Nov. 23, 1954 L. J. PARCÉ ET AL 2,695,038

TUBULAR CONDUCTOR FOR TELECOMMUNICATION COAXIAL PAIRS

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Fig. 1

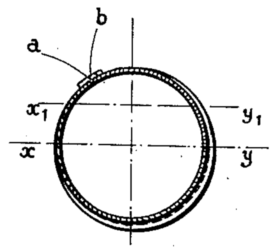

Fig. 2

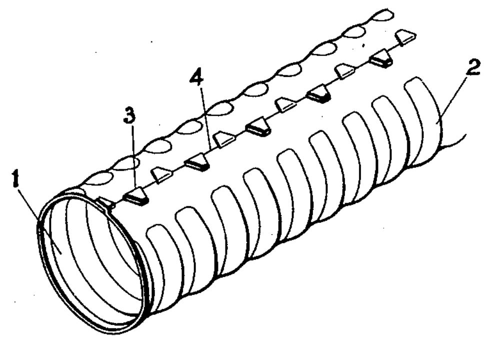

Fig. 3

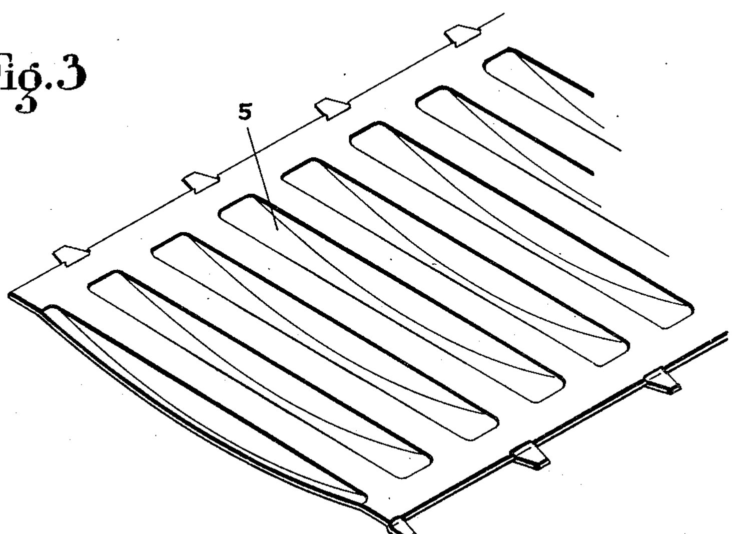

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Fig. 4

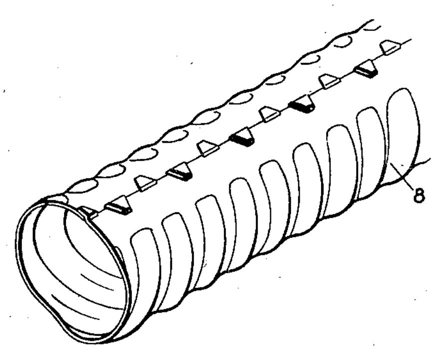
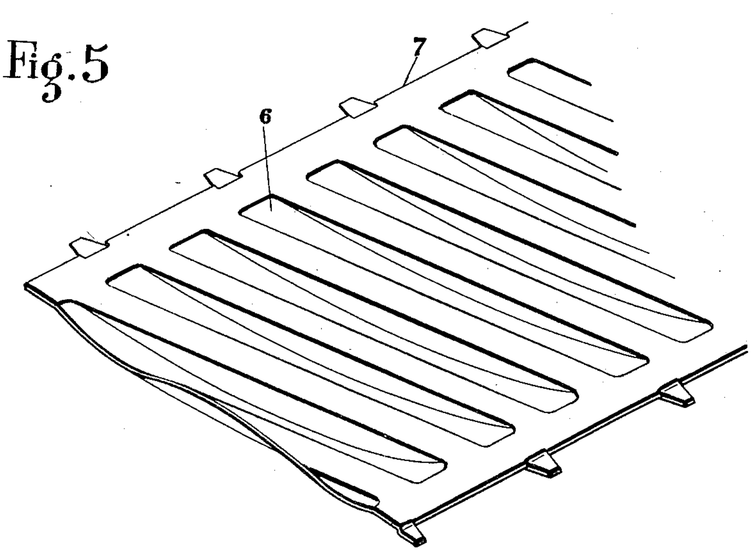


Fig. 5



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TUBULAR CONDUCTOR FOR TELECOMMUNICATION COAXIAL PAIRS

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Claims priority, application France April 20, 1951

4 Claims. (Cl. 138—50)

The present invention relates to improvements in the construction of metallic tubular conductors particularly for coaxial pairs used in telecommunication cables.

Tubular conductors are known, consisting of a single metal tape wound cylindrically, parallel to the longitudinal axis of said tape. As used in cables, these conductors offer only a poor resistance to the stresses caused by the bending required by manufacturing and laying.

An inspection of the damage caused to these tubular conductors when they have been bent beyond the limits of their elastic resistance, shows that the damage generally consists of deep creases located at intervals. The number and depth of these creases increase as the radius of curvature of the bending becomes smaller. These creases are localized more particularly in the region of the joint of the edges forming the tubular conductor.

These facts can easily be explained:

The work of bending, on a tube, causes longitudinal stresses which create a lengthening of the metal fibres in the region located outside the bend and a compression of the metal fibres in the region located inside the bend. Between these two zones, there exists a neutral zone where the metal fibres are subjected practically to no stress or strain, the strains increasing with the distance from this neutral zone in each region of the tube.

When the limit of elastic resistance is exceeded in a zone subjected to a longitudinal compression, there occurs a yielding of the wall in that zone of the tube. This yielding is shown by one or more substantial creases which may constitute serious faults putting the tubular conductor definitely out of action.

In the joint area of the edges of the tape forming the tube, the division of the tape at the location of the joint increases the liability to yielding of one or the other edge. It is impossible, in fact, to distribute uniformly the mechanical compression stresses in the independent and parallel portions of a divided unit. This divided unit is thus less resistant than a single unit having the same cross-section.

In order more intimately to associate the two sides of the wall of the tube along the joint, systems are already known, particularly, for cutting edges forming interlocking teeth, but this process, though useful, is not entirely efficient.

To increase the bending possibilities of tubular conductors it has already been proposed, also, to provide creases in the cylindrical surface, in the shape of circular or helical ribs or grooves on the surface of the tube. These ribs or grooves localize and distribute the distortions of the tubular surface due to the contractions and lengthenings caused by curvature. Their advantage is limited, however, as their dimensions cannot exceed certain limits defined by the admissible size and electrical resistance. The same damage and deteriorations occur when the bending possibilities of the tube are exceeded, although to a lesser degree.

Further, the solution which consists in providing ribs or grooves, arranged concentrically with respect to the initial cylindrical surface of the tube, does not take into account the different behaviour of the elements of said surface at the time of bending and the unfavorable position of the junction line with respect to the neutral zone.

In accordance with the present invention, a particular arrangement of the ribs is proposed, making it possible to move the neutral zone closer to the fragile zone constituted by this junction line of the edges of the tape, so as to decrease the rate of longitudinal stretching or contraction of the metal fibres in this fragile zone with respect to the other portions of the tubular wall. This arrangement consists in off-centering the ribs with respect to the axis of the tube, their maximum depth being on the opposite side to the line of junction.

The invention will be better understood by means of the appended drawings wherein:

Figure 1 represents the cross-section of a tubular conductor according to the invention.

Figure 2 is a perspective view of a tubular conductor provided with circular ribs, in accordance with the invention.

Figure 3 shows, in perspective view, the preparation to be given to the tape before forming the tube, to obtain the tubular conductor of Figure 2.

Figure 4 represents in perspective view, a tubular conductor in accordance with the invention, provided with helical ribs.

Figure 5 shows the preparation to be given to the tape before forming the tubular conductor according to the invention provided with helical ribs, as in Figure 4.

If, in Figure 1, representing the cross-section of a tubular conductor according to the invention, provided with ribs concentric with the basic cylindrical surface of said conductor, it is assumed that said conductor undergoes bending in a plane perpendicular to the line x—y shown in the figure as a diameter of the cross-section of the tube in the plane of the drawing, line x_1—y_1 may be considered as a neutral line in the bend if the sum of the moments, with respect to x—y, of the stretching forces exerted in the various parts of this section is equal to the sum of the moments of the corresponding compression forces with respect to the same line.

Calling, in general, f, the force applied to a constrained element placed at a distance d from the neutral line, this neutral line is defined, calling respectively f_1, d_1, f_2, d_2, the values corresponding to the compressed or stretched portions of the section, by the known condition:

$$\Sigma f_1 d_1 = \Sigma f_2 d_2$$

If the tube were homogeneous, the neutral line would coincide substantially with the diameter x—y, but in a tube formed by a wound tape, the existence of a junction line or "seam" a—b may cause a decrease in the resistance of the zone located above $x.y$. The neutral line then moves to x_1y_1 on the opposite side of the junction, in such a manner that the sums of the moments of the compressional constraint forces and stretching constraint forces remain equal with respect to said neutral line.

In the case of Figure 1, assuming the tube to be subjected to bending, the longitudinal strain resistance of the wall at a given point of the cross-section is reduced by the rib, and is all the lower as the depth of the rib is larger at that point. This results in a displacement of the neutral line, as otherwise there should be

$$\Sigma f_1 d_1 > \Sigma f_2 d_2$$

To restore equality, the neutral line should then move to x_1—y_1, closer to the smallest depth of the ribs on the side which on Figure 1 is the side of the junction line.

The decrease of the distance between the junction line and the neutral line has the effect of decreasing the rate of distortion along this junction line. For the same curvature, the corresponding lengthenings or contractions will be smaller, which is the result aimed at.

In the perspective view of the tape, in Figure 3, the ribs **5** are formed at intervals on a metal tape, in a direction perpendicular to the length of the tape; they are deeper at the middle than on the edges where their depth becomes substantially zero. After forming the tape in the shape of a tube, a tubular conductor with off-centered ribs such as **2** in Figure 2 is obtained, as shown in Figure 2.

Teeth such as **3**, provided along the edges of the tape rest on the cylindrical non-ribbed portion of the tape and hold the edges of the tube closed along junction line **4**.

Figures 4 and 5 show a variant of the invention in which ribs such as **6** are formed in a direction inclined with respect to the edges **7** of the tape.

Figure 5 shows the preparation of the tape in a particular case of this arrangement, wherein some of the ribs **6** have been arranged in line with two teeth, similar ribs being interposed in the intervals between the ribs **6**.

After rolling the tape into a tube as shown on Figure 4, the off-centered ribs such as **8** become arranged along helical lines around the axis of the tubular conductor.

The arrangements of the invention may also be applied to hollow grooves provided, instead of ribs, in the cylindrical wall, without modifying the principle of the invention.

We claim:

1. A tubular metallic conductor for coaxial pairs of telecommunication cables, comprising a metallic tape rolled to a circular cylindrical shape about an axis parallel to the longitudinal direction thereof and joined along its longitudinal edges, said tape being provided with grooves, said edges being provided with teeth for maintaining said tube closed along the junction line of said edges, each of said teeth being respectively arranged in line with a groove, and wherein the bottom of each of said grooves is off-centered with respect to the axis of the basic cylindrical surface of said tube, the depth of the said grooves being greatest in the region of the surface of the conductor diametrically opposite said junction line after said tape has been formed into a tube.

2. A metallic conductor according to claim 1, wherein the grooves are of a length less than the width of said tape and located centrally of the longitudinal edges of said tape.

3. A tubular metallic conductor for coaxial pairs of telecommunication cables, comprising a metallic tape rolled to a circular cylindrical shape about an axis parallel to the longitudinal direction thereof and joined along its longitudinal edges, said tape being provided with ribs, said edges being provided with teeth for maintaining said tube closed along the junction line of said edges, each of said teeth being respectively arranged in line with a rib, and wherein the bottom of each of said ribs is off-centered with respect to the axis of the basic cylindrical surface of said tube, the depth of the said ribs being greatest in the region of the surface of the conductor diametrically opposite said junction line after said tape has been formed into a tube.

4. A metallic conductor according to claim 3, wherein the ribs are of a length less than the width of said tape and located centrally of the longitudinal edges of the tapes.

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