

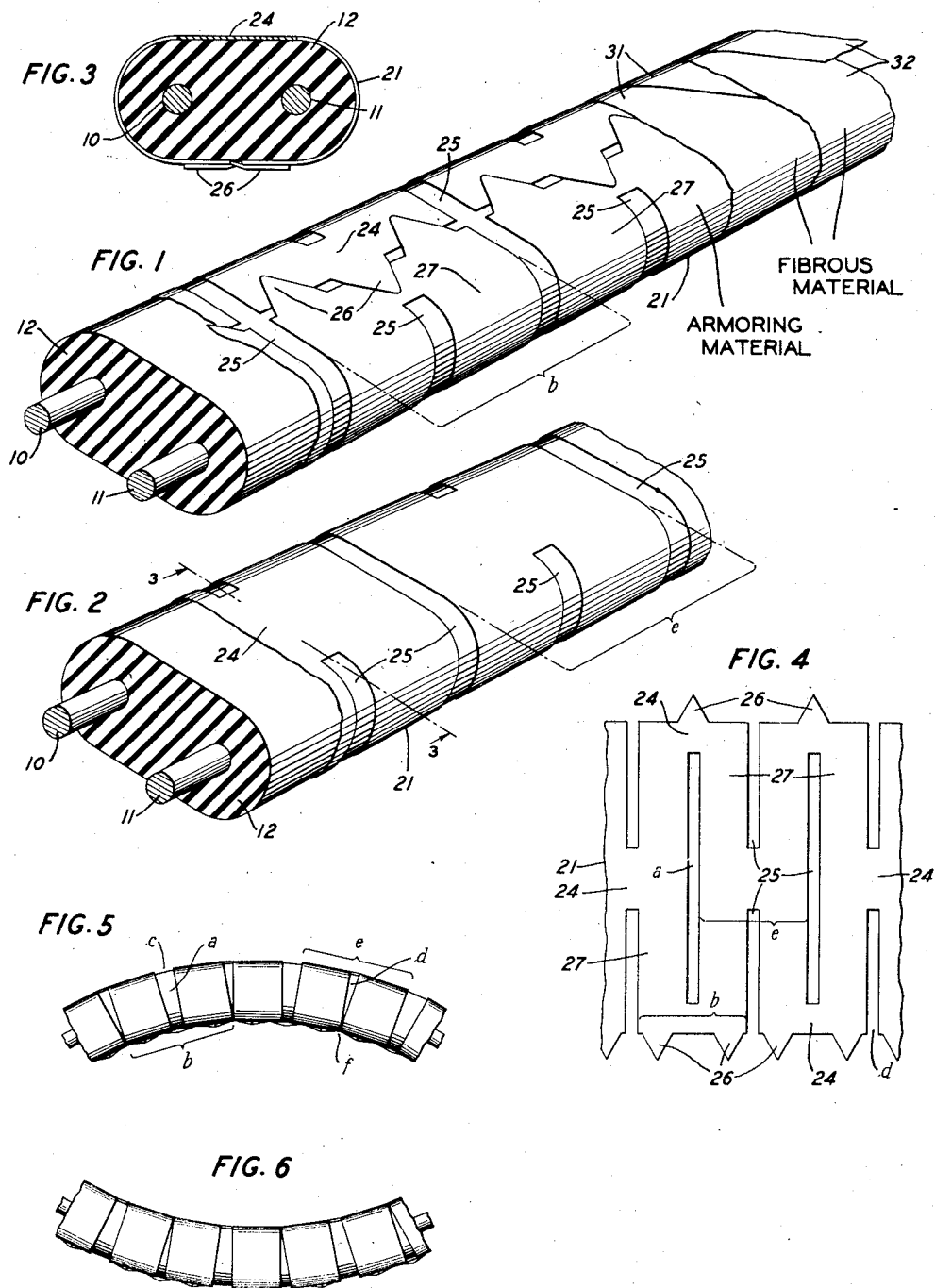
Dec. 18, 1945.

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2,391,037

ARMORED CONDUCTOR STRUCTURE

Filed March 14, 1942



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2,391,037

ARMORED CONDUCTOR STRUCTURE

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Application March 14, 1942, Serial No. 434,739

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 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 substantially without any overlapping portions. The layer of armoring is formed of armoring tape of suitable material applied longitudinally of the conductor structure. The armoring forms a continuous layer entirely enclosing the insulated conductor or conductors, except for narrow transverse openings cut in the material at frequent intervals to permit bending of the armored structure without appreciable buckling of the tape material.

The armoring tape is in effect sectionalized, the sections being separated by narrow openings bridged by small connecting portions to form a continuous structure and the edges of the sections are serrated along the seam between tape edges and the teeth along one edge are made to overlap the opposite edge in a manner to interlock with the tape edges and thus prevent buckling of the tape material along the seam.

The openings in the body portion of the tape are wide enough to prevent crowding of the tape material on the inside of the bend without buckling, when the conductor is bent, and are narrow enough to not unduly expose the insulated conductor when widened on the outside of the bend. 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:

Figs. 1 and 2 are perspective views of the two sides of an armored cable structure with parts broken away to more clearly show the construction;

Fig. 3 is a sectional view of the cable structure in Fig. 1;

Fig. 4 is a plan view of the armoring tape used in the structure of Fig. 1;

Figs. 5 and 6 are views showing the cable structure of Fig. 1 bent over each of its flat sides on a small radius.

Referring now to Figs. 1, 2 and 3, 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 an armoring tape 21 of suitable material for protection against gopher attacks. The structure may further include other 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. 4 in the form it is manufactured before application to the cable structure.

The tape 21 presents a flat surface in effect sub-divided into strip portions 27 by narrow transverse openings 25, the strips being interconnected by means of short connecting portions 24 disposed alternately along the edges and along the center line of the tape.

The edge portions of the tape are serrated, one edge having a tooth 26 for each strip portion 27 and the opposite edge having one tooth intermediate every two strips 27.

The tape 21 is applied longitudinally to one flat side of the conductor structure and return-bent about the two rounded edges to meet and form a seam along the other flat side. The edges of the tape sections will be nearly abutting and the teeth 26 extend across the seam to alternately overlie the opposite edge of the tape.

From Figs. 1 and 2 it will be observed that on each flat side of the cable the tape presents comparatively long rigid sections separated by narrow transverse openings, the sections on one flat side being opposite an opening on the other side.

This arrangement is secured by the disposition of the openings 25, alternate openings extending part-way about the cable from the opposite flat sides. As shown in Fig. 1 the seam of the tape passes longitudinally through the sections on the upper side of the cable and the arrangement of the teeth along the seam is such that the sections on this side will be substantially as rigid and free from buckling as those on the other side.

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.

As will appear from Figs. 5 and 6, the openings in the tape material permit a slight shift of the tape sections on the outside and the inside of the bend, without buckling of the material, due to the alternate disposition of rigid sections on the two sides of the structure. Thus at the opening *a* in Fig. 5, the rigid section *b* on the inside of the bend causes the opening *a* to widen at *c* on the outside of the bend, and at the alternating opening *d* the rigid section *e* on the outside of the bend causes the opening *d* to close up at *f* of the inside of the bend. Similar actions take place when the conductor structure is bent over the other flat side, as will appear from Fig. 6.

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 armored 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 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.

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 rea-

sonable size. The described structure is readily unbent from the reel and laid in sharp curves without danger of the tape buckling and unduly opening 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 spiral armor tapes, since the longitudinal tapes may be applied and locked in position as fast as the insulated conductors 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 spirally applied armor tape.

The absence of buckling of the armoring is especially important in assuring 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. A long insulated conductor having an armoring tape placed tightly about and longitudinally of said insulated conductor to form a single generally continuous layer enveloping said conductor, said tape having narrow openings extending transversely of said conductor and disposed at frequent intervals along said conductor and being adapted to close up on the inside of the bend, when the conductor is bent, thereby substantially preventing buckling of the armoring tape, said transverse openings being disposed at frequent intervals along any surface line parallel with the conductor, each transverse opening being shorter than the tape width and being displaced in the transverse direction relative to others of said openings nearly adjacent thereto.

2. A long insulated conductor having an armoring tape placed tightly about and longitudinally of said insulated conductor to form a single generally continuous layer enveloping said conductor, said tape having narrow openings extending transversely of said conductor and disposed at frequent intervals along said conductor and being adapted to close up on the inside of the bend, when the conductor is bent, thereby substantially preventing buckling of the armoring tape, said openings being disposed at frequent intervals along said layer and extending alternately in opposite directions about said conductor, each opening being shorter than the tape width.

3. A long insulated conductor having an armoring tape placed tightly about and longitudinally

nally of said insulated conductor to form a single generally continuous layer enveloping said conductor, said tape having narrow openings extending transversely of said conductor and disposed at frequent intervals along said conductor and being adapted to close up on the inside of the bend, when the conductor is bent, thereby substantially preventing buckling of the armoring tape, each of said openings being shorter than the tape width and being displaced half way around the conductor relative to the immediately adjacent openings.

4. A long insulated conductor having an armoring tape placed tightly about and longitudinally of said insulated conductor to form a single generally continuous layer enveloping said conductor, said tape having narrow openings extending transversely of said conductor and disposed at frequent intervals along said conductor and being adapted to close up on the inside of the bend, when the conductor is bent, thereby substantially preventing buckling of the armoring tape, said openings being disposed at frequent intervals along any surface line parallel with the conductor, each transverse opening being displaced in the transverse direction relative to others of said openings nearly adjacent thereto, said tape armoring including small connecting portions across said openings for forming a continuous structure.

5. 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.

6. 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 strip portions being long enough in the transverse direction to be return bent about the conductor.

7. 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 strip portions having edge projections extending across the center line of the

seam between tape edges in situ and said edge projections being narrower in the longitudinal direction than the maximum width of said strip portions, the edge projections from opposite sides of the seam being relatively displaced longitudinally of said seam to be interspersed without overlapping of tape material in said projections.

8. An elongated insulated conductor, an armoring tape placed tightly about and with a seam longitudinally of said insulated conductor and forming a single generally continuous layer enveloping said conductor, said armoring tape comprising a continuous series of transverse separated strip portions and 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 strip portions being long enough in the transverse direction to be return-bent about the conductor and each of said strip portions having a narrow opening cut lengthwise of the strip and extending transversely of said conductor.

9. An elongated insulated conductor, an armoring tape placed tightly about and with a seam longitudinally of said insulated conductor and forming a single generally continuous layer enveloping said conductor, said armoring tape comprising a continuous series of transverse separated strip portions and 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 strip portions being long enough in the transverse direction to be return-bent about the conductor and the edge portions of said strip portions having edge projections extending across said seam.

10. An elongated insulated conductor, an armoring tape placed tightly about and with a seam longitudinally of said insulated conductor and forming a single generally continuous layer enveloping said conductor, said armoring tape comprising continuous series of transverse separated strip portions and 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 strip portions being long enough in the transverse direction to be return-bent about the conductor, the edge portions of said strip portions having edge projections extending across said seam, and said edge projections from opposite sides of the seam being relatively displaced longitudinally of said seam and being long enough to overlap with the opposite edge portion.

11. An elongated insulated conductor, an armoring tape placed tightly about and with a seam longitudinally of said insulated conductor and forming a single generally continuous layer enveloping said conductor, said armoring tape comprising continuous series of transverse separated strip portions and small connecting portions connecting adjacent strip portions together into a continuous structure without adding ap-

preciable 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 strip portions being long enough in the transverse direction to be return-bent about the conductor, the edge portions of said strip portions having edge projections extending across said seam, said edge projections from opposite sides of the seam being relatively displaced longitudinally of said seam, the edge portions on opposite sides of said seam being interlocked with the edge projections to reduce buckling along said seam when the conductor is bent.

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 longitudinal seam disposed along one of said flat sides and said tape armoring having a series of short rigid body sections along each of said flat sides and separated by narrow transverse spaces.

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 longitudinal seam disposed along one of said flat sides, said tape armoring having a series of short rigid body sections disposed along each of said flat sides and separated by narrow transverse spaces, said narrow spaces in both of said series of body sections being extended through the armor material around both of said rounded sides to further reduce buckling of the 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, including a plurality of insulated conductors for protection against attacks by rodents, said tape armoring forming a continuous layer enveloping said plurality of conductors with a longitudinal seam disposed along one of said flat sides, and said tape armoring having a series of short rigid body sections along each of said flat sides and separated by narrow transverse spaces, the said narrow spaces on opposite flat sides extending transversely to have their end portions interspersed.

15. 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 longitudinal seam disposed along one of said flat sides, and said tape armoring having a series of short rigid body sections along each of said flat sides, the body sections along opposite sides being relatively displaced in the longitudinal direction.

16. 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 longitudinal seam disposed along one of said flat sides, said tape armoring having a series of short rigid body sections along each of said flat sides, said body sections along opposite flat sides being relatively displaced in the longitudinal direction and said seam extending through the rigid body sections on one of said flat sides.

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