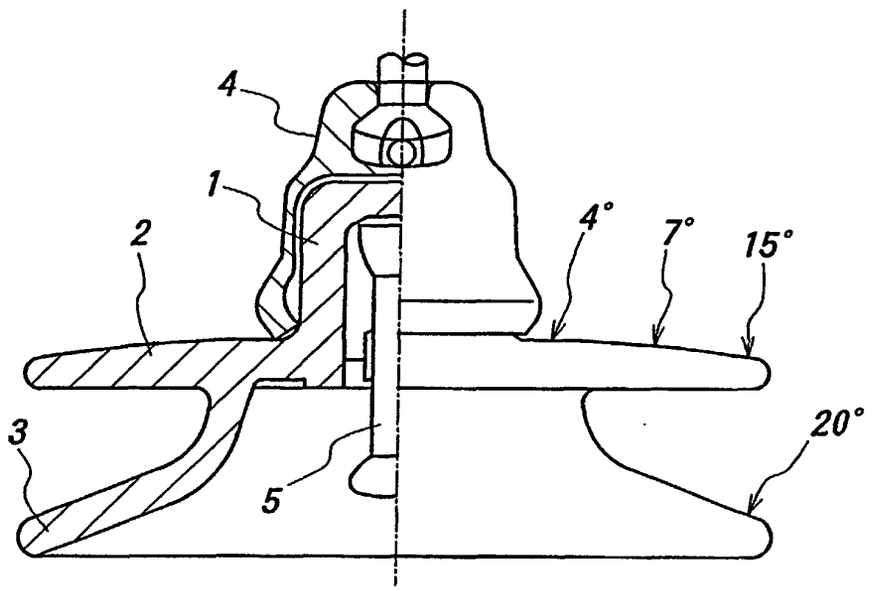
(54) RIBBED SUSPENSION INSULATOR

(57) An upper shed extending in a lateral direction from a lower surface of a head portion is formed, and a lower shed having a gradually spreading shape is formed from a halfway portion of the upper shed in such a manner that it curves. An intermediate shed may be formed between the upper shed and the lower shed. An upper surface of respective upper and lower sheds is inclined by 4 - 35° preferably 5 - 20° so as to prevent a stagnant wind. In this way, it is possible to prevent an adhesion of pollution materials to a lower surface. Moreover, a long creepage distance can be achieved by outer surfaces, and thus it is possible to maintain a voltage resistance performance.

FIG. 1



EP 1 229 557 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an outer-rib type suspension insulator used preferably in an industrially heavy pollution area.

BACKGROUND ART

[0002] As a suspension insulator used under pollution environments, it is general to use an anti-pollution type insulator in which a length of respective under-ribs is longer than that of a standard insulator, as shown in Fig. 6. The anti-pollution type insulator can make an under creepage distance longer since the length of respective under-ribs is long, thereby improving a voltage resistance. The anti-pollution type insulator mentioned above is widely used in our country (Japan).

[0003] Whereas, in the other industrially heavy pollution area of for example Asia, since a large amount of powder dusts are suspended in air, the powder dusts are easy to intrude into an inner portion of the ribs by wind and adhere to a surface of the rib. This phenomenon is different from our country. Therefore, even if the anti-pollution insulator is used in the other industrially heavy pollution area, a long rib of the anti-pollution type insulator has no effect, and an amount of adhered pollution materials is considerably increased in proportion to a long duration of service. In this manner, when the known anti-pollution type insulator is used in the other industrially heavy pollution area of for example Asia, it is necessary to repeat a washing operation frequently.

[0004] An object of the invention is to eliminate the drawbacks mentioned above and to provide a suspension insulator in which an accumulative amount of adhered pollution materials is low even if used in an industrially heavy pollution area and in which an excellent voltage resistance can be maintained for a long duration.

DISCLOSURE OF INVENTION

[0005] According to the invention, an outer-rib type suspension insulator, wherein an upper shed extending in a lateral direction is formed on a periphery of a head portion and a lower shed having a gradually spreading shape is formed from a halfway portion of the upper shed in such a manner that it curves outward, is characterized in that an upper surface of respective upper and lower sheds is inclined by 4 - 35°, thereby decreasing an accumulative amount of adhered pollution materials. In this embodiment, it is possible to form one or more intermediate sheds having an inclination angle of the upper surface of 4 - 35° between the upper shed and the lower shed. Moreover, it is preferred to set an inclination angle of the upper surface of the sheds to 5 - 20°.

[0006] In the outer-rib type suspension insulator according to the invention, since the lower shed having a gradually spreading shape is formed from a halfway portion of the upper shed in such a manner that it curves outward, an inner surface of thereof is smooth with no concavo-convex portions due to the under-ribs. Therefore, pollution materials such as suspended powder dusts are difficult to adhere accumulatively to the inner portion. Moreover, since respective sheds has a small inclination angle and a flat shape, the pollution materials are difficult to adhere to the sheds, and a washing effect due to rain is large. In addition, since a long creepage distance can be assured by the sheds, it is possible to maintain an excellent voltage resistance for a long duration even if used in an industrially heavy pollution area.

[0007] Hereinafter, embodiments of the present invention will be shown.

[0008] Fig. 1 is an outer-rib type suspension insulator according to a first embodiment of the invention. In the first embodiment shown in Fig. 1, a numeral 1 is a hollow head portion and a numeral 2 is an upper shed extending in a lateral direction, which is formed on a lower periphery of the head portion 1. As shown in Fig. 1, an angle of an upper surface of the upper shed 2 (i.e. an angle with respect to a horizontal surface in the case that a center axis of the insulator is assumed to be a perpendicular axis) is 4° at near a center portion and 15° at near an outer peripheral portion. A lower shed 3 having a gradually spreading shape is formed from a halfway portion of a lower surface of the upper shed 2 in such a manner that it curves outward. In this embodiment, an outer diameter of the lower shed 3 is the same as that of the upper shed 2 and is 320 mm. Moreover, an angle of an upper surface of the lower shed 3 is 20°. Further, a cap fitting 4 is connected to an outer portion of the head portion 1 via cement, and a clevis type pin fitting 5 is connected to an inner portion via cement.

[0009] Fig. 2 is an outer-rib type suspension insulator according to a second embodiment of the invention. In the second embodiment shown in Fig. 2, the upper shed 2 is the same as that of the first embodiment. However, an angle of the upper surface of the lower shed 3 is 25°. In addition, one intermediate shed 6 is formed between the upper shed 2 and the lower shed 3. An angle of an upper surface of the intermediate shed 6 is 15°, and an outer diameter of the intermediate shed 6 is slightly smaller than that of the upper shed 2 and the lower shed 3.

[0010] Fig. 3 is an outer-rib suspension insulator according to a third embodiment of the invention. In the third embodiment of the invention shown in Fig. 3, outer diameters of the intermediate shed 6 and the lower shed 3 are 320 mm, and an outer diameter of the upper shed 2 is slightly smaller than that of the intermediate shed 6 and the lower shed 3. An angle of the upper surface of the upper shed 2 is the same as that of the first embodiment, and an angle of the upper surface of the intermediate shed 6 is the same as that of the second embod-

iment. However, an angle of the upper surface of the lower shed 3 is 25°.

[0011] Fig. 4 is an outer-rib type suspension insulator according to a fourth embodiment of the invention. In the fourth embodiment shown in Fig. 4, two intermediate sheds 6 and 7 are formed between the upper shed 2 and the lower shed 3. In the outer-rib type suspension insulator shown in Fig. 4, all of the upper surface angles of the four sheds are 20°. Moreover, since the upper shed 2 and the upper intermediate shed 6 arise upward from a lower portion of the head portion 1, a depression 8 is formed outside of the cap fitting 4. The depression 8 is filled with insulation materials so as not to store water therein.

[0012] In the outer-rib type suspension insulator according to the invention, as shown in the respective embodiments mentioned above, the sheds having a small angle with respect to a horizontal surface and a flat shape thrust outward at a side surface, and a long creepage distance is maintained so as to improve a voltage resistance. In the flat sheds mentioned above, since a wind is not stagnated between shed and shed, there is an effect for reducing an adhesion of the pollution materials supplied by wind as shown in the following experiments. Moreover, since these sheds thrust outward, there is an advantage such that the pollution materials are easy to remove by a rainwater washing effect even if they are adhered. Further, since the lower surface of the lower shed 3 has a flat and gradually spreading shape, it is possible to reduce an adhesion of the pollution materials to the inner portion of the insulator. In order to maintain these effects mentioned above, in the outer-rib type suspension insulator according to the invention, an inclination angle of the upper surface of respective sheds is set to 4 - 35° that is smaller than the known suspension insulator. If the inclination angle is not larger than 4°, a water drip performance becomes bad, and, if the inclination angle is not smaller than 35°, an adhesion prevention effect of the pollution materials is deteriorated. In the preferred embodiment, the upper surface inclination angle of respective sheds is set to 5 - 20°.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

Fig. 1 is a partial cross sectional view showing a first embodiment of the invention.

Fig. 2 is a partial cross sectional view illustrating a second embodiment of the invention.

Fig. 3 is a cross sectional view depicting a third embodiment of the invention.

Fig. 4 is a cross sectional view showing a fourth embodiment of the invention.

Fig. 5 is a partial sectional view illustrating a standard insulator.

Fig. 6 is a partial sectional view depicting a known anti-pollution type insulator.

Fig. 7 is a schematic view showing an adhesion distribution of pollution materials for the known standard insulator in an experiment.

Fig. 8 is a schematic view illustrating an adhesion distribution of pollution materials for the known anti-pollution type insulator in an experiment.

Fig. 9 is a schematic view depicting an adhesion distribution of pollution materials for the outer-rib type suspension insulator according to the invention in an experiment.

BEST MODE FOR CARRYING OUT THE INVENTION

[0014] Hereinafter, a result of a pollution test for the outer-rib type suspension insulator according to the invention will be explained by an experiment.

[0015] Three kinds of insulator strings constructed by using the outer-rib type suspension insulator according to the invention shown in Fig. 3 (third embodiment), the standard insulator shown in Fig. 5 and the anti-pollution type insulator shown in Fig. 6 were set vertically in a test apparatus. Then, a cycle of spraying the pollution materials, supplying a fog, supplying a water and drying was repeated 4 times under the condition such that the insulator string was rotated slowly at 1 rpm. As the pollution materials, use was made of a mixture of NaCl and kaolin fine particles. The pollution materials were followed into the test apparatus for 20 minutes with a rate of 250 g/min. by means of a fan. Moreover, a dust catcher was set in an opposite side of the test apparatus, and airflow with a wind speed of 3.5 m/s was caused in one direction in the test apparatus. Further, humidity was maintained under 70 %. The fog supplying operation was performed for 10 minutes, and the water supplying operation was performed for 5 minutes with an angle of 30° with respect to a horizontal line. This water supplying operation simulated a rainfall of 2 mm/min. After that, the drying operation was performed for 60 minutes. Then, an amount of adhered pollution materials on the lower surface of respective insulators was measured. As a result, a relative value, where an amount of adhered pollution materials of the anti-pollution type insulator was 100, was 156 in the standard insulator and was 12 in the outer-rib type suspension insulator according to the invention.

[0016] Then, a rotation of the insulator string was stopped, and the pollution materials were sprayed with respect to the insulator string, so that an adhesion distribution of the pollution materials due to wind was measured. In this case, wind speed was 3.5 m/s, humidity was 75 %, and the pollution materials were sprayed for 20 minutes with a rate of 250 g/min. by means of a fan. The thus measured results were shown in Figs. 7 - 9. In Figs. 7 - 9, portions at which an adhered amount was particularly large were denoted by a numerical value.

[0017] As shown in Fig. 7 illustrating the result of the

standard insulator, a large amount of the pollution materials was adhered to a surface on the windward side of respective ribs as well as a front surface to which the wind blow was directly contacted. Moreover, as shown in Fig. 8 illustrating the result of the anti-pollution type insulator, a large amount of the pollution materials was adhered to a surface on the windward side of respective ribs that are positioned at a back of the center portion as well as a front surface to which the wind blow was directly contacted. It is assumed that a whirlpool was formed in a recess between rib and rib and the wind flows came into contact with each other at a backside recess, so that the pollution materials were adhered. On the other hand, in the outer-rib type suspension insulator according to the invention shown in Fig. 9, a large amount of the pollution materials was adhered to a front surface to which the wind blow was directly contacted, but an adhesion of the pollution materials on the lower surface was very few while a slightly large amount of the pollution materials was adhered to a rear upper surface of the head portion. However, since the pollution materials adhered to the rear upper surface of the head portion are easily removed by a water washing effect in case of rain, the pollution materials are not accumulated even though the insulator is used for a long time.

INDUSTRIAL APPLICABILITY

[0018] As mentioned above, according to the outer-rib type suspension insulator of the invention, since flat sheds having a small inclination angle are combined, it is possible to suppress an adhesion of the pollution materials on the lower surface. Therefore, if the outer-rib type suspension insulator according to the invention is used in the industrially heavy pollution area, an accumulative adhesion amount of the pollution materials is very few for a long duration as compared with the known anti-pollution type insulator. In addition, it is not necessary to perform a washing operation frequently as usual, and also it is possible to reduce a maintenance operation that takes a lot of time and effort.

Claims

1. An outer-rib type suspension insulator, wherein an upper shed extending in a lateral direction is formed on a periphery of a head portion and a lower shed having a gradually spreading shape is formed from a halfway portion of the upper shed in such a manner that it curves outward, **characterized in that** an upper surface of respective upper and lower sheds is inclined by 4 - 35°, thereby decreasing an accumulative amount of adhered pollution materials.

2. The outer-rib suspension insulator according to claim 1, wherein one or more intermediate sheds having an inclination angle of the upper surface of 4 - 35° are formed between the upper shed and the lower shed.

3. The outer-rib suspension insulator according to claim 1 or 2, wherein an inclination angle of the upper surface of the sheds is set to 5 - 20°.

FIG. 1

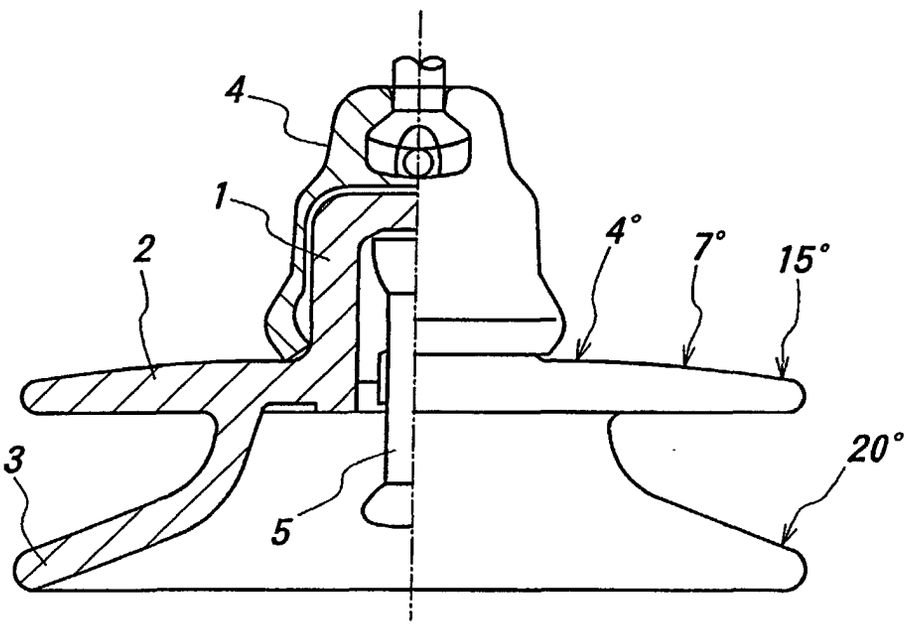


FIG. 2

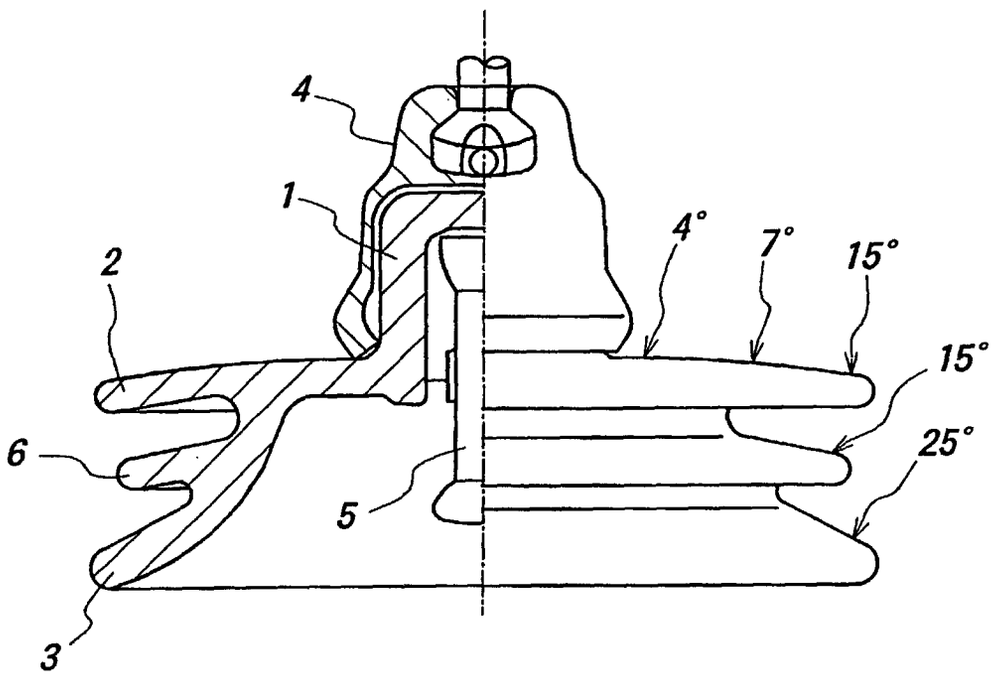


FIG. 3

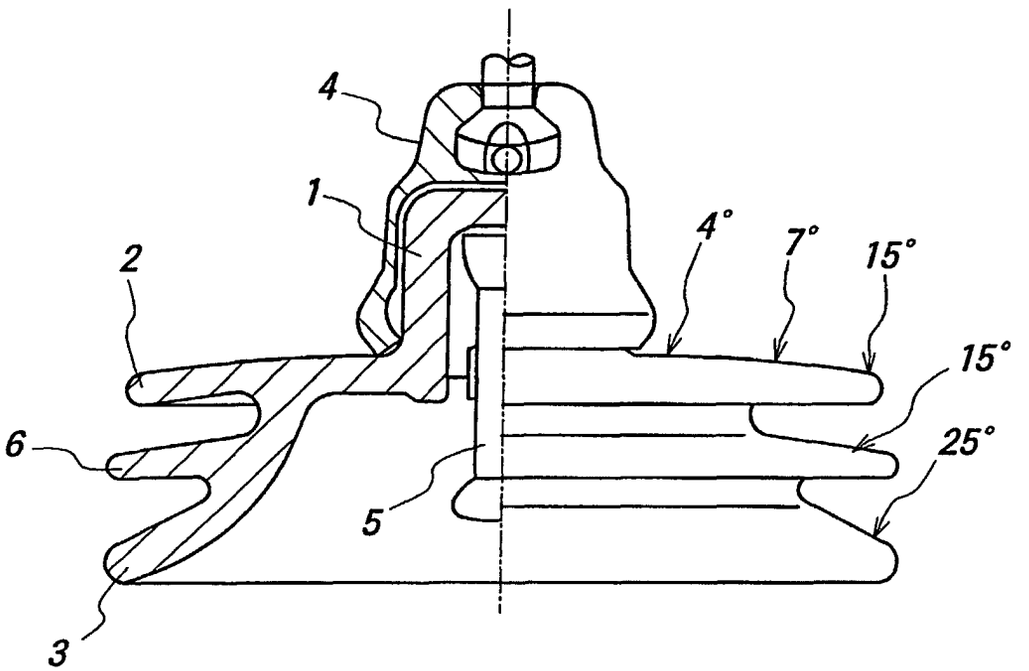


FIG. 4

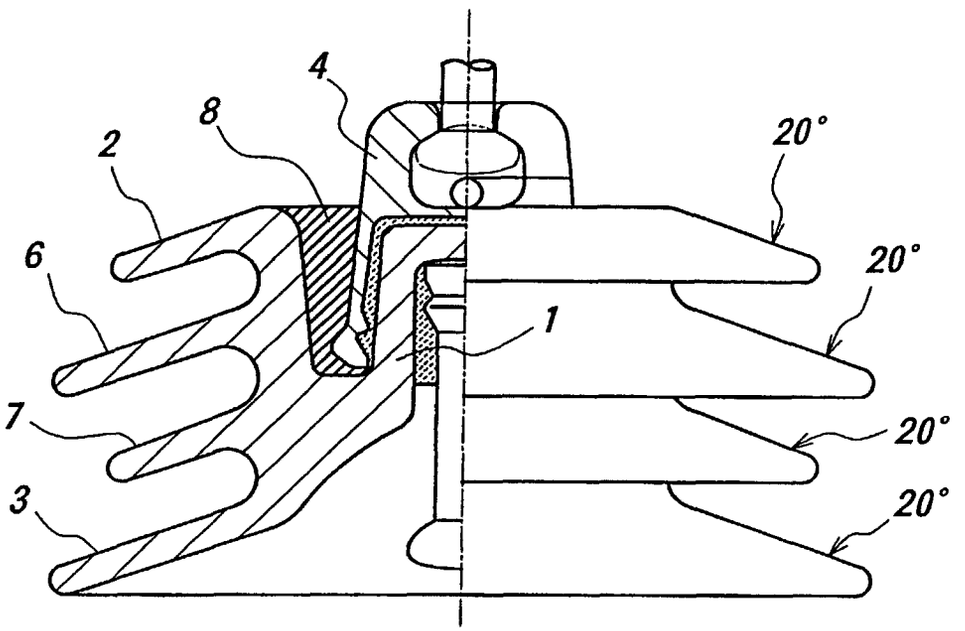
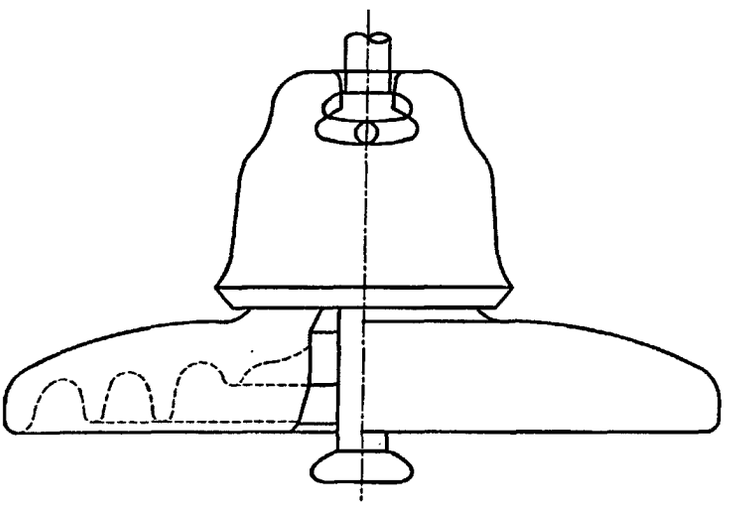
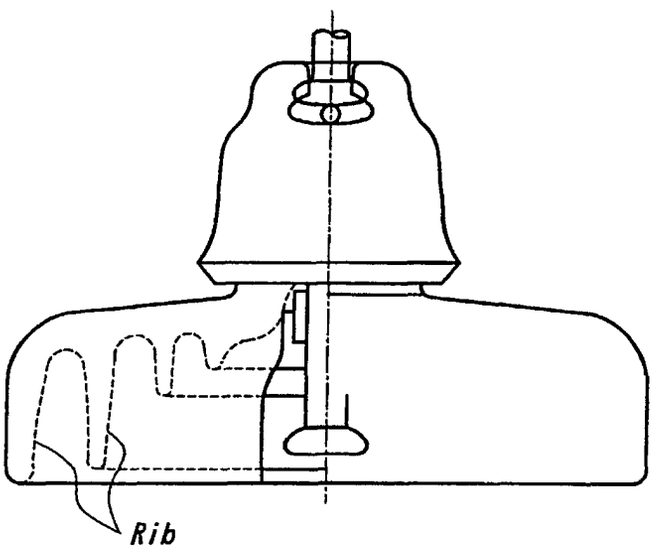


FIG. 5



Standard insulator

FIG. 6



Anti-pollution type insulator

FIG. 7

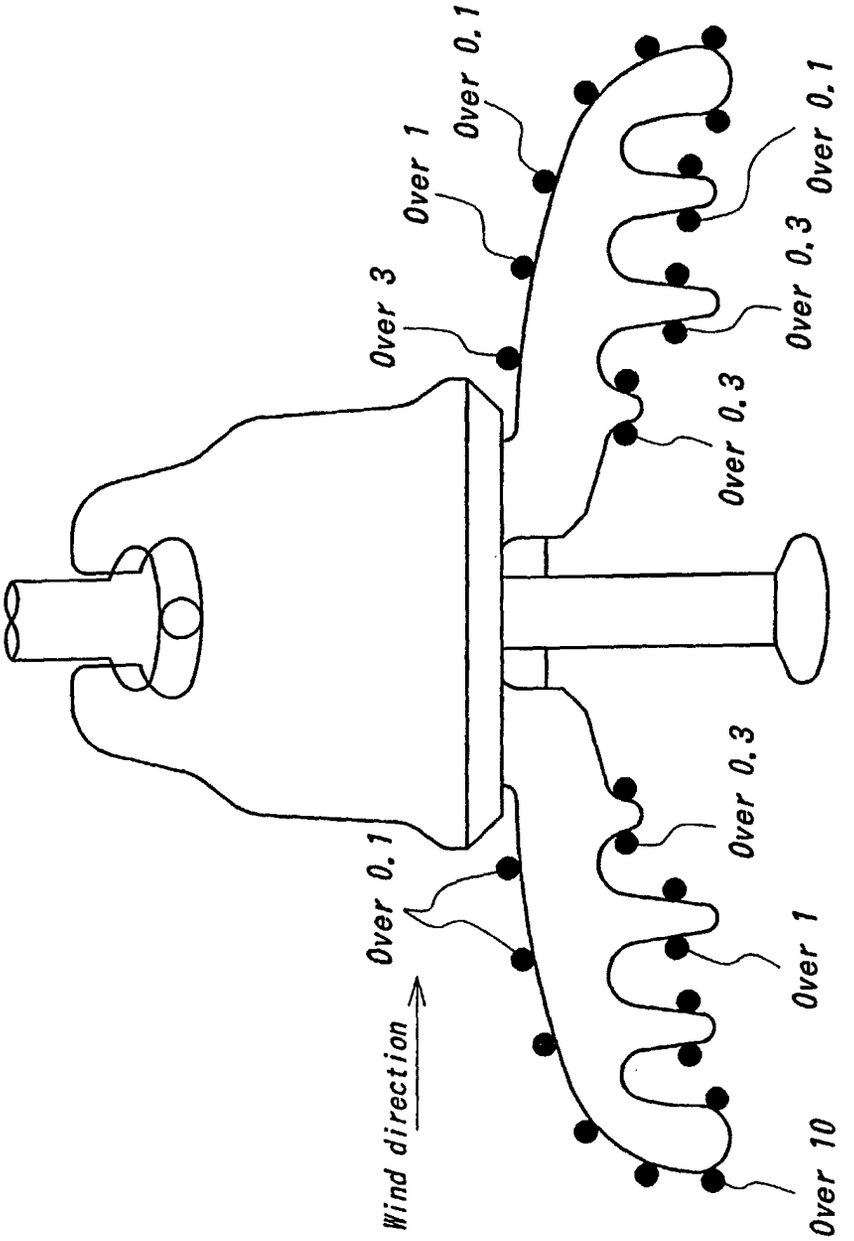

Over 0.1
Over 1
Over 3
Over 0.1
Over 0.3
Over 0.3
Over 0.1
Over 0.3
Over 1
Over 10
Wind direction

FIG. 8

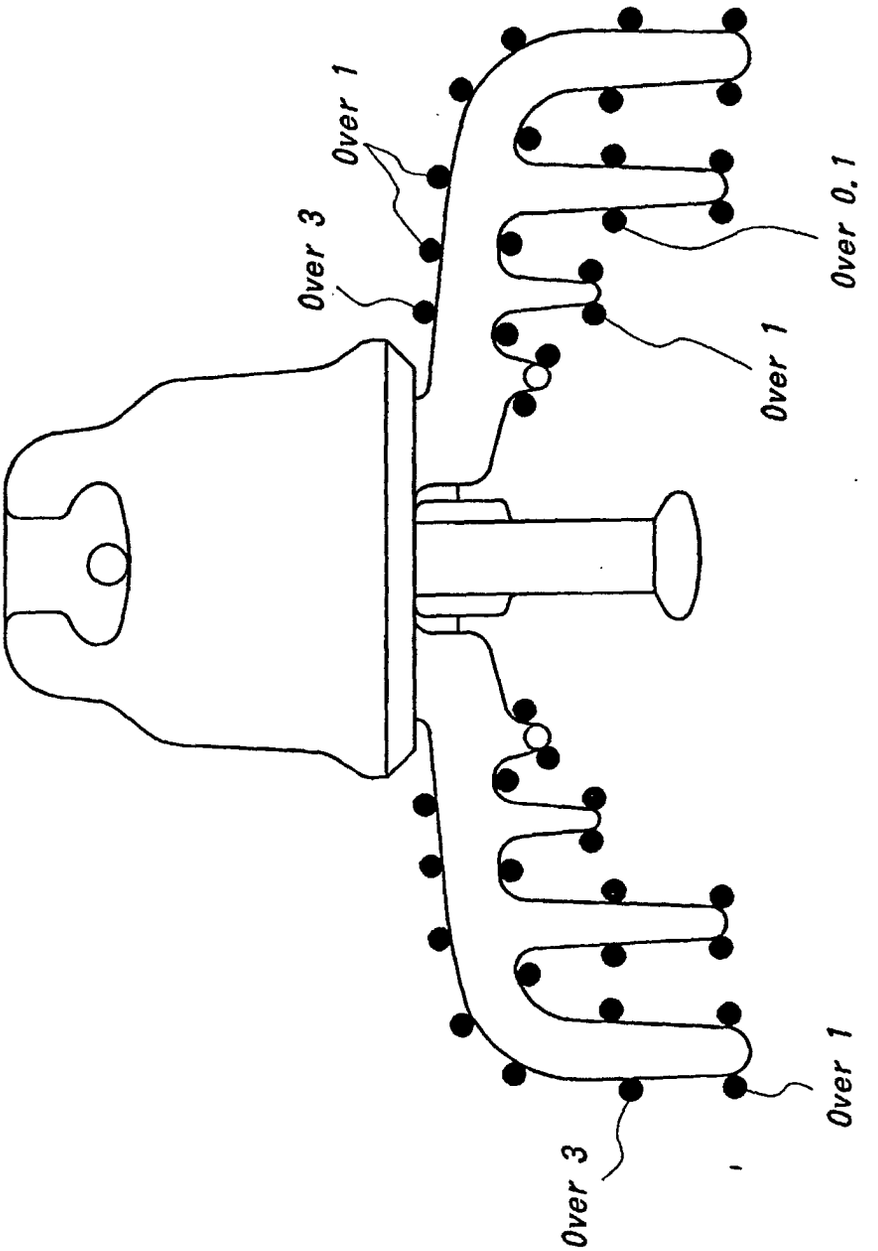
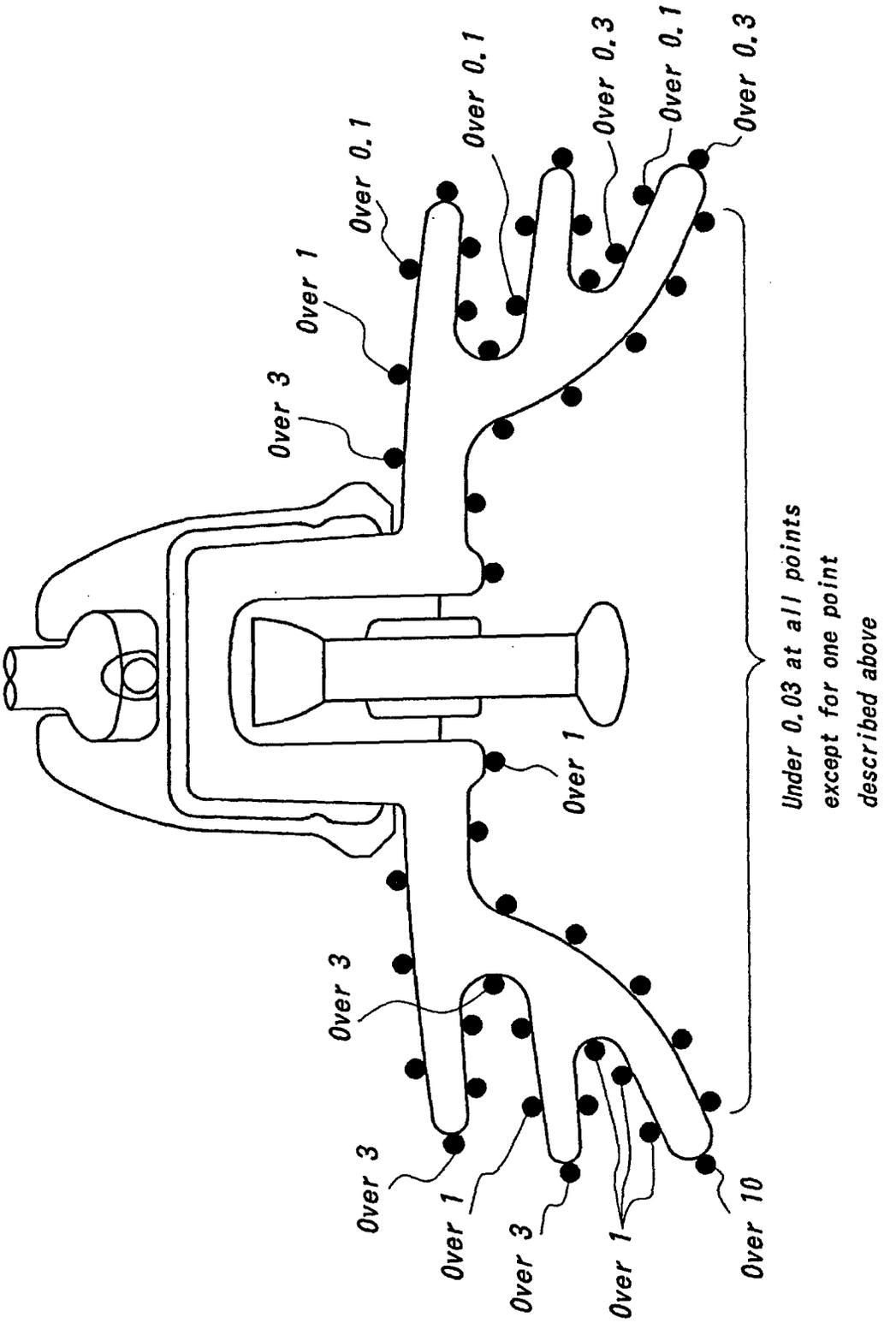


FIG. 9


Over 3
Over 1
Over 0.1
Over 0.1
Over 0.3
Over 0.1
Over 0.3
Over 1
Over 3
Over 3
Over 1
Over 3
Over 1
Over 10
Under 0.03 at all points
except for one point
described above

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/06168

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01B17/02

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)
Int.Cl[7] H01B17/02-17/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI (H01B17/02-17/10, shed, transversely) (in Japanese)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4740659 A (NGK Insulators, LTD.), 26 April, 1988 (26.04.88), Column 5, line 62 to Column 6, line 66; Figs. 1 to 5 & EP, 257725, A2 & CN, 87101776, A & CA, 1271241, A & JP, 63-62115, A	1-3
Y	Denshi Kagaku Tsuushin Kyouikukai, "Gaishi", Tokyo: Kabushiki Kaisha Ohmsha, 15 June, 1983 (15.06.83), page 1 to 2, Fig.1, 3	1-3
A	US 4045604 A (Raychem Limited,), 30 August, 1977 (30.08.77), Column 3, lines 1 to 17 & DE, 2544992, A & FR, 2287756, A & GB, 1530994, A & JP, 56-35313, A	1-3
E,X	JP 2000-260241 A (NGK INSULATORS, LTD.), 22 September, 2000 (22.09.00), Claims 1 to 3; Figs. 1 to 4 (Family: none)	1-3

☐ 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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 December, 2000 (12.12.00)	19 December, 2000 (19.12.00)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)