July 12, 1966 A. T. EDWARDS 3,260,789

BUNDLED CONDUCTOR SPACER DAMPER

Filed Dec. 20, 1963

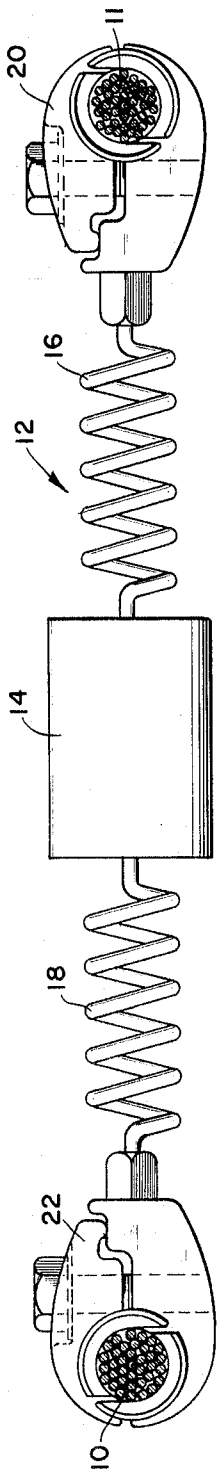

FIG. 1

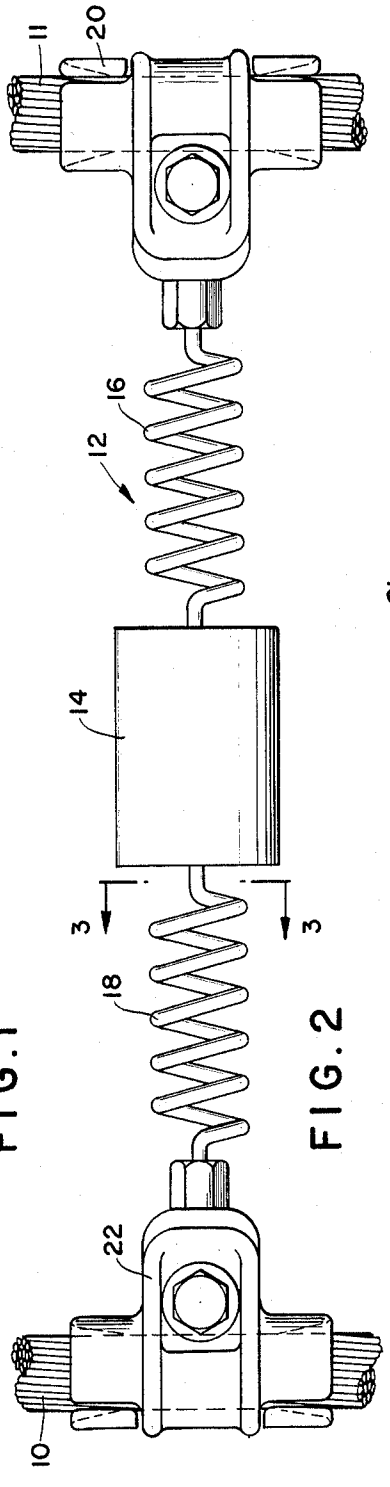

FIG. 2

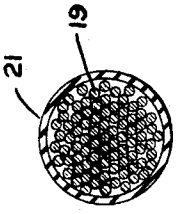

FIG. 3

INVENTOR.
AUBREY T. EDWARDS
BY Howard A. Reiter
ATTORNEY

United States Patent Office 3,260,789 Patented July 12, 1966

3,260,789

BUNDLED CONDUCTOR SPACER DAMPER

Aubrey T. Edwards, 35 Carolyn Drive, Oakville, Ontario, Canada

Filed Dec. 20, 1963, Ser. No. 332,210
2 Claims. (Cl. 174—42)

This invention relates to spacers for bundled transmission line conductors and, more particularly, to spacers capable of dampening vibration in such conductors.

It is well known that spacing devices are needed between the sub-conductors of bundled conductor lines in order to keep the several conductors the required distance apart. Generally, the conductors of bundled lines are held in uniformly spaced apart relationship by means of a bundle-spacer or frame which is securely clamped to each conductor in the bundle and yet is arranged to permit some relative movement between the conductors.

These bundled conductor installations suffer from many of the same problems as do single conductor installations, particularly from mechanical vibration. Cross winds of low velocity tend to induce vibrations or oscillations in the conductors, mainly in the vertical plane. This vibration of the conductors can cause continuous and severe flexure at the points of attachment to the supporting towers which, in turn, often leads to early fatigue of the conductors at these points. This problem is aggravated by the modern tendency toward stringing conductors at increasingly higher mechanical tensions.

Many protective schemes have been tried for reducing the stresses set up in the conductors due to vibration. A common method is the use of weights which are either resiliently connected to single conductors to absorb energy therefrom, or are fixedly connected to single conductors with their centers of gravity spaced from the vertical plane of the conductor, so as to cause the conductor to twist and thus dissipate energy by inter-strand friction. Devices using various combinations of the above principles have also been tried.

I have found that under commonly encountered operating conditions conductors vibrate at one or more frequencies within a specific band. The frequencies of vibration are determined by a number of factors including conductor diameter, stranding arrangement, cross sectional shape, weight per unit length, span between supporting towers, temperature and tension at which the conductor is operating, and wind speed and direction.

Other types of vibration, arising from icing and corona and referred to as "galloping," may also occur. "Galloping" causes motion of the conductors in both the vertical and the horizontal planes, the latter being in a plane substantially parallel to the ground and normal to the axes of the conductors.

To damp the vibration generated in the conductors, it has generally been found necessary to attach specific dampening devices to the conductor adjacent the tower supporting the conductor.

There are also known spacers for the bundled conductors consisting of a length of wire rope having clamping means at each end and a spring inter-connecting the clamping means coaxial with the wire rope. Such spacers are of generaly simple construction, designed to merely maintain the conductors at their given design distances apart, and no attempt is made to prevent vibration.

The present invention has for its primary object the provision of a spacer for bundled conductor transmission lines incorporating therein dampening mechanism to reduce the vibrations on the line.

Another object of this invention is to employ a spacer for bundled conductor lines having an energy absorbing device incorporated therein to dampen vibrations induced in the conductors in a vertical plane.

A further object is to provide a unified vibration damper to replace the plurality of separate dampers commonly employed on the sub-conductors of a bundled line close to the support points.

One of the features of this invention is to provide a conductor spacer damper for bundled transmission lines comprising a clamp to couple the device to each of the conductors in the bundle and an energy absorbing device comprising a helical shaped spring having high internal friction between the clamp and a centrally disposed mass. The combination of the mass and the internal friction of the energy absorbing device function to dissipate the vibration energy of the conductors in both the horizontal and vertical planes.

These and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the following drawings in which:

FIG. 1 is a side view in elevation of one embodiment of the spacer damper of this invention;

FIG. 2 is a plan top view of the device shown in FIG. 1; and

FIG. 3 is a cross section through the spring element used in this invention, taken in plane **3—3** shown in FIG. 2.

Referring to the drawings, FIGS. 1 and 2 show a portion of a transmission line having a pair of conductors **10** and **11** which together form the transmission line conductors for one phase of a system.

In general, these conductors are supported between towers in a known and usual manner. The two conductors **10** and **11** are spaced apart at given intervals between the towers by means of a plurality of spacer damper structures **12** which serve not only to maintain the distance between conductors **10** and **11** but also to dampen the vibration of the conductors, as will be described below.

The spacer damper structure of this invention comprises a centrally disposed mass **14** joined on either side to energy absorbing devices **16** and **18**. The devices **16** and **18** comprise a helical spring formed of stranded steel **19** covered with a coating **21** such as rubber, having high internal damping. It also may be possible to use solid steel in lieu of the stranded steel, as will be hereinafter pointed out.

The mass **14** is supported by the conductors **10** and **11** by means of the springs **16** and **18**. At moderately low wind velocity the conductors will vibrate in the vertical direction. By proper selection of the mass **14** and the stiffness of the springs **16** and **18**, considering also the effects of the conductor stiffness and the mass of the conductor clamps, relative motion may be provided between the mass **14** and the conductors **10** and **11**. If an appropriate damping effect (i.e. a capacity for absorbing or dissipating energy) is incorporated between each conductor **10** and **11** and the mass **14**, the spacer will absorb or dissipate vibrational energy due to the relative motion between the conductors **10** and **11** and the mass **14**. By proper location of the spacer in a bundled conductor, the vibration energy of the conductors can be reduced or dissipated to a level which will not cause conductor fatigue and will thus eliminate the need for the separate vibration dampers which are normally coupled to the conductors adjacent the supporting towers. This is of great advantage in the design of extra high voltage transmission lines since it will reduce the number of potential sources of corona and radio interference.

From the above it will be seen that the energy spring, or elastic means such as elements **16** and **18**, must have incorporated therein a capacity for absorbing or dissipating energy. I have found that the use of stranded steel in helical configuration can provide, through utilization of inter-strand friction, a sufficient capacity for energy

absorbing or dissipation. In order to increase this capacity to absorb or dissipate energy, in the present applications I have found it advantageous to coat the stranded steel with rubber to create an elastic means which has a sufficient amount of internal dampening. A suitable rubber coating **21** on a solid steel spring core will often provide sufficient capacity for energy absorption or dissipation.

Thus, referring again to the drawings, it will be seen that the spacer damper of this invention comprises a central mass **14**, a plurality of conductor clamps **20** and **22** which engage the conductors **10** and **11**, and energy absorbing or dissipating devices **16** and **18** which join the clamps **20** and **22** to the centrally disposed mass **14**. The clamps **20** and **22** may be of any conventional design suitable for the purposes intended; the design of the clamps forms no part of this invention.

As any given conductor will tend to vibrate at a number of frequencies within a band, depending upon the characteristics of the conductor and its environment, it is desirable that the spacer damper be tuned to a representative frequency, e.g. the center frequency of this band, so that effective damping is achieved over the band range. This turning may be accomplished by the proper selection of the mass **14**.

The invention has thus been described but it is desired to be understood that it is not confined to the particular forms or usages shown and described, the same being merely illustrative, and that the invention may be carried out in other ways without departing from the spirit of the invention and, therefore, the right is broadly claimed to employ all equivalent instrumentalities coming within the scope of the appended claims, and by means of which objects of this invention are attained and new results accomplished, as it is obvious that the particular embodiments herein shown and described are only some of the many that can be employed to obtain these objects and accomplish these results.

I claim:

1. Spacer damper assembly is connected to a pair or more of conductors in a bundled conductor transmission line comprising:

a plurality of cable clamps, each bolted to one of said conductors;

a plurality of energy absorption or dissipation means, each having one end connected to one said cable clamp;

said energy absorption or dissipation means comprising a helical spring composed of stranded wire to provide a high coefficient of internal friction;

a mass centrally disposed between said clamps and coupled to the other end of said energy absorption or dissipation means to provide relative motion between the conductors and said mass upon movement of said conductors;

said mass having a greater weight per unit of axial length than said energy absorption means.

2. A spacer damper assembly according to claim **1** wherein said stranded wires are coated with an elastomeric material.

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LARAMIE E. ASKIN, *Primary Examiner.*

JOHN F. BURNS, ROBERT K. SCHAEFER, *Examiners.*

J. F. RUGGIERO, *Assistant Examiner.*