

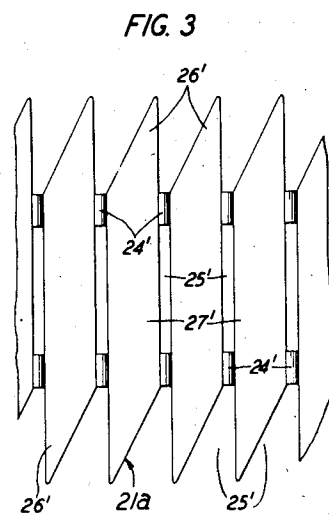
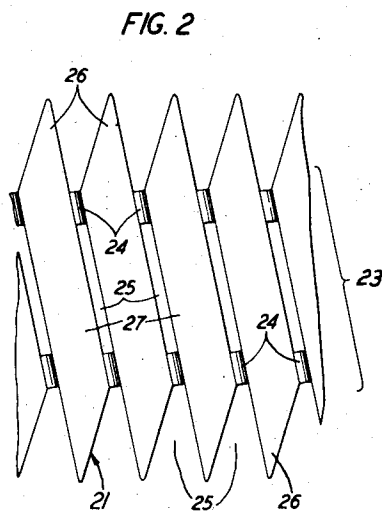
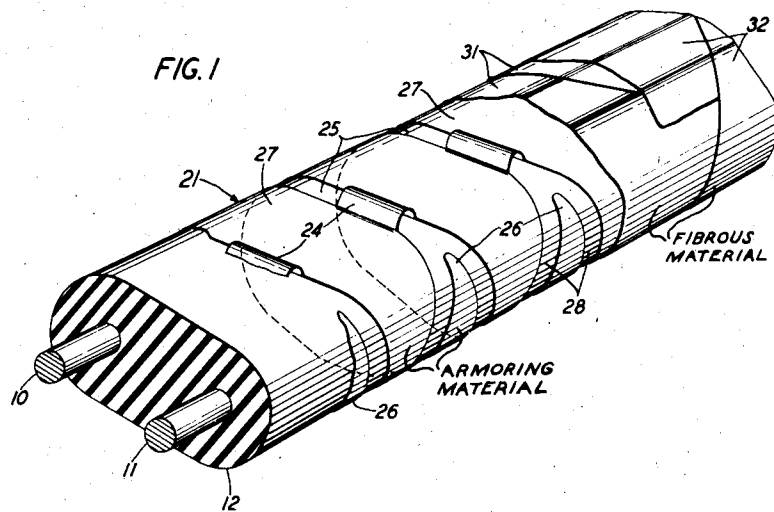
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ARMORED CONDUCTOR STRUCTURE

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ARMORED CONDUCTOR STRUCTURE

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This invention relates to armored conductor structures and more particularly to structures of this kind intended for burial directly in the ground.

It is an object of the invention to provide an armored cable structure which is simple to produce, easy to lay and which will provide safe protection against attacks by burrowing rodents.

The requirements of a cable of this type capable of answering these objects are as follows: The construction should be as light as possible to reduce cost of material and to simplify transportation and handling; the armoring should cover the insulated wires as completely as possible to give adequate protection against attacks and, on the other hand, should permit bending of the cable on a comparatively small radius without undue deformation of the armoring, thus permitting the use of comparatively small reels; the structure should be non-tangling and should present a smooth surface to facilitate general handling.

In accordance with the invention a cable structure of this kind is provided which includes a single layer of armoring tape with no overlapping portions. The armoring tape is applied longitudinally on the conductor structure and forms a continuous layer entirely enclosing the insulated conductor or conductors, except for narrow transverse openings disposed at frequent intervals along the cable to permit bending of the armored structure without appreciable buckling of the tape material. The longitudinal seam between tape edges is arranged to provide similar narrow openings along the seam to permit bending of the structure on a comparatively small radius without buckling of the tape material, thereby avoiding exposure to gopher attacks along the seam.

The openings in the body portion of the tape and along the edges are wide enough to prevent crowding of the tape material on the inside of the bend without buckling, when the cable is bent, and are narrow enough to not unduly expose the insulated conductors when widened on the outside of the bend. The armoring tape furthermore includes small connecting portions across the transverse openings for forming a continuous structure and the connecting portions are crimped to not appreciably reduce the flexibility of the conductor structure secured by the openings. Other features of the invention will appear from the following detailed description.

The invention will now be described as applied in a practical embodiment of its various features and reference will be made to the accompanying drawing in which:

Fig. 1 is a perspective view of an armored cable structure with parts broken away to more clearly show the construction;

Fig. 2 is a plan view of the armoring tape used in the structure of Fig. 1; and

Fig. 3 is a plan view of an armoring tape adapted for use in a structure such as that shown in Fig. 1, but slightly modified from that shown in Fig. 2.

The preferred cable structure comprises two conductors 10 and 11 placed in parallel relation throughout the structure and enclosed in insulating material 12, which may form a single continuous body or may comprise two separate bodies of insulation, one about each conductor. The tape armoring surrounding the insulation 12 comprises the single armoring tape 21 of suitable material for protection against gopher attacks. The structure may further include outer wrappings, such as 31 and 32, applied about the armoring tape.

This structure containing two parallel conductors, thus is substantially oval-shaped having two comparatively flat sides and two rounded sides or edges. Whereas the armoring tape shown in Fig. 1 is particularly adapted for the oval-shaped structure, it may readily be adapted for cable structures of circular or other cross section. The armoring tape is shown more in detail in Fig. 2 in the form it is manufactured before application to the cable structure.

The tape 21, shown in Fig. 2, presents a flat surface formed of a series of separated transverse strips 27 with two rows of short crimped connecting portions 24 forming a central intermittently corrugated body portion 23 with laterally extending edge sections or projections 26. The flat surface is thus interrupted at frequent intervals by the transverse spaces 25 extending the full width of the tape and bridged by the connecting portions 24. It will be noted in Fig. 2 that these strip portions 27 are placed at an oblique angle with the central line of the tape and that each strip is terminated at each end by one of the edge projections 26 formed as a triangular tooth. The object of the oblique disposition of the strip portion 27 is to offset the teeth 26 along one edge of the tape relatively to those along the opposite edge.

The tape material may be iron or steel or any other suitable composition and may or may not have its surface treated as by tinning or galvanization. The material may be non-oxidizing and acid resistant to have a long life in contact with earth or other substances present in the ground.

The tape 21 is applied longitudinally and is formed about the insulated conductors in such a manner that the two rows of corrugations will be disposed longitudinally of the two opposite flat sides of the cable and the tooth-like edge sections 26 will be bent about one of the rounded edges of the structure to lock the tape in position. Due to the oblique disposition of the tape strips 27 the corrugation on one side of the cable will be offset with respect to those on the opposite side. Also, due to the oblique disposition of the strips 27 the edge projections 26 along one edge of tape will be locked in the spaces 25 between the projections on the opposite tape edge; they thus supplement each other in the protection of the insulation. The projections 26 are, however, narrower than the spaces 25 between them so that, when they are folded in position, a series of narrow transverse openings 28 will be formed of about the same width as the narrow portion of the openings 25 separating the strips 27. Thus a series of narrow transverse openings will be formed all about the cable combining along the seam to form a continuous helix throughout the length of the armoring.

The openings in the completed armoring should be not more than $\frac{1}{8}$ inch and should preferably average about $\frac{1}{16}$ inch in width. This is to permit laying the cable in the ground with fairly sharp curves or bends without unduly exposing the insulation to gopher attacks when the openings are widened on the outside of the bend. On the other hand, openings of this width will also prevent crowding of the tape material on the inside of the bend, when the cable is laid or when it is reeled, so that the armoring tape will not be unduly deformed and forced out of position, thereby exposing the insulation to gopher attacks.

It has been found that by means of these narrow transverse openings the tape portions forming the main surface of the armoring are free to shift slightly along the cable surface either to widen the openings or to close them up when the cable is bent and therefore the tendency to buckle and expose the underlying cable insulation is absent when small cables are wound on their flat sides on reels as small as 12 inches in diameter.

It has also been found that the introduction of narrow transverse openings in the tape material and particularly of the helical distribution of the openings with a comparatively small pitch is greatly effective in reducing the usual stiffness of armored cables of this general type and in easing the handling thereof, both in factory and field.

In the described structure an undulating seam is formed along one of the rounded edges of the cable which also contributes to the flexibility of the cable. The tape is locked safely in position along the seam, but if desired the outer wrappings 31 and 32 may be applied about the armoring, which will hold the tape locked around the edge of the conductor structure while the cable is being laid.

The modified armoring tape structure 21', shown in Fig. 3, is similar to that shown in Fig. 2 but differs from that of Fig. 2 by having its transverse strip portions 21' disposed at right-angle to the center line of the tape and by having its tooth-like projections 26' extending at oblique angle relative to the strip portion in order to project into the space between the projections along the opposite tape edge, where the projections are formed about the rounded side of the cable, without overlapping of tape material. Thus the pro-

jections on the tape 21a will supplement each other in the protection of the insulation and will form an undulating seam in a manner similar to those of the tape shown in Fig. 2.

As will appear from the drawing, the corrugations are short and straight and thus offer little resistance to the bending of the cable. When the cable is bent the corrugations on the outside of the bend become flattened and those on the inside close up and are thereby preventing the tape from buckling and opening up along the seam.

The outer wrappings 31 and 32 may be of fibrous material, such as paper, and are helically applied in tape form. The wrappings may be impregnated or coated with any suitable substance to retard their deterioration.

Cables of the type described above may be used for supplying electric light and power or for communication purposes. Since they are particularly adapted for use in rural areas the distances over which such cables will be used are usually quite considerable. It is therefore of great importance that the cost of manufacture and the cost of transportation and laying be as low as possible.

The self-contained cable structure described above is therefore preferable over cables laid in conduits, since the cable may be plowed down in a fast continuous process from reels of reasonable size. The described structure is readily unbent from the reel and laid in sharp curves without danger of the tape buckling and unduly opening along the seam. With one or two wrappings outside the armoring there is no danger of tangling or catching as the cable leaves the reel and the cable may also readily be manipulated by hand without danger of injury.

The described structure lends itself particularly to fast manufacturing as compared with cables having helically armored tapes, since the longitudinal tape may be applied and locked in position as fast as the insulated conductor structure can be produced.

Due to the fact that the finished armoring is in effect broken up into a large number of small shields or strips separated by narrow openings a degree of flexibility may be secured which is at least as high as with helically applied armoring tape.

The absence of buckling of the armoring is especially important in insuring definite protection against gopher attacks and is attained by the introduction of the transverse openings in the material which will permit a slight shifting of the armoring material relative to the insulation, particularly on the inside of the bend, when the cable is bent. The armored cable may therefore be wound on reasonably small reels without danger of opening up along the seam. Thus storage, transportation and laying is greatly facilitated.

It should be understood that the cable may include more than two conductors arranged in a single layer and may contain more than one such layer of a plurality of conductors. A single conductor cable, circular or flat, is also contemplated within the scope of the invention. The two or more conductors may be twisted together or otherwise intertwined and a concentric arrangement is also contemplated within the scope of the invention.

What is claimed is:

1. An elongated insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor, the tape of said armoring forming a single generally continuous

layer enveloping said conductor and being formed of a continuous series of transverse separated strip portions and including small connecting portions connecting adjacent strip portions together into a continuous structure without adding appreciable stiffness to said armoring, said strip portions being sufficiently separated to permit bending of the armored conductor on a small radius without appreciable buckling of the tape material in said strip portions, said tape armoring comprising an armoring tape forming said single generally continuous layer without overlapping portions, said strip portions being disposed at an oblique angle with the conductor to form a substantially continuous helical tape about said conductor.

2. An elongated insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor, the tape of said armoring forming a single generally continuous layer enveloping said conductor and being formed of a continuous series of transverse separated strip portions and including small connecting portions connecting adjacent strip portions together into a continuous structure without adding appreciable stiffness to said armoring, said strip portions being sufficiently separated to permit bending of the armored conductor on a small radius without appreciable buckling of the tape material in said strip portions, said tape armoring comprising an armoring tape forming said single generally continuous layer without overlapping portions, said strip portions being disposed at an oblique angle with the conductor to form a substantially continuous helical tape about said conductor, said tape armoring having two series of short crimped connecting portions disposed longitudinally and on opposite sides of said conductor.

3. An elongated insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor, the tape of said armoring forming a single generally continuous layer enveloping said conductor and being formed of a continuous series of transverse separated strip portions and including small connecting portions connecting adjacent strip portions together into a continuous structure without adding appreciable stiffness to said armoring, said strip portions being sufficiently separated to permit bending of the armored conductor on a small radius without appreciable buckling of the tape material in said strip portions, said tape armoring comprising an armoring tape forming said single generally continuous layer without overlapping portions and having a seam parallel with said conductor, said strip portions being long enough in the transverse direction to be return-bent about the conductor and being disposed at an oblique angle with the longitudinal direction of said structure to form with an adjacent strip portion the general pattern of a helically applied tape, said strip portions having tapered edge projections extending across the average center line of the seam to be interspersed without overlapping along said seam.

4. A flexible cable structure and a single armoring tape with toothed edges applied tightly about said structure to form a substantially continuous layer with a narrow longitudinal undulating seam opening, said tape being sectionalized by narrow transverse openings extending entirely around said structure to form substantially continuous series of bands about the cable struc-

ture and including short offset connecting pieces across said openings, said transverse openings and the offset portions of said seam openings being only wide enough to permit bending of the armored structure without appreciable buckling of the tape material.

5. A long insulated conductor and tape armoring of a single tape placed tightly about and longitudinally of said insulated conductor, said tape armoring forming a single generally continuous layer enveloping said conductor and having a body portion running longitudinally of said conductor and having edge sections extending transversely of said conductor from the opposite sides of said body portion, said edge sections from each side of said body portion being spaced apart and alternating with the edge sections from the other side whereby to form a longitudinal locking seam together with the edge sections along the opposite side of said seam without overlapping of tape material.

6. A long insulated conductor and tape armoring of a single tape placed tightly about and longitudinally of said insulated conductor, said tape armoring forming a single generally continuous layer enveloping said conductor and having a body portion running longitudinally of said conductor and having edge sections extending transversely of said conductor from the opposite sides of said body portion, said edge sections from each side of said body portion being spaced apart and disposed to form a longitudinal locking seam together with the edge sections along the opposite side of said seam without overlapping of tape material, said edge sections along opposite sides of the seam between tape edges being relatively displaced longitudinally with narrow spaces between them adapted to close up when the armored conductor is bent.

7. A long insulated conductor and tape armoring of a single tape placed tightly about and longitudinally of said insulated conductor, said tape armoring forming a single generally continuous layer enveloping said conductor and having a body portion running longitudinally of said conductor and having edge sections extending transversely of said conductor from the opposite sides of said body portion, said edge sections from each side of said body portion being spaced apart and disposed to form a longitudinal locking seam together with the edge sections along the opposite side of said seam, said edge sections from the opposite sides of said seam being relatively displaced longitudinally to be interspersed along said seam without overlapping of tape material and being long enough to be return-bent about said conductor.

8. A long insulated conductor and tape armoring of a single tape placed tightly about and longitudinally of said insulated conductor, said tape armoring forming a single generally continuous layer enveloping said conductor and having a body portion running longitudinally of said conductor and having edge sections extending transversely of said conductor from the opposite sides of said body portion, said edge sections from each side of said body portion being spaced apart and alternating with the edge sections from the other side whereby to form a longitudinal locking seam together with the edge sections along the opposite side of said seam without overlapping of tape material, said body portion being intermittently corrugated.