March 27, 1945. C. S. GORDON 2,372,323

ARMORED CONDUCTOR STRUCTURE

Filed March 14, 1942

FIG. 1

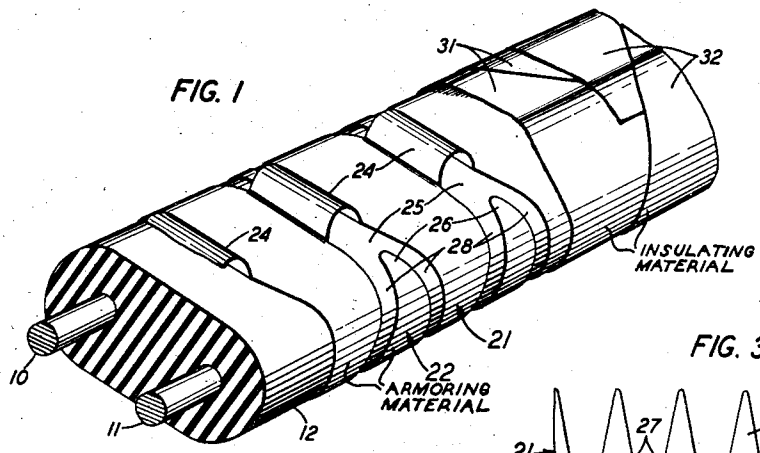


FIG. 2

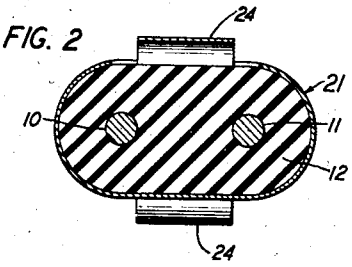


FIG. 3

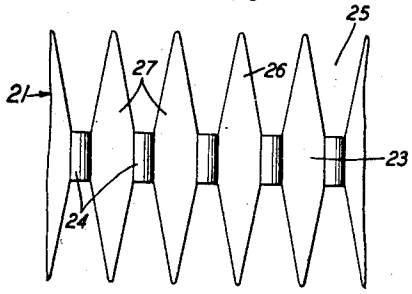


FIG. 4

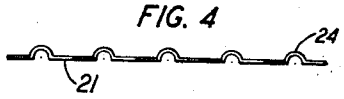
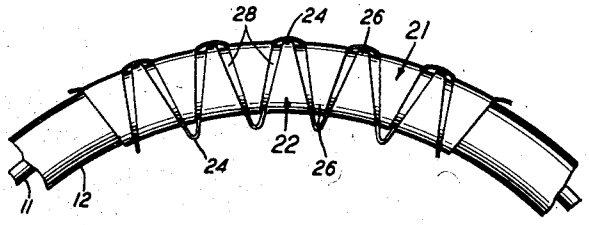


FIG. 5



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ARMORED CONDUCTOR STRUCTURE

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16 Claims. (Cl. 174—102)

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 materials and tools 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 of 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, thus preventing 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 imparted 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 sectional view of the cable structure in Fig. 1;

Fig. 3 is a plan view of the armoring tape used in the structure of Fig. 1;

Fig. 4 is a longitudinal edgewise view of the armoring tape; and

Fig. 5 is a view showing the cable structure of Fig. 1 bent over one of its flat sides on a small radius.

Referring now to Figs. 1 and 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 two armoring tapes 21 and 22 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 Figs. 1 and 2 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 Figs. 3 and 4 in the form it is manufactured before application to the cable structure.

The two tapes 21 and 22 are alike. Thus the tape 21 presents a flat surface formed of a series of separated transverse strips 27 with short crimped or offset 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.

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 and other substances present in the ground.

The two tapes are applied longitudinally

against the flat sides of the cable and, in the assembling process, are displaced longitudinally so that a corrugation 24 on one side of the cable will be opposite a flat body portion between corrugations on the opposite side of the cable, as will appear more clearly from Fig. 5. The edge projections 26 are folded about the insulated conductors to be return-bent around the rounded sides of the structure, thereby locking the tapes in position. Due to the fact that the two tapes are relatively shifted the edge projections 26 of one tape will be locked in the spaces 25 between the projections of the other tape; they thus supplement each other in the protection of the insulation. The projections 26 are, however, narrower than the spaces 25 so that, when they are folded in position, a series of narrow transverse openings 28 will be formed all about the cable, combining to form two opposite helices throughout the length of the armoring.

The openings thus left in the completed armoring should be not more than ⅛ 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 these 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 armor 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 that 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 double 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 each of the rounded edges of the cable which also contributes to the flexibility of the cable. The two tapes are locked safely in position along these seams, but, if desired, the outer wrappings 31 and 32 may be applied over the armoring, which will hold the tape locked around the edges of the conductor structure while the cable is being laid.

As will appear from the drawing, the corrugations are short and straight and thus offer little resistance to the bending of the cable. As shown in Fig. 5, when the cable is bent the corrugations on the outside of the bend become flattened and those on the inside of the bend close up, thereby preventing the tape from buckling and opening up along the seams. As will also appear from Fig. 5 the openings along the seam permit shifting of the tape material in the projections 26 along the surface of the insulation so that the openings will close up near the inside of the bend and open slightly on the outside of the bend when the conductor is bent, as in the case of it being wound upon a reel of reasonably small diameter.

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 ploughed 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 seams. 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 helical armor tapes, since the longitudinal tapes may be applied and locked in position as fast as the insulated conductor structure can be produced. The two tapes are readily locked about the conductors and kept at equal speeds to be in accurate relation on the cable.

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 armor 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 seams. 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 structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure and having narrow openings extending transversely of said structure, said openings being disposed at frequent intervals along said structure and being adapted to close up on the inside of the bend, when the structure is bent, thereby substantially preventing buckling of the armoring tape, said tape

armoring comprising two supplementary armoring tapes forming said single continuous layer about said structure without overlapping portions and each of said transverse openings extending entirely around said structure and each of said tapes having offset connecting portions across said openings.

2. An elongated structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure and having narrow openings extending transversely of said structure, said openings being disposed at frequent intervals along said structure and being adapted to close up on the inside of the bend, when the structure is bent, thereby substantially preventing buckling of the armoring tape, said tape armoring comprising two supplementary armoring tapes forming said single continuous layer about said structure, each tape having transverse interruptions in said generally continuous surface and each interruption being formed partly by one of said openings cut in the armoring material and partly by a crimp of about the same width as the opening.

3. An elongated structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure and having narrow openings extending transversely of said structure, said openings being disposed at frequent intervals along said structure and being adapted to close up on the inside of the bend, when the structure is bent, thereby substantially preventing buckling of the armoring tape, said tape armoring comprising two supplementary armoring tapes forming said single continuous layer about said structure and each having offset connecting portions across said opening, and said transverse openings being aligned to form a helix about said structure.

4. An elongated structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure and having narrow openings extending transversely of said structure, said openings being disposed at frequent intervals along said structure and being adapted to close up on the inside of the bend, when the structure is bent, thereby substantially preventing buckling of the armoring tape, and said transverse openings being aligned to form two opposite continuous helices about said structure, said tape armoring including connecting portions bridged across said openings.

5. An elongated structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure and having narrow openings extending transversely of said structure, said openings being disposed at frequent intervals along said structure and being adapted to close up on the inside of the bend, when the structure is bent, thereby substantially preventing buckling of the armoring tape, said tape armoring including short, crimped connecting portions across said openings arranged in a pair of rows on opposite sides of said structure and placed in alternations to permit bending of the structure over a small radius without buckling of the tape material.

6. An elongated structure including insulated conducting means, tape armoring placed tightly about and longitudinally of said structure and forming a single generally continuous layer enveloping said structure, said tape armoring comprising two supplementary armoring tapes forming said single continuous layer about said structure with seams having their general direction parallel with the axis of said conductor structure, each of said tapes having a continuous intermittently corrugated body portion and having body extensions projecting from each side of said continuous body portion, said body extensions from the opposite sides of each seam being relatively displaced longitudinally to be interspersed along said seam without overlapping of tape material.

7. A long insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor and an outer insulating sheathing for projection of said armoring, said tape armoring comprising two supplementary armoring tapes forming a single generally continuous layer enveloping said conductor without overlapping of tape material, each of said tapes having a continuous intermittently corrugated body portion and having body extensions projecting from each side of said continuous body portion, said body extensions being spaced apart and return-bent about said conductor and one of said tapes being displaced longitudinally relatively to the other of said tapes so that said body extensions from one tape extend between the separated body extensions of the other tape.

8. 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 short 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 two supplementary armoring tapes, said connecting portions in each tape being disposed in a row substantaially parallel with the conductor axis and on the opposite side of the conductor from the row in the other tape.

9. A long insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor, said tape armoring comprising two similar tapes forming a single generally continuous layer enveloping said conductor and each 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 seam together with the edge sections along the opposite side of said seam.

10. A long insulated conductor, tape armoring placed tightly about and longitudinally of said insulated conductor, said tape armoring comprising two similar tapes forming a single generally continuous layer enveloping said conductor and each 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 seam together with the edge sections along the opposite side of said seam, 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.

11. A long, substantially oval-shaped armored conductor structure having two opposed comparatively flat sides and two opposed rounded sides and being particularly adapted for bending over said flat sides on a small radius, including a plurality of insulated conductors and tape armoring closely surrounding said insulated conductors for protection against attacks by rodents, said tape armoring forming a continuous layer enveloping said plurality of conductors with a seam having its general direction parallel with the axis of said conductor structure, the edges of said tape armoring along said seam forming complementary notches and teeth alternating from opposite sides of said seam without overlapping of the tape material to form a narrow undulating opening along said seam, said teeth being return-bent about a rounded side of the conductor.

12. A long, substantially oval-shaped armored conductor structure having two opposed comparatively flat sides and two opposed rounded sides and being particularly adapted for bending over said flat sides on a small radius, including a plurality of insulated conductors and tape armoring closely surrounding said insulated conductors for protection against attacks by rodents, said tape armoring forming a continuous layer enveloping said plurality of conductors with a seam having its general direction parallel with the axis of said conductor structure, said tape armoring comprising an armoring tape having a continuous body portion disposed along one of said flat sides and a second similar armoring tape with its body portion disposed along the opposite flat side, the edges of said armoring tape forming complementary notches and teeth along said rounded sides alternating from opposite tape edges without overlapping of tape material.

13. A long, substantially oval-shaped armored conductor structure having two opposed comparatively flat sides and two opposed rounded sides and being particularly adapted for bending over said flat sides on a small radius, including a plurality of insulated conductors and tape armoring closely surrounding said insulated conductors for protection against attacks by rodents, said tape armoring forming a continuous layer enveloping said plurality of conductors with a seam having its general direction parallel with the axis of said conductor structure, said tape armoring comprising two armoring tapes each having a body portion with a series of short, spaced transverse corrugations along one of said flat sides and transverse tooth-like extensions from said body portion bent around said rounded sides without overlapping of tape material.

14. A long, substantially oval-shaped armored conductor structure having two opposed comparatively flat sides and two opposed rounded sides and being particularly adapted for bending over said flat sides on a small radius, said structure including a plurality of parallel insulated conductors, tape armoring closely surrounding said insulated conductors for protection against attacks by rodents and an outer insulating sheathing for retaining said armoring in position, said armoring comprising two armor tapes placed on opposite flat sides of said structure, each having a lengthwise body portion placed along the flat side, having tooth-like extensions from both sides of said body portion return-bent about the rounded sides of said structure and having short transverse corrugations disposed between said extensions, one of said tapes being displaced longitudinally relatively to the other tape to prevent overlapping of tape material in said return-bent extensions and to place said corrugations in alternations on the opposite flat sides of said structure.

15. An armored cable including an insulated conductor and two supplementary armoring tapes each comprising a series of substantially diamond-shaped portions and crimped connecting pieces between said portions, said two tapes being applied on the opposite sides of the cable and being return-bent about said cable without overlapping of tape material.

16. An armoring tape for a cable comprising a series of substantially diamond-shaped portions and crimped connecting pieces between said portions.

CHESTER S. GORDON.