COMPOSITE INSULATED TOWER FOR GRID

Abstract: A composite insulated tower for grid (100) includes a main body (10) made of glass fibers and resin impregnating in the glass fibers, and at least one cross arm (11). The at least one cross arm (11) includes an insulated rod (111), at least one petticoat (113) mounted on the outside of the insulated rod (111), and a hanging fitting (115) disposed on the free end of the insulated rod (111). The insulated rod (111) is made of glass fibers and resin impregnating in the glass fibers and connected to the main body (10). By the reason of the composite insulated tower for grid (100) comprising the main body (10) and the cross arm (11) which are made of insulating material, the insulators can be omitted or shortened, so the total height of the composite insulated tower for grid (100) can be decreased.
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— with international search report (Art. 21(3))
COMPOSITE INSULATED TOWER FOR GRID

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to power tower for transmission lines and, more particularly, to composite insulated tower for grid.

2. Discussion of the Related Art

Tower is used to support transmission lines in power transmission, communication, railway, municipal facility, and so on. The material and configuration of the tower can involve the safety, cost and reliability thereof. Conventional pole or tower in civil and oversea mainly includes wooden, concrete, prestressed concrete, steel concrete, steel pipe, steel tower, and so on. The steel tower is a general type in ultrahigh voltage transmission. Generally, concrete hole is used in the range from 35KV to 110KV. But, in above 220KV, lattice tower is normal.

The above power pole or tower includes a main body and at least a cross arm disposed on the main body. The cross arm is used for supporting transmission line and is made of steel whether in wooden, concrete, prestressed concrete, or steel pipe and steel tower. Therefore, an insulator must be mounted on free end of the cross arm for further prohibiting conduction between the tower or pole and transmission line. Moreover, the tower or pole must have a certain height. Especially, when the transmission line crosses through populated country, or buildings, the tower or pole must have higher height than the conventional. Therefore, the height of the tower or pole must be designed according to geographical position, more particularly, nominal height of the tower or pole. Nominal height means the shortest distance between the ground and the cross arm. The nominal height is designed according to the following formula:
\[ H = \lambda + f_{max} + h_x + Ah \]

wherein, \( H \) is nominal height;
\( \lambda \) is length of the insulator;
\( f_{max} \) is arc sag of the transmission line;
\( h_x \) is safety distance between the transmission line and the ground or buildings;
\( Ah \) is threshold.

Under condition of same geographical position, span distance between poles, voltage level, and whether, \( l_{max}, h_x \), and \( Ah \) is invariable. As a result, the length of the insulator may determine the nominal height of that. Therefore, it can decrease the total height by decreasing the length of the insulator or repealing the insulator.

What is needed, therefore, is a composite insulated tower for grid which can use shorter insulator than the conventional or not use the insulator.

SUMMARY OF THE INVENTION

Other advantages and novel features will become more apparent from the following detailing description of the present composite insulated tower for grid when taken in conjunction with the accompanying drawing.

A composite insulated tower for grid includes a main body, and at least a cross arm disposed on the main body. The main body is made of glass fibers and resin impregnating in the glass fibers. The at least a cross arm includes an insulated rod, at least a petticoat mounted on the outside of the insulated rod, and a hanging fitting disposed end of on the insulated rod. The insulated rod is made of glass fibers and resin impregnating in the glass fibers. The petticoats are made of vulcanized silicone rubber. The hanging fitting extends along the axis of the insulated rod and is configured for hanging insulators or transmission lines.

Compared with a conventional steel tower for grid, the composite insulated
tower for grid uses the main body and the cross arm which are made of insulative material, and the cross arm further has petticoats defined thereon. As a result, the composite insulated tower for grid can omit the insulator or use shorter insulator than the conventional, and the total height of the composite insulated tower for grid can be decreased. Moreover, the composite insulated tower for grid has less occupied area, lower cost and weight.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Many aspects of the present apparatus can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present apparatus. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. 1 is a schematic view of a composite insulated tower for grid according to a first embodiment.

FIG. 2 is a schematic view of a cross arm of the composite insulated tower for grid of FIG. 1.

FIG. 3 is a schematic view of a metal connector of the composite insulated tower of grid of FIG. 1.

FIG. 4 is a schematic view of the composite insulated tower for grid of FIG. 1 having a boom.

FIG. 5 is a schematic view of another composite insulated tower for grid according to a second embodiment.

**DETAILED DESCRIPTION PREFERRED EMBODIMENTS**

Reference will now be made to the drawing to describe preferred embodiments of the present composite insulated tower for grid, in detail.

Referring to FIG. 1, a composite insulated tower for grid 100 according to a
first embodiment is shown. The composite insulated tower for grid 100 includes a main body 10, at least a cross arm 11 disposed on the main body 10, and at least a metal connector 12 configured for connecting the main body 10 to the cross arm 11.

It needs to further illustrate that the composite insulated tower for grid 100 is a straight-line tower. Understandably, the composite insulated tower for grid 100 may be one of a corner tower, a straight line corner tower, a transposition tower, a terminal tower, a branch of tower, and an across tower, and so on. The same item between the straight-line tower and the above tower is that all of them have same elements, such as the main body 10, the cross arm 11, and the metal connector 12, and so on. In the preferred embodiment, the straight-line tower is described only as an example to explain the configurations and functions of the composite insulated tower for grid 100.

The main body 10 is manufactured by pulling and extruding process or winding process, and is made of glass fibers and resin impregnating in the glass fibers. The glass fibers may be alkali-free and continuing glass fibers. The resin may be polyurethane resin or vinyl ester resin. When the resin is polyurethane resin, the weight ratio of the glass fibers in the main body 10 may be in a range from 60% to 78%. The polyurethane resin is made from polyol and isocyanic acid tallow in combination reaction. A weight percent of the polyol in the all of material is in the range from 8% to 15%. A weight percent of the isocyanic acid tallow in the all of material is in the range from 8% to 15%. When the resin is vinyl ester resin, a weight percent of the glass fibers in all of the material for making the main body 10 is in the range from 55% to 75%, and a weight percent of the vinyl ester resin is in the range from 22% to 40%. Additional, when the resin is vinyl ester resin, the material for making the main body 10 include curing agent, and a weight percent of the curing agent in all of the material is in the range from 0.2% to 0.5%. Moreover, the material may further include composite enhancer or/and filler for accelerating
the curing of the main body 10 or/and decreasing cost. In the preferred embodiment, the resin is vinyl ester resin. A full height of the main body 10 includes nominal height and distance between two lines and height of arrester. Understandably, when portion of the main body 10 is embedded in the earth for fixing the main body 10, the full height of the main body 10 further includes the height of the portion.

Referring to FIG. 2, the schematic view of the cross arm 11 is shown. The straight-line tower of the embodiment has three cross arms 11. One of the three cross arms 11, called up-cross arm, is mounted on the end of the main body 10, the other, called down-cross arms, are mounted between the up-cross arm and ground and are vertical to the main body 10. The distance between the up-cross arm and the down-cross arm is determined by voltage level. The up-cross arm has same configuration and function with the down-cross arm. Therefore, the down-cross arm is described only as an example. And only for simple, the up-cross arm and the down-cross arm are called the cross arm 11 in the preferred embodiment. The cross arm 11 includes an insulated rod 111, a sheath 112 wrapping on outside of the insulated rod 111, petticoats 113 disposed on the outside of the insulated rod 111, at least a metal connector 114 mounted on end of the insulated rod 111, and a hanging fitting 115 mounted on another end of the insulated rod 111.

The insulated rod 111 may be a hollow rod or a solid rod, and is made of glass fibers and resin impregnating in the glass fibers. In the preferred embodiment, the insulated rod 111 is a solid rod. When the diameter of the insulated rod 111 is less than certain value, such as 111 micrometers, the insulated rod 111 is manufactured by pulling and extruding process. When the diameter of the insulated is larger than the value of 111 micrometers, the insulated rod 111 is manufactured by winding process. In the manufacture of the insulated rod 111, a serial of physical and chemistry reactions arise between the glass fibers and the vinyl ester resin and a
vinyl ester resin substrate forms between the glass fibers and the vinyl ester resin. The vinyl ester resin substrate is called cured epoxy resin. The cured epoxy resin functions as an interface which has good configuration and capability. The interface integrates the glass fibers and the vinyl ester resin. As a result, the insulated rod 111, which is made of vinyl ester resin and the glass fibers, has good mechanical property and electrical performance.

The sheath 112 and the petticoats 113 may be made of high temperature Vulcanized silicone rubber, room temperature vulcanized silicone rubber, or liquid Vulcanized silicone rubber. In the preferred embodiment, the sheath 112 and petticoats 113 are made of the high temperature vulcanized silicone rubber. The sheath 112 and the petticoats 113 are manufactured by injection process and wrap onto the insulated rod 111. The sheath 112 is interposed between the petticoats 113 and the insulated rod 111. Understandably, the sheath 112 and the petticoats 113 may be respectively made, and then, they are combined by some method, such as adhesive. The sheath 112 covers all of surface of the insulated rod 111. The high temperature vulcanized silicone rubber is made by a chemical process for converting rubber or related polymers, such as polysiloxane, into more durable materials via the addition of sulfur or other equivalent "curatives". These additives modify the polymer by forming crosslinks (bridges) between individual polymer chains in high temperature. The additives include enhanced filler. The filler may be silica which can enhance the strength of the high temperature vulcanized silicone rubber. The additives are aimed to decrease cost of the high temperature vulcanized silicon rubber, improve its performance to give it special capability, such as flame retardancy, conductivity, and so on. In the preferred embodiment, the high temperature vulcanized silicone rubber mainly has the following components: methyl vinyl silicone rubber, silica, aluminum hydroxide, silicon oil, curing agent, and so on.
The petticoats 113 functions as to increase creepage distance of the cross arm II for avoiding creepage. The petticoats 113 include several petticoats group. Each of petticoats group includes three petticoats bodies which have different diameters. Understandably, the cross arm 11 may include many petticoats group, or one. When the cross arm 11 includes many petticoats group, the many petticoat group may be integratedly formed or respectively injected. When the many petticoat groups are respectively injected, they can be adhered into the petticoats 113.

The metal connector 114 includes a connecting base 141, and a connecting sleeve 142 disposed on the connecting base 141. The connecting sleeve 142 is vertical to the connecting base 141. The connecting base 141 and the connecting sleeve 142 may be integratedly formed or combined via welding process. The connecting base 141 includes many through holes 143 arranged thereon. The through holes 143 are used for connecting the cross arm 11 to the main body 10 with bolts, or so. The connecting sleeve 142 is used for interposing the insulated rod III therein. As a result, the insulated rod 111 is mounted on the main body 10. The insulated rod 111 may be fixed into the connecting sleeve 142 of the metal connector 114 by adhesive or by interference fit process. Understandably, the metal connector 114 also includes many reinforcing ribs 144 disposed between the connecting base 141 and the connecting sleeve 142. The reinforcing ribs 144 are formed outside of the connecting sleeve 142 and configured for enhancing the strength of the metal connector 114.

The hanging fitting 115 includes a hanging base 151, a hanging sleeve 152 disposed one side of the hanging base 151, and a hanging portion 153 disposed another side of the hanging base 151 opposite to the hanging sleeve 152. The hanging base 151 and the hanging sleeve 152 have same configurations and functions with that of the connecting base 141 and the connecting sleeve 142.
Therefore, the detail description of that is omitted. At least a hanging through hole 153 is defined in the hanging portion 153 for connecting an insulator or transmission lines.

Referring to FIG. 3, the body connector 12 is arranged on the main body 10 for connecting the cross arm 11 by the metal connector 114. The body connector 12 includes a pipe 121, at least a connecting arm 122 disposed outside of the pipe 121, and at least a connecting board 123 disposed on the free-end of the connecting arm 122. The pipe 121 has a same inner diameter with outer diameter of the main body 10. Therefore, the main body 10 can cross through the pipe 121 for fixing the body connector 12 thereon. The fixing method may be adhesive or interference fit. The connecting arm 122 is fixed on the pipe 121 by jointing, bolt, and so on. In the preferred embodiment, the body connector 12, which is used for connecting down cross arm, has two connecting arms 122. The body connector 12, when used for connecting up cross arm, has one connecting arm 122. The connecting board 123 has many connecting holes 124 defined therein for connecting and fixing the metal connector 114.

Understandably, the composite insulated tower for grid 100 further includes at least a boom 13. The boom 13 is disposed between the main body 10 and the cross arm 11 as shown in FIG. 4. The boom is configured for enhancing the mechanical performance of the cross arm 11 and prohibits to curve or break the cross arm 11 for the weight of transmission line. The boom 13 may be made by the same material to that of the main body 10.

Referring to FIG. 5, the composite insulated tower for grid 200 according to a second embodiment is shown. The composite insulated tower for grid 200 includes a main body 20, at least a cross arm 21 disposed on the main body 20, at least a metal connector 22 configured for connecting the main body 20 to the cross arm 21, and at least an insulator 23 mounted on the free end of the cross arm 21.
The main body 20, the cross arm 21 and the metal connector 22 of the second embodiment have same functions and configurations with that of the first embodiment. Therefore, the detailed descriptions of the main body 20, the cross arm 21 and the metal connector 22 are omitted.

The insulator 23 functions to further increasing the creepage distance. As for the main body 20 and the cross arm 21 is manufactured by insulative material, and the cross arm 21 has petticoats 213 for increasing the creepage distance, the insulator 23 may have shorter length than that of a conventional insulator under same voltage level. The insulator 23 may have same configurations and functions with that of the conventional insulator. The insulator 23 is disposed on the cross arm 21 by some standard fittings, such as U-shaped hanging rings, and so on.

Compared with a conventional steel tower for grid, the composite insulated tower for grid uses the main body and the cross arm which are made of insulative material, and the cross arm further has petticoats defined thereon. As a result, the composite insulated tower for grid can omit the insulator or use shorter insulator than the conventional. Therefore, the total height of the composite insulated tower for grid can be decreased. Moreover, the composite insulated tower for grid has less occupied area, lower cost and weight.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.
Claims

What is claimed is

1. A composite insulated tower for grid, comprising:
   a main body being made of glass fibers and resin impregnating in the glass fibers;
   at least a cross arm disposed on the main body, the at least a cross arm comprising
   an insulated rod, petticoats mounted on the outside of the insulated rod, and a
   hanging fitting, the insulated rod being made of glass fibers and resin
   impregnating in the glass fibers and connected to the main body, the petticoats
   being made of vulcanized silicone rubber, and the hanging fitting being disposed
   end of on the insulated rod, the hanging fitting extending along the axis of the
   insulated rod and being configured for hanging insulators or transmission lines.

2. The composite insulated tower for grid as claimed in claim 1, wherein the
   insulated rod is a hollow rod.

3. The composite insulated tower for grid as claimed in claim 1, wherein the
   insulated rod is a solid rod.

4. The composite insulated tower for grid as claimed in claim 1, wherein the resin is
   polyurethane resin.

5. The composite insulated tower for grid as claimed in claim 1, wherein the resin is
   vinyl ester resin.

6. The composite insulated tower for grid as claimed in claim 1, wherein the cross
   arm further comprises a metal connector configured for connecting the insulated
   rod to the main body.

7. The composite insulated tower for grid as claimed in claim 6, wherein the metal
   connector is a flange, the flange comprises a connecting base and a connecting
   sleeve connected to the connecting base, the connecting base is mounted on the
   main body, the connecting sleeve is configured for interposing the insulated rod.

8. The composite insulated tower for grid as claimed in claim 1, further comprising
at least a boom disposed between the main body and the cross arm.

9. The composite insulated tower for grid as claimed in claim 8, wherein the boom is made of glass fibers and resin impregnating in the glass fibers.

10. The composite insulated tower for grid as claimed in claim 1, wherein the vulcanized silicone rubber is high temperature vulcanized silicone rubber.

11. The composite insulated tower for grid as claimed in claim 1, further comprising a body connector for connecting the cross arm and the main body.

12. The composite insulated tower for grid as claimed in claim 11, wherein the body connector comprises a pipe, at least a connecting arm disposed on the outside of the pipe, and at least a connecting board disposed on the connecting arm opposite to the pipe, the pipe is configured for mounting on the main body, the connecting board is configured for connecting the cross arm to the main body.

13. The composite insulated tower for grid as claimed in claim 12, wherein the connecting arm is vertical to the pipe.

14. The composite insulated tower for grid as claimed in claim 12, wherein the connecting board comprises at least a through hole for fixing the cross arm.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

See extra sheet
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)

IPC: E04H, H01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,CNKL,WPI,EPDOC: connect, join, cross, sleeve, hang, insul+

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of Box C.

* 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
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  **“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
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  **“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
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02 Dec. 2010 (02.12.2010)

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Form PCT/ISA/210 (second sheet) (July 2009)
### INTERNATIONAL SEARCH REPORT

**Information on patent family members**

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## A. CLASSIFICATION OF SUBJECT MATTER

- E04H12/00 (2006.01) i
- H01B17/00 (2006.01) n