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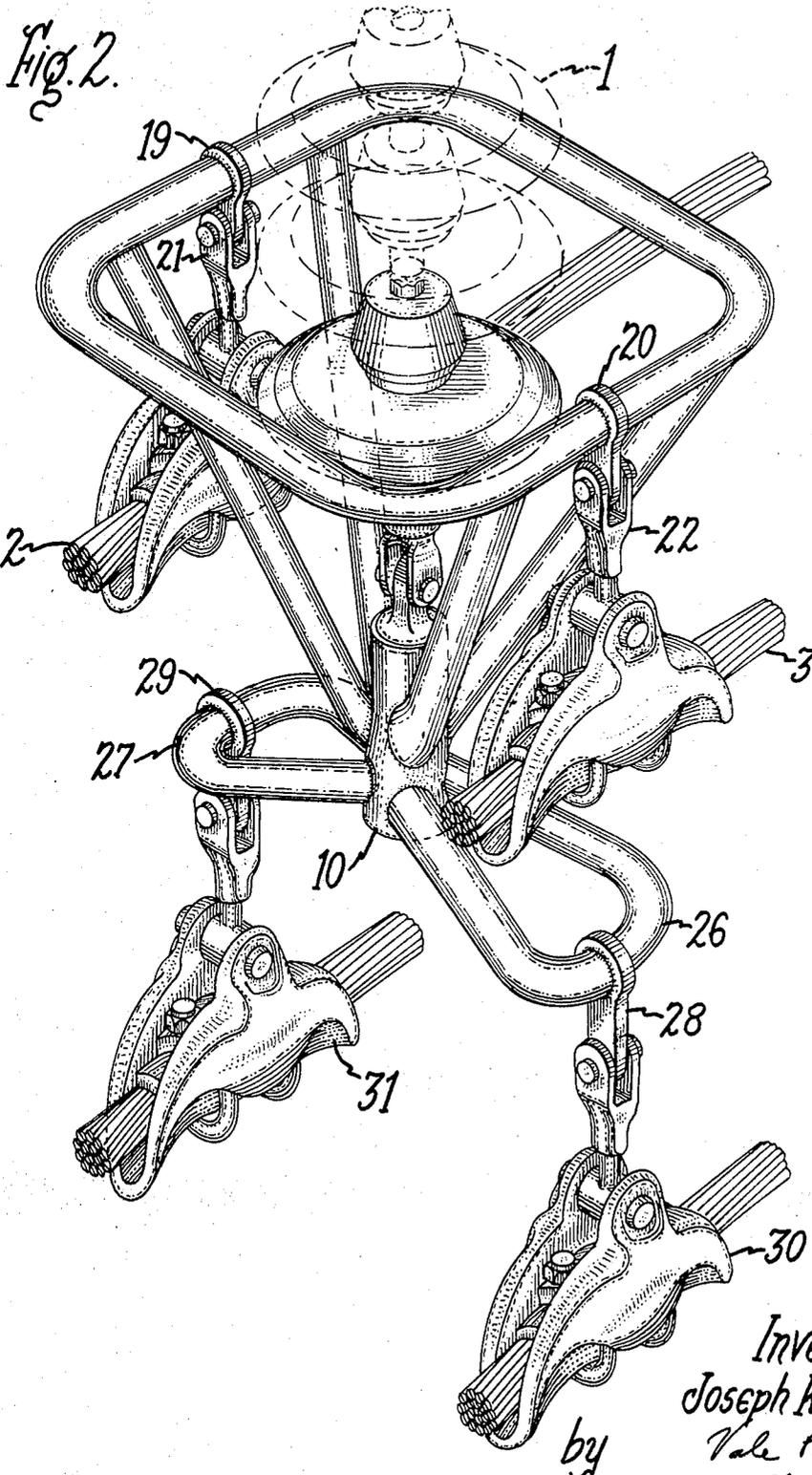
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3,471,633

COMBINED CONDUCTOR SUPPORT AND CORONA SHIELD

Filed Nov. 22, 1967

3 Sheets-Sheet 2



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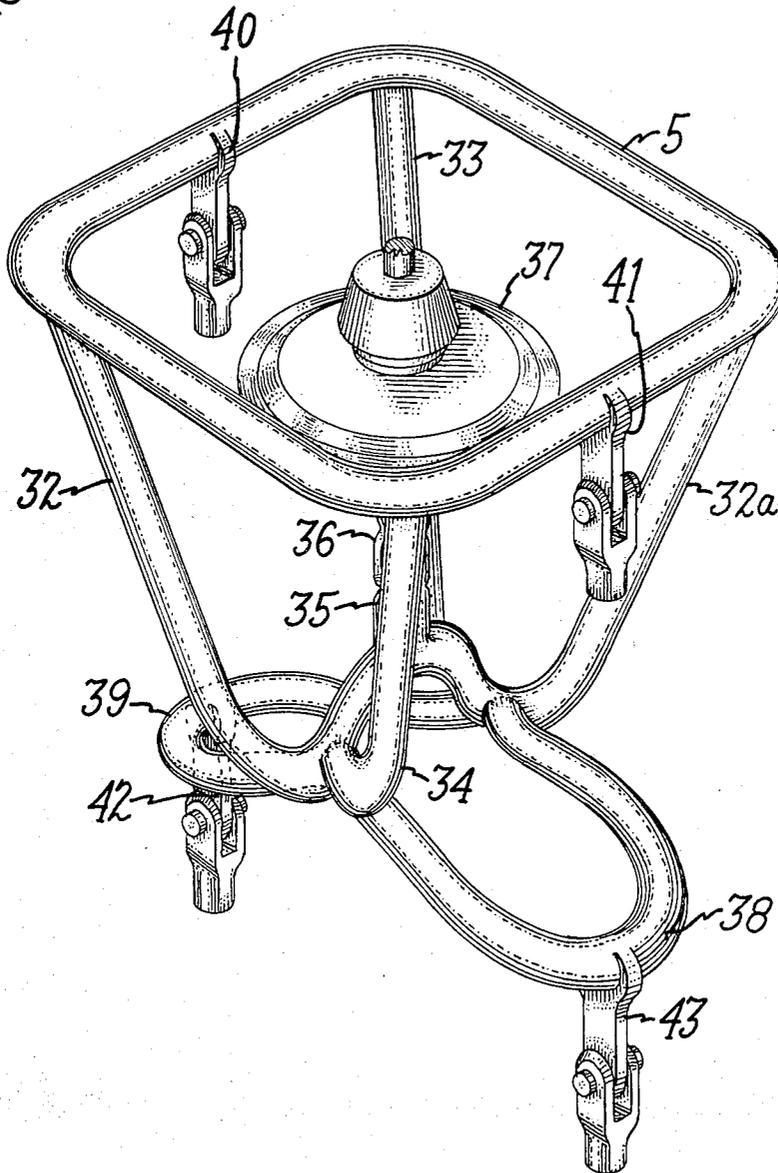
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3 Sheets-Sheet 1

Fig. 3.



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3,471,633  
**COMBINED CONDUCTOR SUPPORT AND  
 CORONA SHIELD**

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**ABSTRACT OF THE DISCLOSURE**

A combined multiple conductor support and corona shield assembly for attachment to a suspension insulator string of a high voltage power transmission line. The assembly includes a metallic shielding loop spaced for optimum voltage grading and shielding effect with relation to an insulator string. Multiple conductor supporting fittings are provided directly on the shielding loop and the loop positioning structure.

This invention relates to conductor supports and shielding apparatus for extra high voltage power transmission lines, and more particularly to combination conductor supports and corona shielding and voltage grading apparatus for polyphase power transmission lines having multiple separate conductors for each phase line.

It is a known practice in the power transmission field to provide corona shielding and voltage grading apparatus between extra high voltage transmission lines and the suspension insulators used to hang such lines from power poles or towers. The advantages derived from using grading apparatus to reduce the electrical stresses that develop due to the sharp voltage differential between the lower end of suspension insulators and the power transmission lines that they support was recognized at an early date. More recently, the need for effective shielding apparatus has come to be increasingly realized as transmission voltages more frequently exceed the 300 kilovolt range. At such high voltages, all sharp surface discontinuities on energized portions of the transmission line hardware, such as the edges presented by conventional bolts, cotter keys and cable clamping apparatus used to secure power transmission lines to insulators, tend to produce corona discharge. Among other undesirable effects this type of discharge causes considerable radio and television interference and is thus very objectionable. Accordingly, quite sophisticated shielding devices have already been developed in the prior art. It has also been recognized heretofore that where a plurality of conductors are used in each phase of a power transmission line it is necessary to provide means for supporting each conductor of each phase in close fixed relation to the other conductors of its phase bundle. To achieve this optimum close spacing, various plate and bracket support means have been employed in the prior art. However, these prior art devices are generally fabricated from a relatively large number of separate pieces that are joined together with conventional bolt or pin assembly means which by their nature tend to increase the corona discharge problem inherent in high voltage transmission systems. A further problem presented by many of the known multiple conductor supporting plates is occasioned by the fact that the support plates themselves are so designed that they are wider than the spacing between the conductors they support. Thus, the supporting plates reduce the striking or arcing distance between the energized portion of the transmission line and adjacent ground potential apparatus such as the power transmission towers from which the lines are suspended.

It is a primary object of this invention to provide an improved and mechanically simplified combined conductor support and corona shield which will substantially diminish the disadvantages inherent in the prior art devices discussed above.

Another object of the invention is to provide a multiple conductor support apparatus which incorporates self-shielding features and is also designed to reduce to a minimum distance the required clearance between the supported conductors and adjacent ground potential apparatus.

A further object of the invention is to provide a combined multiple conductor support and corona shield apparatus that is economical to manufacture and mechanically stable under operating conditions.

Additional objects and advantages of the invention will become apparent from the following description and the appended claims. A complete understanding of the invention can be obtained from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a preferred form of the invention.

FIG. 2 is a perspective view of the invention depicted in FIG. 1 showing a modification that enables an additional conductor to be supported from the assembly.

FIG. 3 is a perspective view of another embodiment of the invention which, like the modification shown in FIG. 2 is adapted to support four conductors.

Referring now to the drawings and particularly to FIG. 1 my preferred form of the invention is illustrated with respect to a single insulator string 1 and three conductors 2, 3, and 4 that constitute the multiple conductors of a single phase line of a polyphase power transmission system. The conductor support and shielding assembly embodying my invention comprises a metallic corona shielding loop 5 attached to the upper end of four metallic rods 6, 7, 8 and 9 which project downwardly and inwardly from the loop to a normally vertical rod 10. The lower ends of rods 6-9 are attached to rod 10 intermediate its ends. Fitting 11 is provided on the upper end of metallic rod 10 to afford means for coupling the conductor support and corona shielding assembly to the lowermost insulator disc 12 of the insulator string 1. In FIG. 1 a conventional clevis 13 and pin 14 arrangement is shown to illustrate one form of suitable coupling, but it will be understood that any conventional fitting, such as a ball and socket, could be provided to couple the insulator string to the combination support and shield assembly of the invention. The lower end of metallic rod 10 is also provided with a fitting 15, which is coupled to another conventional clevis 16 and pin 17 that supports a conductor saddle clamp 18. Two additional conductor supporting fittings 19 and 20 are attached to diametrically opposite points of the metallic loop 5 adjacent the respective points of attachment of the normally inclined metallic rods 6 through 9. The fittings 19 and 20 are also coupled through conventional clevis and link assemblies 21 and 22 respectively to conductor saddle clamps 23 and 24.

It has been discovered that improved voltage grading between suspension insulator string 1 and conductors 2 and 3 is obtained when loop 5 is positioned substantially above the lower end of insulator string 1. Accordingly, the preferred embodiment of my invention depicted in FIG. 1, the normally inclined metallic rods 6-9 are designed to terminate in a horizontal plane that intersects the insulator string 1 between its lowermost insulator disc 12 and the next lowermost insulator disc 25 in the string thus positioning the metallic loop 5 that is attached to the upper ends of rods 6-9 in its optimum voltage grading

and corona shielding position. In order to reduce the tendency of corona discharge to occur from the conductor support and shielding assembly, the metallic bar and loop portions 5 through 10 are formed of rounded metallic bar stock in the embodiment of the invention illustrated and the respective bar members are attached to each other and to the loop 5 by a welding operation that forms smooth joints therebetween with a minimum of surface discontinuity or irregularity. The use of solid metallic bar stock to form these members also affords a strong, mechanically stable support and shield assembly that will withstand the tensions applied to the assembly during normal operating conditions by the weight and movement of conductor cables 2-4 when they are subjected to wind and icing conditions. Those familiar with the electrical high voltage transmission field will understand that other types of electrically conductive and mechanically strong materials may be employed and means other than those described for attaching the individual sections and metallic loops to one another might be used without departing from the spirit of my invention.

It will be seen that fittings 19 and 20 are designed to support cable clamps 23 and 24 in a horizontal plane substantially above the bottom of insulator coupling clevis 13. This arrangement further enhances the voltage grading attributes of the combined support and shielding assembly because the conductors 2 and 3 are thus maintained in a position closer to the optimum horizontal plane occupied by metallic loop 5 than the third conductor 4 so the voltage grading capacitance is distributed more evenly between conductors 2 through 4 and the lowermost insulator discs 12 and 25 of string 1 than would be the case if all of the conductors were supported in positions below the insulator clevis 13. In addition to maintaining conductors 2 and 3 in a relatively elevated position, the fittings 19 and 20 are designed to support these conductors in positions normally directly below their respective sides of metallic shielding loop 5. With this arrangement, optimum corona shielding is obtained without having any portion of the shielding assembly exceed the horizontal spacing of the conductors 2 and 3. Thus, the striking or arcing distance between the outermost conductors 2 and 3 of the phase bundle shown and electrical ground or conductors of adjacent phases is determined solely by the spacing requirement of the respective conductors rather than by a design requirement imposed on the system due to the dimensions of the corona shielding and support assembly. Accordingly, the length of suspension tower crossarms and related apparatus can be economically designed with these advantageous features in mind.

FIG. 2 of the drawing, wherein like reference numerals to those used in FIG. 1 are employed to indicate identical parts, shows an embodiment of my invention which is adapted to support four conductors in relatively stable relationship. In this embodiment, metallic bars 26 and 27 are attached to normally vertical bar 10 intermediate its upper and lowermost ends and radiate in opposite directions outwardly therefrom in a substantially horizontal plane. Conductor supporting fittings 28 and 29 are attached respectively to the outer ends of normally horizontal bars 26 and 27 and cable saddle clamps 30 and 31 are coupled through conventional clevis and link assemblies to these fittings.

From the foregoing description of my invention, it will be understood that the essence of the invention consists of providing a novel assembly that combines a corona shielding metallic loop in an electrically and mechanically optimum manner with multiple conductor supporting means. In order to further highlight the desirable simplicity of design inherent in the invention, a third embodiment of it is depicted in FIG. 3 of the drawing. In this embodiment, the metallic shielding loop 5 is attached to the uppermost ends of downwardly inclined metallic rods 32-32A, 33 and 34. A fitting 35 is at-

tached to the center of rod 32-32A to afford means for coupling the combined conductor support and shielding assembly to a conventional clevis and pin arrangement 36 on the lowermost insulator disc 37 of a conventional suspension insulator string (not shown). Rods 33 and 34 are attached at their respective common junction points to rod 32-32A and normally horizontal rods 38 and 39 are attached to rod 32-32A adjacent these common junction points. The resulting combination assembly is a smoothly curvilinear arrangement having a minimum number of sharp angular surfaces or projections, thus, reducing the likelihood of corona discharge from the assembly. The four conductor supporting fittings 40, 41, 42 and 43 depicted in this embodiment of the invention are disposed in the same relative relationship as the conductor supporting fittings 19, 20 and 28, 29 shown in FIG. 2 of the drawing. Thus they afford like optimum grading and shielding characteristics and will not be discussed further here.

It will now be understood that my invention provides in a desirably simplified form a combined conductor support and corona shield assembly wherein the supported conductors are positioned to afford optimum voltage grading and corona shielding effect while the overall width of the assembly is maintained at a minimum. Furthermore, the invention provides a combined conductor support and corona shield having a minimum number of segments all of which are formed in an integral assembly that greatly reduces the likelihood of corona discharge inherent in related assemblies heretofore employed in the prior art.

It will be understood by those skilled in the art that while my invention has been described with reference to particular embodiments thereof, different modifications and adaptations can be made within the scope of the invention. Accordingly, therefore, I wish to have it understood that I intend herein to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A combined multiple conductor support and corona shield for supporting conductors in spaced relationship to an insulator comprising a metallic shielding loop, coupling means for fastening said loop to a suspension insulator string, spacing means integral with said loop and coupling means for positioning the loop in a horizontal plane intersecting said insulator string at a point above the lowermost end thereof when the coupling means are fastened to the insulator, and fittings on said loop for supporting at least two conductors in juxtaposition therewith, said fittings comprising a link member connected to said loop and a cable support member connected to said link member.

2. A combined multiple conductor support and corona shield as defined in claim 1, wherein said spacing means is provided with at least one fitting for supporting at least one additional conductor in juxtaposition thereto.

3. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a metallic member having a fitting thereon for attachment to the lower end of a suspension insulator, at least two rods of equal length attached to said metallic member and radiating outwardly and upwardly therefrom to terminate in a plane that intersects said insulator string between its lowermost and next lowermost insulator disc, a metallic loop in said plane attached at predetermined points thereon to the uppermost ends of said rods, fittings on said loop adjacent said points of attachment for supporting at least two conductors in juxtaposition to said loop, and at least one fitting on said metallic member for supporting at least one additional conductor in juxtaposition thereto, said fittings on said loop comprising a link member connected to said loop and a cable support member pivotally connected to said link member.

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4. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally vertical metallic rod having a fitting at its upper end for attachment to the lower end of a suspension insulator string, at least two normally inclined metallic rods attached at their lower ends to said normally vertical rod intermediate the ends thereof, said normally inclined rods radiating outwardly and upwardly from their points of attachment to said normally vertical rod to a horizontal plane that intersects said insulator string between its lowermost and next lowermost insulator disc, a metallic loop in said plane attached to the upper ends of said inclined rods, fittings respectively adjacent said points of attachment on said loop for supporting a pair of conductor clamps, and at least one other fitting on the lower end of said normally vertical rod for supporting another conductor clamp therefrom, said fittings on said loop comprising a link member depending from said loop and a cable clamp pivotally suspended from said link member.

5. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally vertical metallic rod having a fitting at its upper end for attachment to the lower end of a suspension insulator string, at least four normally inclined metallic rods attached at their lower ends to an intermediate location on said normally vertical rod, said normally inclined rods radiating outwardly and upwardly from their point of attachment to said normally vertical rod to a horizontal plane substantially above the lower end of said suspension insulator string, a metallic loop in said plane attached at substantially equally spaced points thereon to the upper ends of said inclined rods, fittings at two diametrically opposite points on said loop for supporting a pair of conductor clamps, and at least one other fitting on the lower end of said normally vertical rod for supporting another conductor clamp therefrom, said fittings on said loop comprising a link member depending from said loop and a cable clamp pivotally suspended from said link member.

6. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally vertical metallic rod having a fitting at its upper end for attachment to the lower end of a suspension insulator string, four normally inclined metallic rods attached at their lower ends to an intermediate location on said normally vertical rod, said normally inclined rods radiating outwardly and upwardly from their point of attachment to said normally vertical rod to a horizontal plane between the lowermost and next lowermost insulators of said string, a rectangular metallic loop of rounded cross section and corners in said plane attached on two opposite sides thereof to the upper ends of said inclined rods with one pair of said rods attached to spaced points on one of said opposite sides and the other pair attached to spaced points on the other one of said opposite sides, fittings at two diametrically opposite locations on said loop respectively between the points of attachment of each pair of rods to said loop for supporting a pair of conductor saddle clamps, and at least one other fitting for supporting at least one other conductor saddle clamp from the lower end of said normally vertical rod, said fittings on said loop comprising a link member depending from said loop and a cable clamp pivotally suspended from said link member.

7. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally vertical metallic rod having a fitting at its upper end for

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attachment to the lower end of a suspension insulator string, at least four normally inclined metallic rods attached at their lower ends to an intermediate location on said normally vertical rod, said normally inclined rods radiating outwardly and upwardly from their point of attachment to said normally vertical rod to a horizontal plane substantially above the lower end of said suspension insulator string, a rectangular loop of metallic rod in said plane attached at substantially equally spaced points on opposite sides thereof to the upper ends of said inclined rods, fittings at two diametrically opposite locations on said loop on said opposite sides between said points for supporting a pair of conductor clamps, and at least one other fitting for supporting another conductor clamp from the lower end of said normally vertical rod, said fittings on said loop comprising a link member depending from said loop and a cable clamp pivotally suspended from said link member.

8. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally vertical metallic rod having a fitting at its upper end for attachment to the lower end of a suspension insulator string, at least two normally inclined metallic rods attached at their lower ends to said normally vertical rod intermediate the ends thereof, said normally inclined rods radiating outwardly and upwardly from their point of attachment to said normally vertical rod to a horizontal plane that intersects said insulator string between its lowermost and next lowermost insulator disc, a metallic loop in said plane attached to the upper ends of said inclined rods, fittings respectively adjacent said points of attachment on said loop for supporting a pair of conductor clamps, at least two normally substantially horizontal metallic rods attached at their respective innermost ends to said normally vertical rod and radiating outwardly therefrom in opposite directions, and conductor clamp supporting fittings attached to the respective outer ends of said normally horizontal rods.

9. A combined multiple conductor support and corona shield for attachment to the lower end of a suspension insulator string comprising, in combination, a normally horizontal metallic loop, conductor supporting fittings at two diametrically opposite locations on said loop, at least two metallic rods attached to said loop at diametrically opposite points thereon, said metallic rods radiating downwardly and inwardly from said points of attachment to at least one common junction point, at least two normally substantially horizontal metallic rods attached at their respective inner ends to at least one of said downwardly radiated rods adjacent one of said common junction points, and conductor supporting fittings attached to the respective outer ends of said horizontal rods.

## References Cited

## UNITED STATES PATENTS

1,690,185	11/1928	Wahlberg	-----	174—144
3,036,149	5/1962	Fiero	-----	174—141
3,165,284	1/1965	Kaminski et al.	-----	248—63
3,368,027	2/1968	Claren et al.	-----	174—149 X

## FOREIGN PATENTS

661,517	3/1929	France.
899,966	12/1953	Germany.
403,499	4/1943	Italy.

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U.S. Cl. X.R.

174—141; 248—63