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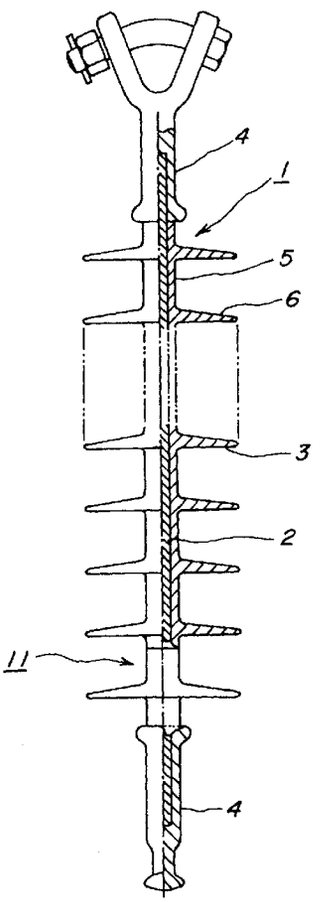
(54) Polymer insulator

(57) A disclosed polymer insulator has an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of the FRP rod, and securing metal fittings which are secured and fixed to both ends of the FRP rod. In the polymer insulator mentioned above, a reinforcing portion for achieving a long life thereof which is arranged on a line side portion of the insulation overcoat member to which a high stress of electric field is applied (first aspect) . Moreover, in the polymer insulator mentioned above, the line side portion of the insulation overcoat member is made of a low temperature vulcanizing rubber (second aspect) or a high elastic rubber (third aspect).

FIG. 1



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Description

Background of the Invention

Field of the Invention

The present invention relates to a polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, and especially relates to a polymer insulator having a long life.

Related Art Statement

Fig. 4 is a partial cross sectional view showing one embodiment of a known polymer insulator. In the embodiment shown in Fig. 4, a polymer insulator 51 comprises an FRP rod 52, an insulation overcoat member 53 made of rubber such as silicone rubber which is arranged on an outer surface of the FRP rod 52, and securing metal fittings 54 which are secured and fixed to both ends of the FRP rod 52. Moreover, all the insulation overcoat member 53 is made of the same insulation overcoat member forming material and has a uniform thickness not only at a line side portion thereof to which a high stress of electric field is applied but also at an earth side portion thereof.

In an actual use, a stress distribution of electric field which is applied to the polymer insulator 51 is not uniform but is concentrated at the line side portion of the insulation overcoat member 53. In this case, the line side portion is deteriorated faster than the earth side portion. Therefore, there is a drawback such that a crack is generated at the line side portion of the insulation overcoat member 53, to which a high stress of electric field is applied, while the earth side portion of the insulation overcoat member 53 is not deteriorated. The thus generated crack introduces an insulation failure of the insulation overcoat member 53 due to a water inclusion through the crack. As a result, a life of the insulation overcoat member 53 is shortened. In this case, since a life of the polymer insulator 51 depends on that of the insulation overcoat member 53, there is a drawback such that a life of the polymer insulator is shortened.

Summary of the Invention

An object of the invention is to eliminate the drawbacks mentioned above and to provide a polymer insulator which achieves a long life by reducing an influence of a high stress of electric field at a line side portion.

According to a first aspect of the invention, a polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, comprises: a reinforcing portion which is arranged on a line side portion of said insulation overcoat member to which a high stress of electric field is applied. Preferably the reinforcing portion extends from the metal fitting at one end to at least the second shed along the insulator from that end, more preferably to the third shed.

According to a second aspect of the invention, a polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, comprises: a construction such that a line side portion of said insulation overcoat member, to which a high stress of electric field is applied, is made of a low temperature vulcanizing rubber.

According to a third aspect of the invention, a polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, comprises: a construction such that a line side portion of said insulation overcoat member, to which a high stress of electric field is applied, is made of a high elastic rubber.

In the first aspect of the invention, the reinforcing portion is arranged on the line side portion of the insulation overcoat member to which a high stress of electric field is applied during an actual use in which a power is applied to the polymer insulator. Therefore, an electric field stress enduring property can be improved and a stress of electric field can be reduced, so that it is possible to delay a crack generation at the line side portion. Moreover, even if a crack generates, a time interval till the thus generated crack reaches to the FRP rod can be increased, and a crack propagating speed can be reduced. As a result, it is possible to achieve a long life of the polymer insulator.

In the second aspect of the invention, the line side portion of the insulation overcoat member, to which a high stress of electric field is applied during an actual use in which a power is applied to the polymer insulator, is made of a low temperature vulcanizing rubber. Therefore, since a temperature difference between a temperature of 60-80°C necessary for vulcanizing and a room temperature can be decreased, a shrinkage of rubber at the line side portion due to the temperature difference can be reduced and thus a residual stress is not liable to be generated at the line side portion. In the third aspect of the invention, the line side portion of the insulation overcoat member, to which a high stress of electric field is applied during an actual use in which a power is applied to the polymer insulator, is made of a high elastic rubber. Therefore, the line side portion can be easily trace a rubber shrinkage due to a decrease of temperature from a high temperature of 170°C necessary for vulcanizing to a room temperature, and thus a residual stress is not liable to be generated at the line side portion. In the second and third aspects of the invention, as

is the same as the first aspect of the invention, a crack is not liable to be generated at the line side portion of the insulation overcoat member, and thus it is possible to achieve a long life of the polymer insulator.

In the second and third aspects, too, the portion which is of the low temperature vulcanizing rubber, or is of the high electric rubber, preferably extends from the end fitting to at least the second shed from the end, more preferably the third shed.

In the invention, the reason why a crack is generated at the line side portion of the insulation overcoat member, which is an object of the invention, is estimated as follows. That is to say, in a method of manufacturing the polymer insulator according to the invention, at first, the FRP rod is set in a metal mold, and silicone rubber for forming the insulation overcoat member is injected into a space between the FRP rod and the metal mold. Then, the metal mold is heated to a temperature of about 170°C to vulcanize silicone rubber, and after the vulcanization the metal mold is cooled from 170°C to a room temperature. During this cooling, a large temperature variation from 170°C to a room temperature is applied to the FRP rod and silicone rubber. In this case, the FRP rod is not shrunk so much in an axial direction, but silicone rubber is shrunk much in an axial direction. Since silicone rubber is firmly connected to the FRP rod by the vulcanization, silicone rubber does not trace such a shrinkage in silicone rubber, and thus a residual stress is generated in silicone rubber. In addition to the residual stress, a high stress of electric field due to a long term power supply is applied to the line side portion of the insulation overcoat member, and further the line side portion of the insulation overcoat member is exposed to severe conditions such that ultraviolet rays due to sun shine are applied thereto or a corona discharge after rain fall is also applied thereto.

Any suitable elastomeric material may be used as the rubber employed in the invention.

Brief Description of the Drawing

Fig. 1 is a partial cross sectional view showing one embodiment of a polymer insulator according to the invention;

Fig. 2 is a cross sectional view illustrating one detail construction of a line side of the polymer insulator according to the invention;

Fig. 3 is a cross sectional view depicting another detail construction of a line side of the polymer insulator according to the invention; and

Fig. 4 is a partial cross sectional view showing one embodiment of a known polymer insulator.

Description of the Preferred Embodiments

Fig. 1 is a partial cross sectional view showing one embodiment of a polymer insulator according to a first aspect of the invention. In the embodiment shown in Fig. 1, a polymer insulator 1 comprises an FRP rod 2, an insulation overcoat member 3 made of rubber such as silicone rubber which is arranged on an outer surface of the FRP rod 2, and securing metal fittings 4 which are secured and fixed to both ends of the FRP rod 2. Moreover, the insulation overcoat member 3 is constructed by a sheath portion 5 and a plurality of sheds 6. These constructions are the same as those of the known polymer insulator. A different point from the known polymer insulator is that a reinforcing portion 11 is arranged on a line side portion of the insulation overcoat member 3.

Hereinafter, the reinforcing portion 11 will be explained. Figs. 2 and 3 are cross sectional views respectively showing one detail construction of a line side of the polymer insulator according to the invention. In the polymer insulator 1 according to the invention, as clearly understood from Figs. 2 and 3 each showing a line side of the polymer insulator, the reinforcing portion 11 having various constructions is arranged on a specific line side portion of the insulation overcoat member 3 to which a high stress of electric field is applied.

In the embodiment shown in Fig. 2, the reinforcing portion 11 is constructed in such a manner that a thickness of the line side portion is exclusively thicker than that of the sheath portion 5 of the insulation overcoat member 3 other than the line side portion. In this case, an electric field stress enduring property can be improved. In this embodiment, the reinforcing portion 11 having a different thickness can be manufactured according to a known manufacturing method if a shape of the metal mold is varied correspondingly. The present applicant discloses a similar technique in Japanese Patent Laid-Open Publication No.7-272558 (JP-A-7-272558) in which a thickness of a specific part of the sheath portion in the insulation overcoat member 3 is made thicker than that of the other portion in the insulation overcoat member 3. However, in the technique disclosed in JP-A-7-272558, since an end portion of the insulation overcoat member covers an end of the securing metal fitting, a flashover through the end portion of the insulation overcoat member which covers the end of the securing metal fitting is liable to be generated. Therefore, in order to improve a flashover enduring property, a thickness of the specific part of the sheath portion is made thicker. In this respect, the technique disclosed in JP-A-7-272558 is thought to be similar with the present invention at first glance, but it is a fundamentally different technique as compared with the present invention.

In the embodiment shown in Fig. 3, the reinforcing portion is constructed in such a manner that a reinforcing ring 12 is arranged exclusively on the line side portion of the insulation overcoat member 3. As the reinforcing ring 12, use is made of a rubber ring made of the same silicone rubber as that of the insulation overcoat member 3 or an another kinds of rubbers, which functions to reduce an electric field stress, or a metal ring such as stainless steel which functions to not only re-

duce an electric field stress but also prevent an affection of ultraviolet rays. Moreover, the reinforcing ring 12 can be constructed by a pair of divided ring pieces. In this case, the reinforcing ring 12 can be attached later on to the polymer insulator during in-use or the polymer insulator which is manufactured according to the known manufacturing method so as to form the reinforcing portion 11, and thus this construction is preferable.

In the embodiment mentioned above, the reinforcing portion 11 is arranged exclusively on the line side portion of the insulation overcoat member 3. However, a portion to which the reinforcing portion 11 is arranged may be arbitrarily determined with respect to respective polymer insulators 1 corresponding to size, shape or the like of the polymer insulator 1. In this case, the portion to which the reinforcing portion 11 is arranged may be set in a range on the insulation overcoat member 3 defined from an end of the insulation overcoat member 3, to which the securing metal fitting 4 positioned at a line side is connected, to a second or a third shed 6 from this end. Moreover, in this embodiment, the reason why the reinforcing portion 11 is exclusively arranged on the line side portion of the insulation overcoat member 3 is that an electric field stress of the line side portion during a power supply condition in an actual use is extremely larger than that of an earth side portion of the insulation overcoat member 3, while an affection of ultraviolet rays is uniform at both of the line side portion and the earth side portion.

Then, a polymer insulator according to a second aspect of the invention will be explained. In the second aspect of the invention, the line side portion of the insulation overcoat member 3 (corresponding to the reinforcing portion 11 in Fig-1), to which a high stress of electric field is applied during a power supply condition in an actual use, is made of a low temperature vulcanizing rubber which is different from the other portion of the insulation overcoat member 3. As the low temperature vulcanizing rubber, use is made of a liquid type rubber of an addition polymerization type using platinum as a catalyst or a condensation polymerization type, or a Millable rubber. In this case, it is possible to vulcanize rubber positioned at the line side portion within 60 minutes at a temperature of 60-80°C by using such a low temperature vulcanizing rubber for the line side portion. Moreover, a vulcanization of rubber positioned at the line said portion of the insulation overcoat member 3 is performed with no heat stress, if the line side portion is made of a low temperature vulcanizing rubber. Therefore, no residual stress due to the heat stress remains in the line side portion of the insulation overcoat member 3, and thus it is effective to prevent a crack generation in the line side portion. A method of forming such a low temperature vulcanizing rubber is as follows. At first, a portion of the insulation overcoat member 3 other than the line side portion is formed by vulcanizing a normal silicone rubber or the like at a high temperature. Then, the line side portion of the insulation overcoat member 3 is formed by vulcanizing a low temperature vulcanizing rubber at a room temperature or a temperature of 60-80°C. In this case, a residual stress in the line side portion becomes zero or an extremely smaller value than that of the insulation overcoat member 3 other than the line side portion. Therefore, it is possible to prevent a crack generation in the line side portion and to achieve a long life of the polymer insulator 1.

Then, a polymer insulator according to a third aspect of the invention will be explained. In the third aspect of the invention, the line side portion of the insulation overcoat member 3 (corresponding to the forcing portion 11 in Fig. 1), to which a high stress of electric field is applied during a power supply condition in an actual use, is made of a high elastic rubber. Normally, silicone rubber used for the polymer insulator includes silicone polymer, silica (SiO_2), filling agent (such as ATH) and so on. A high elastic rubber used in the third aspect of the invention is obtained by increasing an amount of silicone polymer in this normal silicone rubber. As is the same as the second aspect of the invention, the polymer insulator 1 according to the third aspect of the invention can be obtained by first forming a portion of the insulation overcoat member 3 other than the line side portion by vulcanizing a normal silicone rubber of the like and secondly forming the line side portion of the insulation overcoat member 3 by vulcanizing a high elastic rubber. Also in this case, a residual stress is not liable to be generated in the line side portion of the insulation overcoat member 3, and thus a crack generation in the line side portion can be prevented. Therefore, it is possible to achieve a long life of the polymer insulator 1.

As mentioned above, according to the invention, since the reinforcing portion is arranged on the line side portion of the insulation overcoat member, to which a high stress of electric field is applied during a power supply condition in an actual use (first aspect of the invention), it is possible to improve an electric field stress enduring property and to reduce an electric field stress. Moreover, since the line side portion is made of a low temperature vulcanizing rubber (second aspect of the invention) or a high elastic rubber (third aspect of the invention), it is possible to reduce a residual stress in the line side portion of the insulation overcoat member. Therefore, a crack generation in the line side portion of the insulation overcoat member can be delayed. Further, if a crack generates, a time interval till a crack reaches to the FRP rod can be increased, and thus it is possible to reduce a crack propagating speed. As a result, it is possible to achieve a long life of the polymer insulator.

Claims

1. A polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and

securing metal fittings which are secured and fixed to both ends of said FRP rod, comprising: a reinforcing portion which is arranged on a line side portion of said insulation overcoat member to which a high stress of electric field is applied.

2. The polymer insulator according to claim 1, wherein said reinforcing portion is constructed in such a manner that a thickness of said line side portion is exclusively thicker than that of a sheath portion of said insulation overcoat member other than said line side portion.

3. The polymer insulator according to claim 1, wherein said reinforcing portion is constructed in such a manner that a reinforcing ring is arranged exclusively on said line side portion.

4. The polymer insulator according to claim 3, wherein said reinforcing ring is made of a metal ring or a rubber ring.

5. A polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, comprising: a construction such that a line side portion of said insulation overcoat member, to which a high stress of electric field is applied, is made of a low temperature vulcanizing rubber.

6. A polymer insulator according to claim 5 wherein said low temperature vulcanizing rubber is vulcanizable at a temperature not higher than 100°C.

7. A polymer insulator having an FRP rod, an insulation overcoat member made of rubber which is arranged on an outer surface of said FRP rod, and securing metal fittings which are secured and fixed to both ends of said FRP rod, comprising: a construction such that a line side portion of said insulation overcoat member, to which a high stress of electric field is applied, is made of a high elasticity rubber.

8. A polymer insulator according to claim 7 wherein said high elasticity rubber is a rubber having more than 200% elongation.

FIG. 1

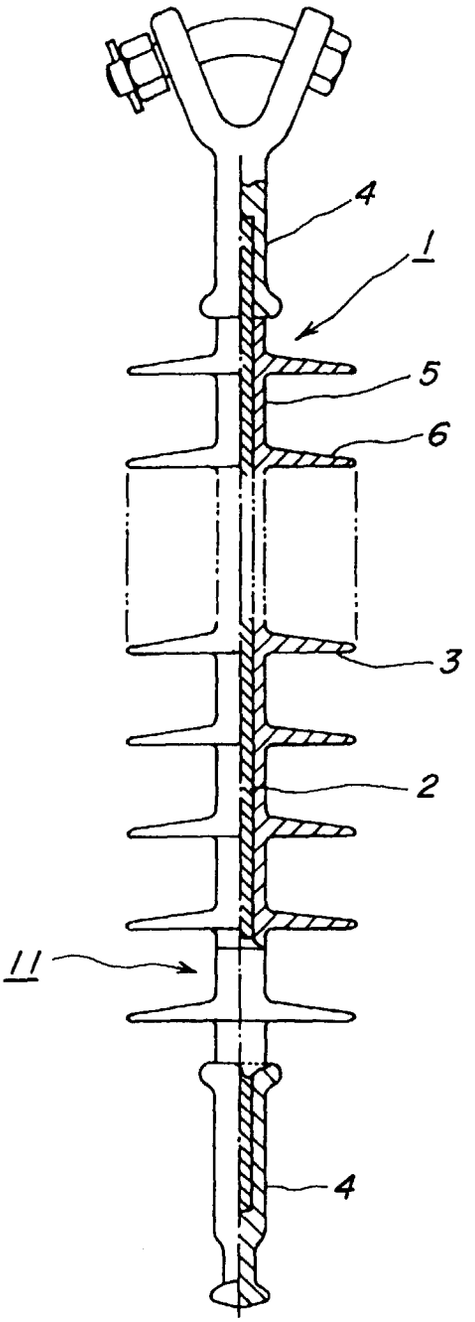

FIG_2

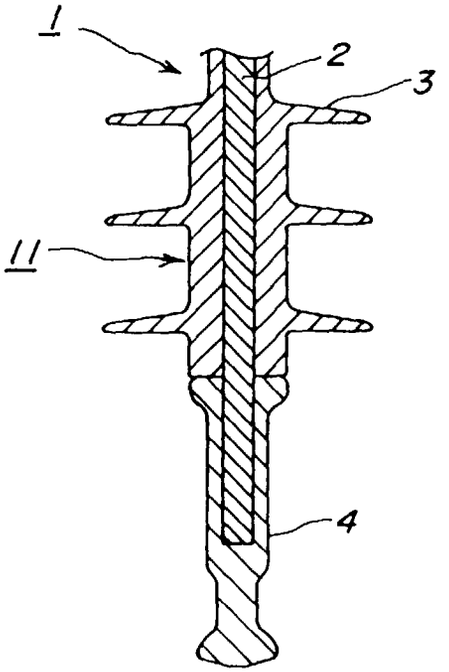

FIG_3

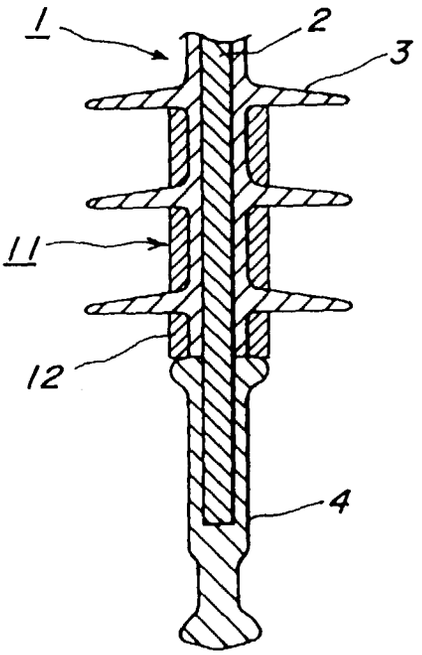

FIG_4 PRIOR ART