No. 689,613. Patented Dec. 24, 1901.

G. E. HEYL-DIA.

ELECTRIC CABLE AND PROCESS OF MANUFACTURING SAME.

(Application filed May 16, 1901.)

(No Model.)

Fig. 1.

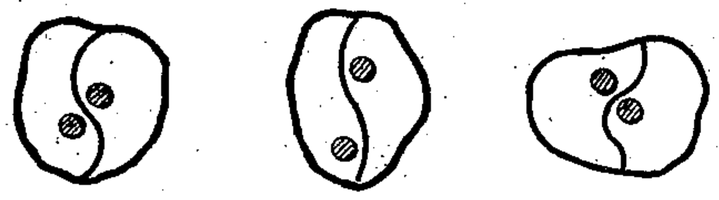


Fig. 2.

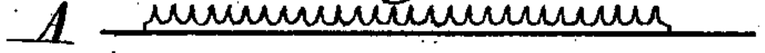
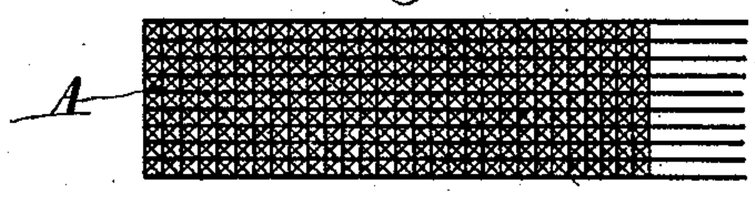


Fig. 3.



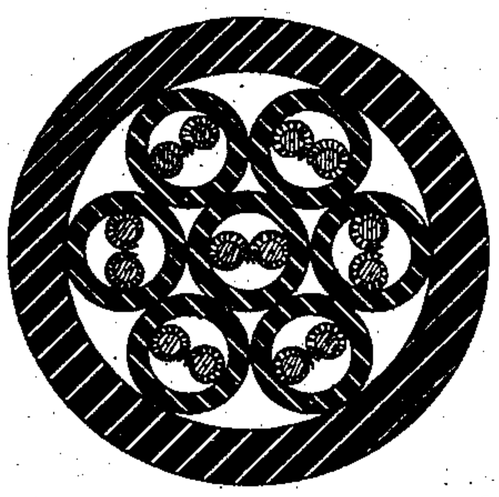


Fig. 6.

Fig. 4.

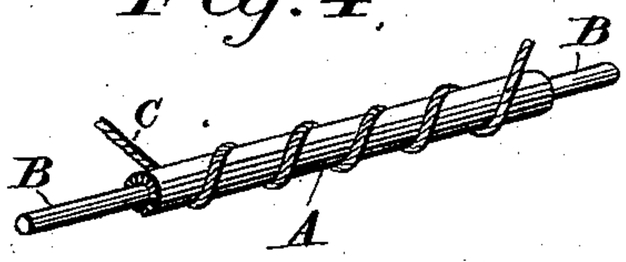


Fig. 8.

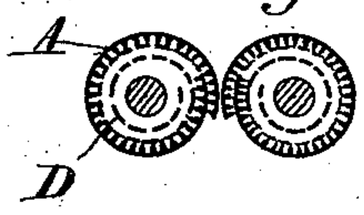


Fig. 7.

Fig. 5.

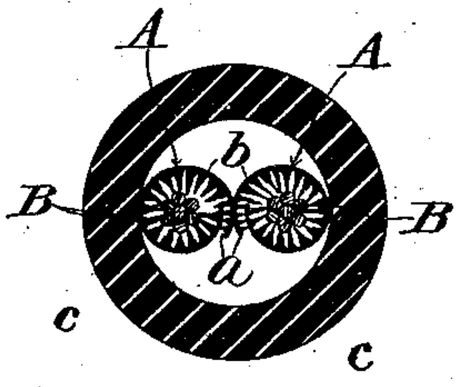
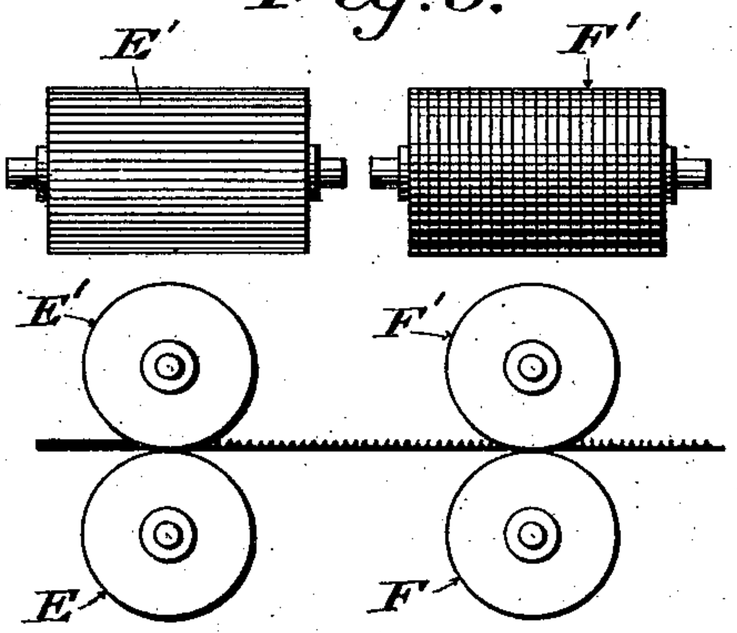


Fig. 9.



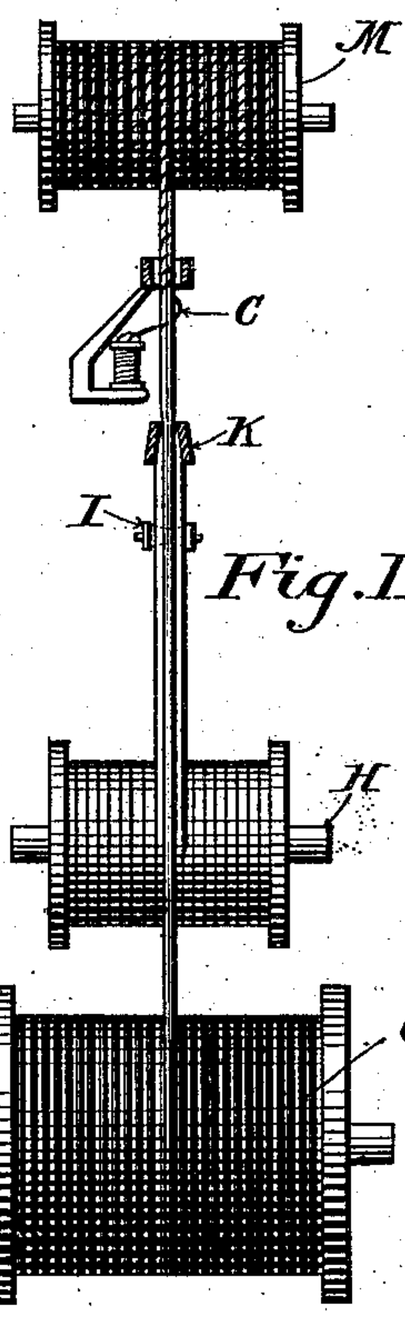


Fig. 10.

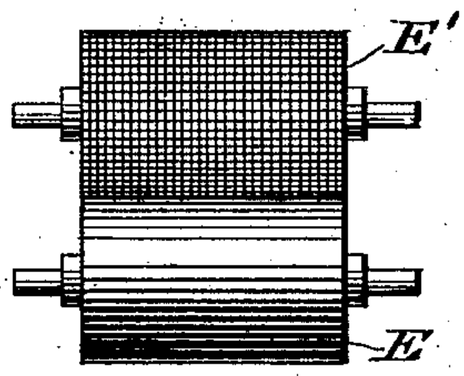


Fig. 11.

Witnesses
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By P. T. Dodge
Attorney

UNITED STATES PATENT OFFICE.

GEORGE EDWARD HEYL-DIA, OF WARRINGTON, ENGLAND.

ELECTRIC CABLE AND PROCESS OF MANUFACTURING SAME.

SPECIFICATION forming part of Letters Patent No. 689,613, dated December 24, 1901.

Application filed May 16, 1901. Serial No. 60,589. (No model.)

To all whom it may concern:

Be it known that I, GEORGE EDWARD HEYL-DIA, engineer, a subject of the King of Great Britain, residing at Warrington, (private address Birk Crag, 236 Great Clowes street, Higher Broughton, Manchester,) in the county of Lancaster, England, have invented certain new and useful Improvements in Processes of Manufacturing Electric Cables, (for which applications for patent in Great Britain have been made under No. 18,044, dated October 10, 1900, and No. 19,951, dated November 6, 1900; in Germany, filed January 23, 1901; in Austria, filed January 24, 1901, and in Sweden, filed January 24, 1901,) of which the following is a specification.

This invention relates to electric cables, and has for its object to increase the speaking or transmission efficiency of same when used for telephonic and telegraphic purposes and to obtain a greater flexibility, which obviates the danger of rupture of the insulation material in bending, particularly when the cables are required for electric lighting or power.

To facilitate description, reference will be had to the accompanying drawings, in which—

Figure 1 is a set of diagrams illustrating distortion of the usual paper strip; Figs. 2 and 3, a side elevation and plan of my improved paper strip; Figs. 4 and 5, perspective and cross-sectional views of the conductor with longitudinally-applied paper strip, the latter figure showing a pair of conductors laid up into a cable; Fig. 6, a cross-section of several pairs of conductors laid up into a single cable; Fig. 7, a cross-section of a pair of conductors with longitudinally-applied gauze; Fig. 8, a similar view showing the paper about the gauze; Fig. 9, side and front elevations of rolls as used in grooving the paper strips; Fig. 10, a front elevation of a modified form of rolls; Fig. 11, a diagrammatic view, in front elevation, of a longitudinal covering machine with flier for the thread-binding.

In the existing types of telephonic or telegraphic low-capacity cables, subterranean as well as submarine, every effort is made to insulate the conductor with a dielectric having a total electrostatic capacity as low as possible, but without due regard as to how this total is made up—that is, as to how the capacity is distributed around the conductor or between the conductors in case of multiple conductors in the same cable. If a cross-section of such a low-capacity cable be examined, it will be found to have an irregular form, which, moreover, will vary at different points of the cable if several sections be taken, so that there is always a different and varying shape in the dielectric surrounding each conductor. This is due to the old method of covering, in which the conductors are separated, for instance, by thin strips of paper, which get distorted into all sorts of shapes, quite preventing any symmetrical arrangement of the conductors within the cable, as will be seen by referring to Fig. 1 of the accompanying drawings, which shows diagrammatically, for instance, three cross-sections at different points of such a cable, from which the irregular distribution of the capacity can be seen, which produces distortion of the speaking effect.

Now according to the present invention the dielectric is always distributed uniformly about the conductor or conductors, which are maintained symmetrically within the cable, so that there will be found practically the same conditions around one wire as there are around its fellow wires, and undulatory currents can be transmitted with a minimum of distortion. By this uniform distribution of the capacity it is rendered possible in the case of long-distance telephony, for instance, to properly reproduce speech, as inductive disturbances from either pairs of conductors or from single wire to single wire are effectively eliminated, and even on short cables the speaking efficiency is increased. This increased efficiency of my cable is due not only to the uniform distribution of the dielectric or electrostatic capacity around and between the conductors, but also to the less deterrent effects of the magnetic fields formed by current motions or waves, which in my improved cable are not distorted so much.

In order to attain the object of my invention, I cover the stranded or plain conductors with paper strips A, having a broken surface consisting of numerous pyramidal or pointed projections broadening to their bases, formed closely together by grooving the paper in cross-hatch form on either or both faces, as shown in Figs. 2 and 3, and folding the same longitudinally about the conductor B in the

desired number of layers, with a winding of thread C to retain the paper, as shown in Fig. 4. The conductors thus separately covered may be laid up in one or more pairs into a single cable, as shown in Fig. 5, and I arrange the meeting edges of the paper to well overlap and form an increased thickness *a* at one side of each conductor and place this thickened part *a* of one conductor against the corresponding thickened part *a* of its related conductor in each pair. The combined thickness *a a* thus produced between the two conductors approximates to the combined thickness of the non-thickened parts *b* and of the thicker enveloping insulation *c* around the pairs, thus insuring the same conditions and even distribution of the dielectric or electrostatic capacity all around each conductor of the pair, as there is an even thickness of the insulating material both around and between the conductors of the cable. This cannot be attained with the usual inserted paper strip shown in Fig. 1 or with a spiral winding of the material on the separate conductors, which after the enveloping winding of a thicker layer would produce a greater thickness of insulation about the pair than between the two conductors. It will be seen, moreover, that the paper touches the conductor only at numerous fine points and insures a thorough air-space character for the cable without losing the symmetrical arrangement of the conductor, as is the case with the usual paper strip inserted between the wires, which in laying up the cable becomes distorted, as shown in Fig. 1.

In Fig. 6 a number of pairs are shown laid up into a single cable, from which it will be seen that the same advantageous conditions are produced as described with reference to Fig. 5.

The building up of the conductors into cables may be effected by squirting paper-pulp around them or wrapping on paper in the ordinary way, or they may otherwise receive a final insulation or protective covering of any of the usual kinds.

The peculiar surface of my improved paper strips renders them well adapted also for the final or enveloping insulation of the cable, as not only are uniform and ample spaces provided for air or fluid insulation by the layers only touching at numerous fine points, but great flexibility is afforded, which is so much needed, particularly when the cable is to be used for electric light or power, and danger of rupture of the insulation in bending, to which paper cables are liable, is obviated.

Where a gauze material is used as the preliminary wrapping for the separate conductors, I apply it longitudinally in the same manner as the paper with overlapping edges in order to form an increased thickness between the conductors, as before described. This is shown in Fig. 7, while Fig. 8 shows the paper A longitudinally applied about the gauze D.

The formation of the pyramidal or fine points on the paper may be effected by suitable rolls—for instance, as shown in Fig. 9, in which the paper material A is passed through pressure-rolls E E′, of which either or both are formed with peripheral ribs running longitudinally, and then through another pair, in which the ribs are formed transversely, the combined effects of the two pairs being to produce grooves in cross-hatch form, resulting in the fine points illustrated in Fig. 2. If the first pair of rolls be formed on the periphery with numerous small recesses of pyramidal form, as shown in Fig. 10, the second pair of rolls F F′ may be dispensed with.

Fig. 11 illustrates, as an example, the usual longitudinal-covering machine for applying the paper. G is the drum of wire; H, the spool of paper strip; I, a guide-roller; K, the folding-die, and L a flier of any usual construction adapted to wind the thread C about the paper on the wire, the covered conductor being wound on a reel M.

I declare that what I claim is—

1. The improvement in the process of manufacturing electric cables of low capacity, which consists in preliminarily covering the conductors in a longitudinal manner with a strip of insulating material, overlapping the meeting edges of the strip to form an increased thickness along one side, binding the strip in this position on the conductor with a winding of thread, laying up the conductors into pairs with the said thickened parts of the related conductors placed together, and completing or building up the cable with the desired number of such conductors in the usual manner, substantially as described.

2. The improvement in the process of manufacturing insulated electric cables or conductors, which consists in applying paper in the form of a strip having a surface provided with grooves in cross-hatch form constituting numerous pyramidal points, substantially as described.

3. The process of manufacturing electric cables of low capacity, which consists in preliminarily covering the conductors with a strip of insulating material, forming an increased thickness in said covering along one side, laying up the conductors into pairs with the said thickened parts of the insulation placed together, applying an envelop of insulation about the pair of a thickness which together with the thickness of the unthickened portion of the said preliminary covering equals the combined thickness of insulation between the two conductors, and completing or building up the cable with the desired number of such conductors in the usual manner, substantially as described.

4. An insulated cable of low capacity, in which the preliminary insulating-covering of each conductor is of greater thickness along one side, where related conductors of a pair touch one another, substantially as described.

5. An insulated cable of low capacity, in which the preliminary insulating-covering of

each conductor is of greater thickness along one side where related conductors of a pair touch one another, the combined thickness of such insulation between the conductors being equal to that of the enveloping insulation of the pair together with that of the unthickened portion of the preliminary covering, substantially as described.

6. An insulated electric cable, having a preliminary longitudinal covering of insulation in strip form with overlapped edges constituting an increased thickness along one side of the conductor, and having numerous pyramidal points on the surface of the strip which faces the conductor, substantially as described.

7. An electric cable, having insulation of paper provided with surface projections in the form of numerous pyramidal points, substantially as described.

8. An electric cable having insulation of paper strip provided with surface projections in the form of numerous pyramidal points with the edges of the strip overlapping longitudinally along the conductor, and a winding of thread adapted to retain the strip in this position, substantially as described.

9. In an electric cable, the combination with a pair of conductors arranged longitudinally side by side, of insulation for said conductors comprising a suitable material folded longitudinally around said conductors with its edges overlapping to form thickened walls at the point of contact of said conductors, substantially as described.

In witness whereof I have hereunto signed my name, this 8th day of May, 1901, in the presence of two subscribing witnesses.

GEORGE EDWARD HEYL-DIA.

Witnesses:

ARCHIBALD FRANK STEVENSON,

SIDNEY W. DOD.