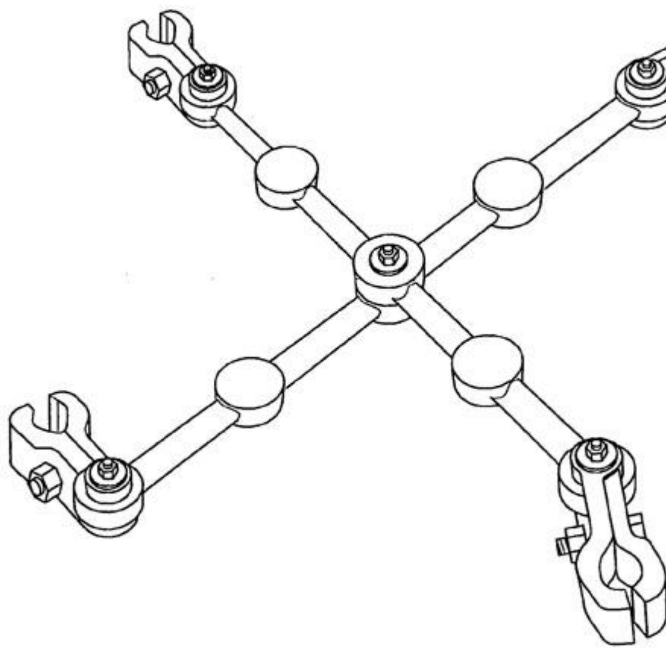
Patents

Spacer Device
US Patent 8,981,227,B2
AR®Lightweight Spacer Damper



SPACER DEVICE (PENDING)
UNITED STATES PATENT APPLICATION
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ABSTRACT
A **spacer device** includes an elongate spacing member extending a longitudinal axis for securing to electrical transmission lines, and has a minimum thickness dm. At least one thickened portion having a thickness Tt and length dt is positioned intermediate along the spacing member to form at least two column lengths Lc separated by the at least one thickened portion. Each column length Lc has a portion with the minimum thickness dm. The thickness Tt and length dt of the at least one thickened portion can be at least two times the minimum thickness dm to form at least one end support for the at least two column lengths Lc, such the at least two column lengths Lc behave as separate Euler type columns for producing increased Euler buckling strength with a minimal increase in weight.

BACKGROUND
Electrical transmission lines, cables or conductors can be subject to galloping during storms, which can cause damage to the transmission line system. If damage is extensive, repairs can be costly and time consuming.

SUMMARY

The present invention can provide a spacer device including an elongate spacing member extending along a longitudinal axis for securing to electrical transmission lines, and can have a minimum thickness d_m. At least one thickened portion having a thickness T_t and length d_t can be positioned intermediate along the spacing member to form at least two column lengths L_c separated by the at least one thickened portion. Each column length L_c can have a portion with the minimum thickness d_m. The thickness T_t and length d_t of the at least one thickened portion can be at least two times the minimum thickness d_m to form at least one end support for the at least two column lengths L_c, such that the at least two column lengths L_c behave as separate Euler type columns for producing increased Euler buckling strength with a minimal increase in weight.

In particular embodiments, the thickened portion can have a thickness T_t that is at least two times the minimum thickness d_m of the spacing member, and a length d_t that is at least three times the minimum thickness d_m. The spacing member can have a column length to minimum thickness L_c/d_m ratio of about 5 to 18, a thickened portion thickness to spacing member minimum thickness T_t/d_m ratio of about 1.5 to 3, and a thickened portion length to spacing member minimum thickness d_t/d_m ratio of about 2 to 5 for producing increased Euler buckling strength with a minimal increase in weight. In some embodiments, the L_c/d_m ratio can be about 6 to 7, the T_t/d_m ratio can be about 1.75 to 2.5, and the d_t/d_m ratio can be about 2.5 to 3.5. The spacing member can be a rod having a length of about 1½ to 3 feet long, and having a minimum thickness d_m of about ⅜ to ¾ inches. The at least one thickened portion can have a thickness T_t of about 1 to 2 inches, and a length d_t of about 1½ to 2½ inches. The at least one thickened portion can be integrally formed on the spacing member. At least two thickened portions can be spaced apart about 5 to 11 inches. The at least one thickened portion can be cylindrical in shape and can have a central axis orthogonal to the longitudinal axis of the spacing member. The at least one thickened portion can have a diameter of about 1½ to 2½ inches. First and second clamps can be secured to opposite ends of the spacing member for securing to respective electrical transmission lines. The clamps can be capable of rotating relative to the spacing member. The spacer device can be capable of spacing two electrical transmission lines about 30 to 32 inches apart. The elongate spacing member can be a first spacing member, and the spacer device can further include a second elongate spacing member secured to the first spacing member and can have at least a third clamp secured to an end of the second spacing member for securing to at least another electrical transmission line.

The present invention can also provide a spacer device for electrical transmission lines including an elongate spacing rod having a length of about 1½ to 3 feet long, and a nominal thickness of about ⅜ to ¾ inches. A series of spaced apart thickened portions can be integrally formed on the spacing rod. The thickened portions can be at least two times thicker than the nominal thickness of the spacing rod and spaced about 5 to 8 inches apart for producing increased Euler buckling strength with a minimal increase in weight.

The present invention can also provide a spacer device including an elongate spacing rod extending along a longitudinal axis for securing to electrical transmission lines, and having a minimum diameter d_m. At least one thickened portion can be positioned intermediate along the spacing rod to form at least two column lengths L_c separated by the at least one thickened portion. The at least one thickened portion can be cylindrically shaped with a central axis orthogonal to the longitudinal axis of the spacing rod, and can have a diameter d_t and thickness T_t large enough to form at least one end support for the at least two column lengths L_c, such that the at least two column lengths L_c behave as separate Euler type columns for producing increased Euler buckling strength with a minimal increase in weight.

The present invention can also provide a spreading device for spreading cables apart including a first spreading arm having a proximal end and a distal end, and a second spreading arm having a proximal end and a distal end. The distal ends of the first and second spreading arms can be configured for engaging respective cables. The proximal ends of the first and second spreading arms can be pivotally connected together by a pivot point. The pivot point can be configured to permit pivoting of the first and second arms relative to each other between an acute angle and just beyond 180°, for spreading the respective cables apart and locking in a spread position.

In particular embodiments, a handle can be pivotally connected to the pivot point for moving the first and second spreading arms between the acute angle and just beyond 180°. The pivot point can include a mechanical stop for preventing rotation of the first and second spreading arms past just beyond 180°.

The present invention can also provide a spacer damper device for electrical transmission lines including two polymeric sleeves, each about 4 to 5 feet long covering a portion of two spaced apart transmission line cables. Two helical armor rods, each about 6 to 7 feet long can be wrapped around a polymeric sleeve. Ends of the armor rods can be wrapped around the cables. A spacing member can have two clamps, each for clamping over a cable at a region to clamp over an armor rod and polymeric sleeve, thereby forming a constrained viscoelastic layer where the polymeric sleeve deforms in shear when the cable bends underneath the clamp, thereby providing damping.

The present invention can also provide a damper device for electrical transmission lines including a polymeric sleeve covering a portion of a transmission line cable. A rod can be wrapped around the polymeric sleeve. Ends of the rod can be wrapped around the cable. A clamp can be clamped over the rod and polymeric sleeve, thereby forming a constrained viscoelastic layer where the polymeric sleeve deforms in shear when the cable bends underneath the clamp, thereby providing damping.
In particular embodiments, the polymeric sleeve can be about 4 to 5 feet long, and the rod can be a helical armor rod about 6 to 7 feet long. The clamp can be a first clamp and the transmission line cable can be a first transmission line cable. The damper device can further include a spacing member to which the first clamp is mounted, and a second clamp mounted to the spacing member for clamping to a second transmission line cable. In some embodiments, the clamp can be mounted to a member extending from a transmission tower.

The present invention can also provide a method of spacing two electrical transmission lines with a spacer device including securing an elongate spacing member to the two electrical transmission lines. The elongate spacing member can extend along a longitudinal axis, and can have a minimum thickness d_m. At least one thickened portion having a thickness T_t and length d_t can be positioned intermediate along the spacing member to form at least two column lengths L_c separated by the at least one thickened portion. Each column length L_c can have a portion with a minimum thickness d_m. The thickness T_t and length d_t of the at least one thickened portion can be at least two times the minimum thickness d_m to form at least one end support for the at least two column lengths L_c, such that the at least two column lengths L_c behave as separate Euler type columns for producing increased Euler buckling strength with a minimal increase in weight.

In particular embodiments, the thickened portion can have a thickness T_t that is at least two times the minimum thickness d_m of the spacing member, and a length d_t that is at least three times the minimum thickness d_m. The spacing member can have a column length to minimum thickness L_c/d_m ratio of about 5 to 18, a thickened portion thickness to spacing member minimum thickness T_t/d_m ratio of about 1.5 to 3, and a thickened portion length to spacing member minimum thickness d_t/d_m ratio of about 2 to 5 for producing increased Euler buckling strength with a minimal increase in

weight. In some embodiments, the L_c/d_m ratio can be about 6 to 7, the T_t/d_m ratio can be about 1.75 to 2.5 and the d_t/d_m ratio can be about 2.5 to 3.5. The spacing member can be a rod with a length of about 1½ to 3 feet long, and a minimum thickness d_m of about ⅜ to ¾ inches. The at least one thickened portion can have a thickness T_t of about 1 to 2 inches, and a length d_t of about 1½ to 2½ inches. The at least one thickened portion can be integrally formed on the spacing member. At least two thickened portions can be spaced apart about 5 to 11 inches. The at least one thickened portion can be cylindrical in shape, and with a central axis orthogonal to the longitudinal axis of the spacing member. The at least one thickened portion can have a diameter of about 1½ to 2½ inches. First and second clamps that are on opposite ends of the spacing member can be secured to respective electrical transmission lines. The clamps can be allowed to rotate relative to the spacing member. The two electrical transmission lines can be spaced about 30 to 32 inches apart. The elongate spacing member can be a first spacing member, and the spacer device can further include a second elongate spacing member secured to the first spacing member and can have at least a third clamp secured to an end of the second spacing member for securing to at least another electrical transmission line.
The present invention can also provide a method of spacing two electrical transmission lines with a spacer device including securing an elongate spacing rod to the two electrical transmission lines. The elongate spacing rod can have a length of about 1½ to 3 feet long, and a nominal thickness of about ⅜ to ¾ inches. A series of spaced apart thickened portions can be integrally formed on the spacing rod. The thickened portions can be at least two times thicker than the nominal thickness of the spacing rod and spaced of about 5 to 8 inches apart for producing increased Euler buckling strength with a minimal increase in weight.

The present invention can also provide a method of spacing two electrical transmission lines with a spacer device including securing an elongate spacing rod to the two electrical transmission lines. The elongate spacing rod can extend along a longitudinal axis and have a minimum diameter d_m. At least one thickened portion can be positioned intermediate along the spacing rod to form at least two column lengths L_c separated by the at least one thickened portion. The at least one thickened portion can be cylindrically shaped with a central axis orthogonal to the longitudinal axis of the spacing rod, and can have a diameter d_t and thickness T_t large enough to form at least one end support for the at least two column lengths L_c, such that the at least two column lengths L_c behave as separate Euler type columns for producing increased Euler buckling strength with a minimal increase in weight.
The present invention can also provide a method of spreading two cables apart including providing a spreading device with first and second spreading arms each having proximal and distal ends. The distal ends of the first and second spreading arms can engage respective cables. The proximal ends of the first and second spreading arms can be pivotally connected together by a pivot point. The pivot point can be configured to permit pivoting of the first and second arms relative to each other. The arms can be pivoted from an acute angle to just beyond 180°, for spreading the respective cables apart and locking in a spread position.

In particular embodiments, the first and second spreading arms can be moved between the acute angle and just beyond 180° with a handle pivotably connected to the pivot point. The first and second spreading arms can be prevented from rotating past just beyond 180° with a mechanical stop included with the pivot point. The two cables can be two electrical transmission lines, and can be spread from an initial distance of about 18 inches to a distance of about 30 to 32 inches. A spacing device can be secured to the two electrical transmission lines for maintaining the distance of about 30 to 32 inches.
The present invention can also provide a method of damping electrical transmission lines including covering two spaced apart transmission line cables with two polymeric sleeves, each about 4 to 5 feet long covering a portion of the two spaced apart transmission line cables. Two helical armor rods, each about 6 to 7 feet long can be wrapped around a polymeric sleeve. Ends of the armor rods can be

wrapped around the cables. A spacing member can be secured to the two transmission line cables. The spacing member can have two clamps, each for clamping over a cable at a region to clamp over an armor rod and polymeric sleeve, thereby forming a constrained viscoelastic layer where the polymeric sleeve deforms in shear when the cable bends underneath the clamp, thereby providing damping.

The present invention can also provide a method of damping an electrical transmission line including covering a portion of an electrical transmission line cable with a polymeric sleeve. A rod can be wrapped around the polymeric sleeve. Ends of the rod can be wrapped around the cable. A clamp can be secured over the rod and polymeric sleeve, thereby forming a constrained viscoelastic layer where the polymeric sleeve deforms in shear when the cable bends underneath the clamp, thereby providing damping.

In particular embodiments, the polymeric sleeve can be about 4 to 5 feet long, and the rod can be a helical armor rod about 6 to 7 feet long. The clamp can be a first clamp and the transmission line cable can be a first transmission line cable. A spacing member can be included to which the first clamp is mounted, and a second clamp mounted to the spacing member for clamping to a second transmission line cable. In some embodiments, the clamp can be mounted to a member extending from a transmission tower.

The use of oversized spacer devices **10** of 30 to 32 inches has many desired benefits which include, (i) increase the power delivery capacity of the transmission line over long distances, (ii) strengthen the ability of the bundle to resist forces F caused by short circuits, (iii) increase the wind speed at which galloping may occur, and (iv) prevent sub-conductor oscillation in large diameter sub-conductors.

While this invention has been particularly shown and described with references to example embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention encompassed by the appended claims.

For example, the devices described above and shown in the drawings are not limited for use with electrical transmission lines, but can also be used for support or suspension cables, for example, towers, bridges, etc. In addition, the sizes or dimensions of the devices and their features can vary depending upon the application at hand. Although the components are typically integrally cast from aluminum for weight and manufacturing purposes, it is understood that other suitable metals and materials can be used, and that other configurations of the components and manufacturing methods can be employed.