

Feb. 28, 1961

J. J. TAYLOR
CONDUCTOR SPACERS

2,973,402

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2 Sheets-Sheet 1

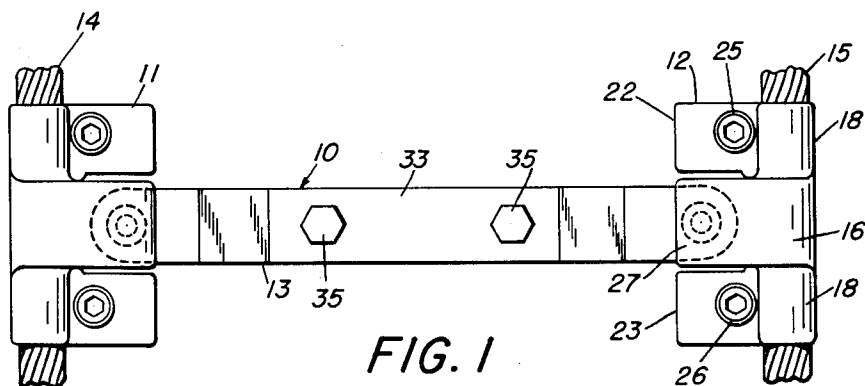


FIG. 1

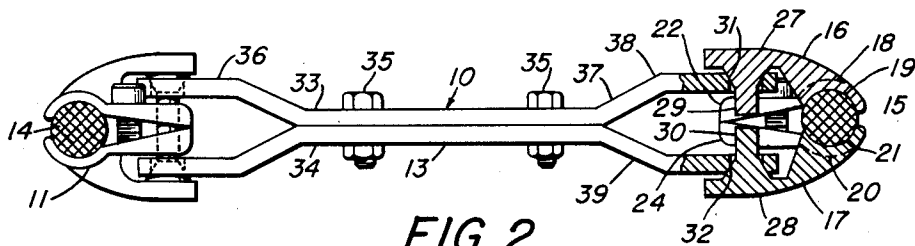


FIG. 2

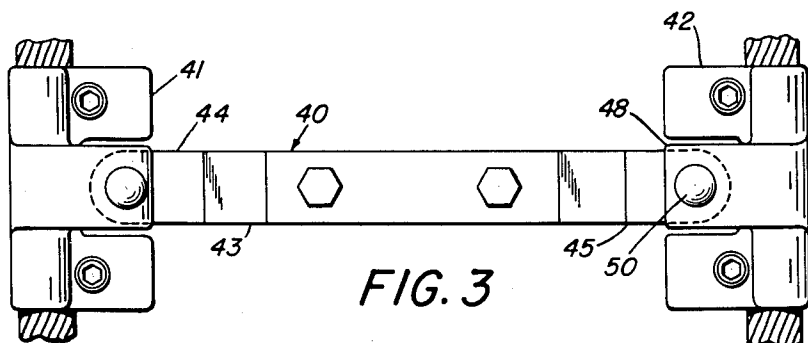


FIG. 3

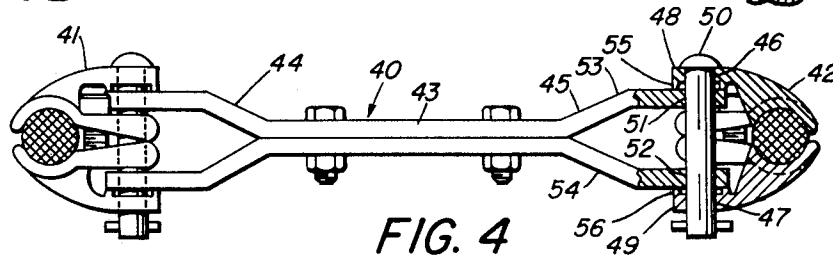


FIG. 4

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2 Sheets-Sheet 2

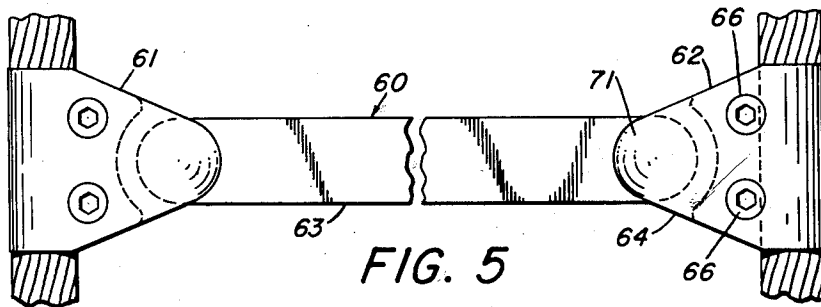


FIG. 5

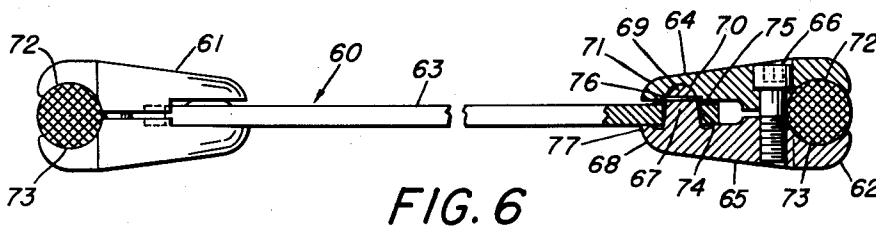


FIG. 6

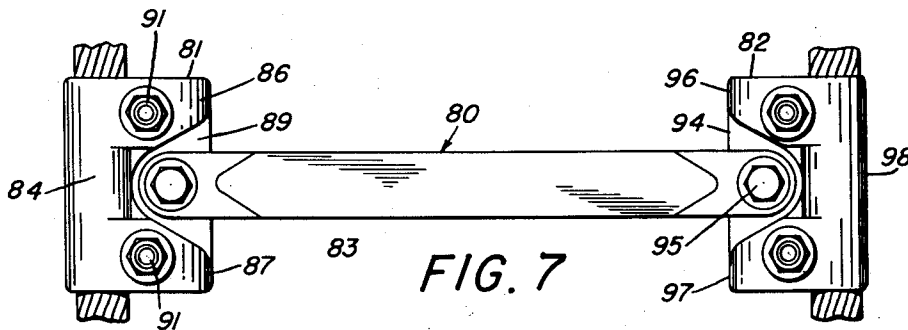


FIG. 7

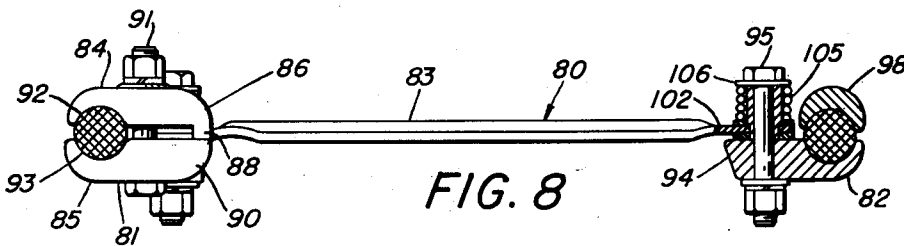


FIG. 8

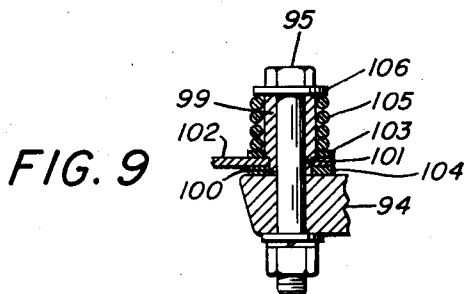


FIG. 9

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2,973,402

CONDUCTOR SPACERS

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13 Claims. (Cl. 174—40)

This invention relates to high voltage transmission lines and, more particularly, to spacers for transmission lines incorporating conductors formed of a multiplicity of cables.

This application incorporates matter originally disclosed and claimed in my application Serial Number 590,661, filed June 11, 1956, now abandoned, and entitled "Transmission Apparatus and Conductor Spacers Therefor" and is a continuation-in-part of that application.

As set forth in my application above referred to, certain advantageous results may be obtained in so-called bundle conductor transmission lines by utilization of spacers which are so designed and constructed that independent torsional movement of the cables which form the bundle conductor is prevented or substantially diminished. One advantage of such an arrangement is that fatigue of the cable adjacent the conductor clamps is greatly reduced. Spacers constructed in accordance with the invention embody two conductor clamps for attachment to the cable of the conductor, together with a rigid spacer bar pivotally arranged and connected to the conductor clamps for holding the conductor clamps, and the attached cables, at a determinate distance when the conductor clamps are aligned each with the other. Additionally, in accordance with the present invention, the spacer bar and conductor clamps are so connected that independent rotational movement of the conductor clamps and cables is prevented and the assemblage can execute only rotational movements as a whole.

According to one embodiment of the invention, a spacer bar having bifurcate ends is pivotally connected to the parts of each of the conductor clamps in such a way that, when the clamps are secured to the cables, the ends of the spacer bar are compressed to provide an elastic force which opposes independent rotation of the cables and conductor clamps.

According to another embodiment of the invention, torsional restraint of a simple spacer bar with respect to the conductor clamp is provided by a separate elastic member.

The invention, together with further objects, features and advantages thereof, will be more clearly understood by reference to the following detailed specification and claims, taken in connection with the appended drawings, in which

Fig. 1 is a plan view of a torsionally restrained spacer in accordance with the invention;

Fig. 2 is an elevation view, partly in section, of the spacer of Fig. 1;

Figs. 3 and 4 are plan and elevation views of a spacer employing the principles of the spacer of Figs. 1 and 2, differing therefrom in minor respects and incorporating static friction energy dissipating means;

Figs. 5 and 6 illustrate another form of spacer construction in accordance with the invention;

Figs. 7 and 8 illustrate another specific embodiment of the spacer of the invention, generally similar to the spacer of Figs. 5 and 6; and

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Fig. 9 is an enlargement of the sectional view of Fig. 8.

Referring now to Figs. 1 and 2, the spacer 10 comprises two conductor clamps 11 and 12 and a spacer bar 13. The conductor clamps 11 and 12 are attached to two conductor cables 14 and 15 to hold the cables in a predetermined transversely spaced position and permit only relative longitudinal movement of the cables. Additionally, the spacer 10 forms an electrically conductive path between the cables so that the two cables function as a single conductor of an electrical transmission line.

The two clamps 11 and 12 are of the same construction, shown for the clamp 12 in the right hand portion of Fig. 2. The clamp 12 comprises two similar metallic body members 16 and 17. Each of the body members constitutes an integral cast or forged metallic piece.

The clamp 12 has three functional parts which are referred to separately for the purpose of description. Thus, a cable receiving part 18 extends longitudinally in the direction of the cable and is formed with a cable groove 19. The body member 17 similarly includes a cable receiving part 20, opposed to the part 18, and a cable groove 21 opposed to the groove 19.

The body members 16 and 17 are pivoted against each other by means of two laterally inward-projecting parts 22 and 23 of the body member 16 and two corresponding laterally projecting parts on the body member 17, of which the part 24 appears in Fig. 2. Two fasteners, such as the screws 25 and 26, extend between the inwardly projecting parts to draw the body members 16 and 17 together upon the cable. As shown, the parts 22 and 24 contact each other at the inward extremities thereof so that the screw 25 exerts a compressive force between the parts to clamp the cable receiving parts 18 and 20 against the cable 15.

The central part 27 of the body member 16 is separate from the inwardly extending parts 22 and 23, and constitutes a pivotal support for the spacer bar 13. The body member 17 has a corresponding central part 28. The parts 27 and 28 diverge in the vertical direction and are formed on the adjacent sides thereof with opposed integral studs 29 and 30. The studs may be formed at the outward extremities thereof with conical bearing portions, indicated generally at 31 and 32, to form a bearing surface for the spacer bar.

The spacer bar 13 comprises two flat metal pieces 33 and 34 in contact along the central part of the bar and secured to each other by means such as the screws 35. The two pieces are spread apart at the outward ends of the bar to form bifurcate end parts 36 and 37. The arms of the end parts have aligned openings and are received over the inwardly projecting studs 29 and 30. Thus, the arms 38 and 39 of the end part 37 are received over the studs 29 and 30 and engage the bearing surfaces 31 and 32 of the studs. The outer portions of the arms at the openings may be tapered to conform to the bearing surfaces 31 and 32.

The initial disposition of the end parts 36 and 37 of the spacer bar is such that the arms are spaced apart a greater distance than the effective distance between the parts 27 and 28 when the spacer is installed on the cable. Thus, in the installed position, the arms are deformed so that a resisting force is exerted by the arms against the bearing surfaces 31 and 32 of the studs. The loading of the material of the pieces 31 and 32 is, however, such that the arms are elastically deformed and no significant permanent set is incurred.

The compressive relationship between the arms of the spacer and the projecting studs of the clamp members is such that good electrical continuity is maintained between the cables by the spacer. Additionally, excess wear of the parts of the spacer, which would otherwise occur

because of the small relative movements and vibrations of the cables, is avoided.

Referring now to Figs. 3 and 4, the spacer 40 there shown is generally similar to the spacer 10 of Figs. 1 and 2 and comprises two conductor clamps 41 and 42 and a spacer bar 43 having bifurcate end parts 44 and 45. The body members of the conductor clamps are provided, however, as is shown in Fig. 4 for the clamp 42, with aligned openings 46 and 47 in the central parts 48 and 49 thereof. A pin 50 passes through the openings 46 and 47 and aligned openings 51 and 52 in the arms 53 and 54 of the spacer bar. The central parts 48 and 49 are, moreover, provided with inwardly directed annular bearing parts 55 and 56 which engage the outer surfaces of the arms 53 and 54 of the end part 45.

The engagement of the bearing parts 55 and 56 with the spacer arms provides a measure of static friction which tends to prevent relative longitudinal movement of the two cables and dissipates the energy of vibrational movements in that direction. The amount of static friction thus obtained is substantial and the actual resisting force for a given design is closely predictable.

The two embodiments of the invention just described depend for their ability to resist separate torsional movement of the cables upon the particular structural configuration of the bars and clamps, e.g., in the pivotal connection between the bifurcate end portions of the spacer bar with the clamp parts as well as on the elastic forces generated on the springing of the arms of the spacer bar. Thus, the relative orientation of the conductor clamp and the spacer bar would be maintained even though the elastic forces of the arms of the spacer bar were to disappear because of progressive relaxation of the stresses in the material over long periods of time.

There is shown in Figs. 5 and 6 another embodiment of the invention in which the conductor clamp is provided with a single pivot in such a way that a limited torsional movement of the cable and conductor clamp relative to the spacer bar could take place in the absence of any restraining force. An elastic restraining means is provided, however, to resist small torsional movements of the cables and conductor clamps.

In Figs. 5 and 6, the spacer 60 comprises two conductor clamps 61 and 62 and a spacer bar 63. The conductor clamp 62 comprises two similar and opposed body members 64 and 65 which are held in clamping relationship by two screws 66. The lower body member 65 is provided with an integral cylindrical stud 67 which extends from a laterally projecting part 68 of the member. The upper end 69 of the stud 67 is rounded and is received in a matching rounded opening 70 in the adjacent side of a laterally projecting part 71 of the upper body member 64. Two cable receiving grooves 72 and 73 are provided in the adjacent sides of the body members for receiving the cable.

The spacer bar 63 constitutes a flat metallic piece which is received between the laterally projecting parts 68 and 71 of the body members 64 and 65 and is received over the stud 67 which extends through an opening 74 near the end of the bar.

Because of the spacing between the adjacent sides of the body members 64 and 65, the conductor clamp may execute very limited rotational movement (in the plane perpendicular to the cables) relative to the bar 63. A spring washer 75 is, however, arranged about the stud 67 and bears upon the bar 63 and a washer 76 which is similarly fitted on the stud and is held by the body member 64. The spring washer 76 exerts a force tending to resist small torsional movements of the conductor clamp with respect to the bar 63 and, additionally, prevents excessive wear between the parts. A projection 77 is formed on the body member 65 to constitute a static friction means, as described in connection with Figs. 3 and 4.

In the conductor clamps 61 and 62 of Figs. 5 and 6,

the stud 67 constitutes a bearing part about which the body member 64 may pivot when the two body members 64 and 65 are drawn together upon the cable by the screws 66. A similar arrangement may be used for the conductor clamps of Figs. 1 and 2 so that the studs 29 and 30 bear upon each other to constitute a pivot for the body members 16 and 17.

In Figs. 7 and 8, the spacer 80 comprises two conductor clamps 81 and 82 and a rigid spacer bar 83. Each of the clamps is formed as two body parts, e.g., the body parts 84 and 85, of the spacer 81. The upper body part 84 has two laterally-inward extending end parts 86 and 87 with pivotal projections, such as the projection 88 shown in Fig. 8, and a laterally recessed central part 89. The lower body part 85 is of uniform generally rectangular construction, indicated at 90, throughout its length. The two body parts are drawn together about the pivotal projections, e.g., the projection 88 and the corresponding projection on the inwardly extending end part 86, to clamp upon the cable by means of fasteners, such as the bolts 91. The cable receiving grooves 92 and 93 are disposed in the longitudinal direction of the body parts 84 and 85.

The spacer bar 83 is formed from a flat metal piece and has the center part twisted with respect to the end parts to increase the resistance to bending movements.

As shown, particularly in Figs. 8 and 9, the spacer bar 83 is pivoted upon the lower body part, e.g., the body part 94 of the conductor clamp 82, by means of a bolt 95 which extends through an opening disposed between the inwardly extending end parts 96 and 97 of the upper body part 98. The bolt 95 carries a bushing 99, having a lower end part 100 of reduced diameter, which extends through an opening 101 in the flat end part 102 of the spacer bar 83. The end part 102 is held between two washers 103 and 104 by a spring 105 which is disposed about the bushing 99 between the washer 103 and the washer 104 at the head of the bolt 95. The bushing 99 is drawn tightly against the body part 94 by the bolt 95 and the spacer bar 83 pivots on the bushing 99.

The functional arrangement of the spacer of Figs. 7, 8 and 9 is such that the spring 105 and the washers 103 and 104 hold the conductor clamp and spacer bar against relative movement, with respect to the bushing 99 and the body part 94, in a transverse vertical plane. The spring 105 and the washers 103 and 104 also act to provide a static friction force resisting relative turning of the spacer bar with respect to the conductor clamp in a horizontal plane.

It is to be understood that the foregoing description is not intended to restrict the scope of the invention and that various rearrangements of the parts and modifications of the design may be resorted to. The following claims are directed to combinations of elements which embody the invention or inventions of this application.

I claim:

1. A spacer for holding two conductor cables in spaced lateral disposition, comprising a spacer bar and two conductor clamps, one at each end of the bar, each conductor clamp including two unitary body parts with opposed longitudinally directed cable receiving grooves adjacent the outer extremity thereof, inwardly extending central parts spaced apart in a direction perpendicular to the cable grooves, pivot means carried by the said central parts and extending in the longitudinal direction thereof perpendicular to the cable grooves, and screw means extending through the body parts for clamping the parts together and upon the cable, and the spacer bar having bipartite end parts received over the pivot means and spaced apart in the longitudinal direction of the pivot means for two point bearing against the pivot means, all for permitting relative longitudinal movement of the conductor clamps with respect to each other in the plane of the spacer bar and cables while preventing separate torsional movement thereof.

2. The invention in accordance with claim 1 in which the pivot means comprises inwardly directed studs integral with the body parts and the said end parts of the spacer bar are received between the said central parts.

3. The invention in accordance with claim 2 in which studs bear upon each other and constitute a pivot for the body parts.

4. The invention in accordance with claim 1 in which the pivot means comprises a pin passing through the said central parts and through the end parts of the bar.

5. The invention in accordance with claim 1 in which the bipartite end parts of the spacer bar are elastically compressed between the offset central parts.

6. The invention in accordance with claim 5 in which the offset central parts have inwardly directed bearing parts engaged with the exterior surfaces of the end parts of the spacer bar for resisting turning movement of the conductor clamp with respect to the bar and constituting a static friction energy dissipating means.

7. A spacer for holding two conductor clamps in spaced lateral disposition comprising a rigid spacer bar and two conductor clamps, one at each end of the bar, each conductor clamp including two unitary body parts with opposed longitudinally directed cable receiving grooves adjacent the outward extremity thereof including inwardly extending central parts spaced apart in a direction perpendicular to the axis of the cable grooves screw means extending through the body parts for clamping the parts together and upon the cable, combined pivot means for the spacer bar and bearing means for the body parts comprising at least one metallic piece extending between the said two central parts, and the spacer bar having spaced bipartite end parts with the arms thereof received over the pivot means and elastically compressed between the said central parts and the pivot means extending through aligned openings in the said arms.

8. The invention in accordance with claim 7 in which the spacer bar comprises two flat metallic pieces having outwardly deformed arms at the ends thereof, and fastener means for holding the pieces together along at least the central part thereof, and in which the compression of the arms between the body parts of the clamps brings the pieces into contacting engagement along the

portion of the bar between the fastener means and the arms.

9. A spacer for holding two conductor cables in spaced lateral disposition comprising a spacer bar and two conductor clamps, one at each end of the bar, each conductor clamp including two unitary body parts with opposed longitudinally directed cable receiving grooves adjacent the outer extremity thereof, at least one having a central part extending inwardly of the two clamps, screw means extending through the body parts at each side of the said central parts for clamping the parts together and upon the cable, pivot means carried by the said central part, arranged perpendicular to the longitudinal direction of the cable grooves, and the spacer bar having an end part received over the pivot means, and elastic means positioned over the pivot means for holding the spacer bar against the body part to provide frictional restraint against relative turning movements of the clamp with respect to the spacer bar about the pivot means and restraint against relative turning movements of the clamp with respect to the spacer bar in a plane perpendicular to the cable receiving grooves.

10. The invention in accordance with claim 9 with an inwardly extending central part on the second body part spaced from the first named central part in a direction perpendicular to the axis of the cable grooves and the elastic means comprises spaced bipartite end parts on the spacer bar.

11. The invention in accordance with claim 9 in which the elastic means comprises a spring washer interposed between the spacer bar and one of the body parts.

12. The invention in accordance with claim 9 in which the elastic means comprises a spring extending between the spacer bar and an end part on the pivot means.

13. The invention in accordance with claim 1 in which the pivot means comprises at least one inwardly directed stud integral with a body part.

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