July 20, 1937. S. J. ROSCH ET AL 2,087,303

INSULATED CONDUCTOR AND METHOD MAKING SAME

Filed April 21, 1934 4 Sheets-Sheet 1

Fig. 1.

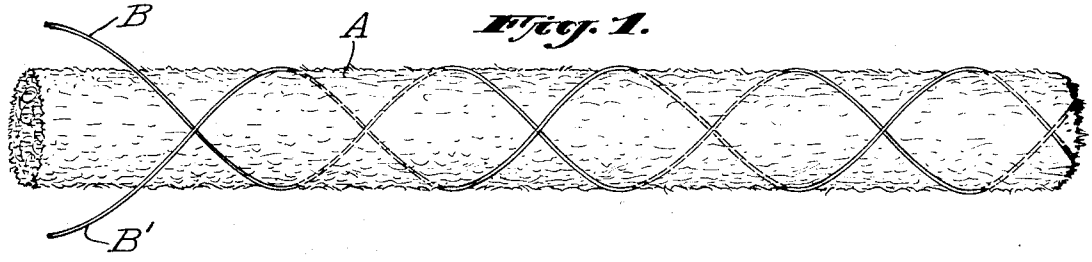


Fig. 2.



Fig. 3.



Fig. 4.

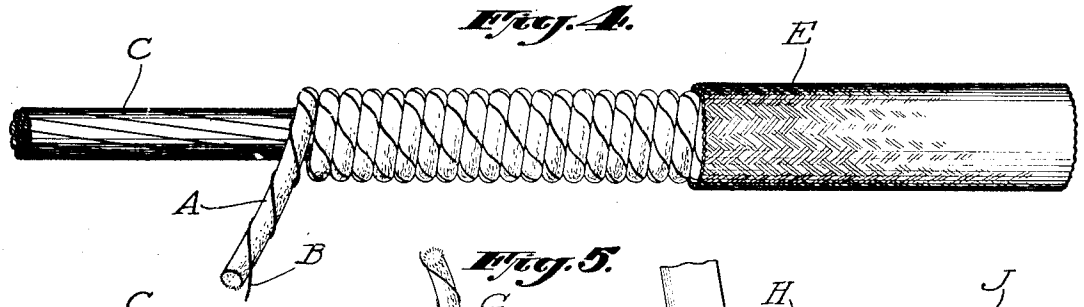


Fig. 5.

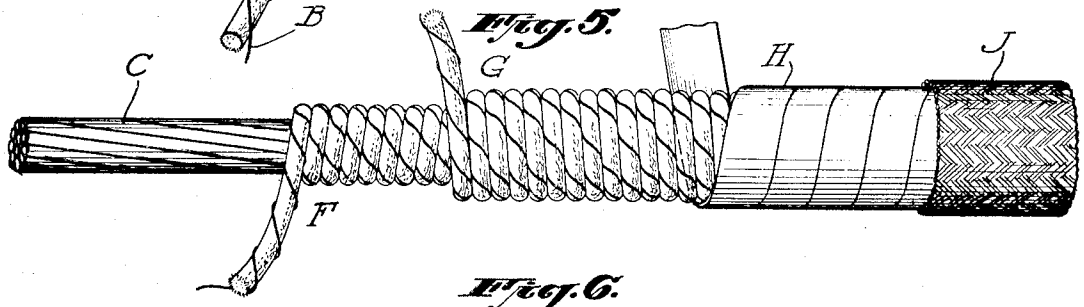
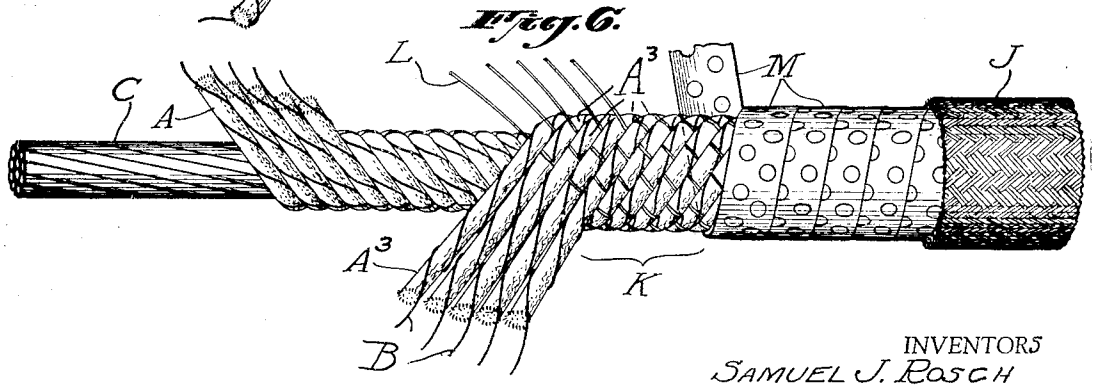


Fig. 6.



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July 20, 1937. S. J. ROSCH ET AL 2,087,303

INSULATED CONDUCTOR AND METHOD OF MAKING SAME

Filed April 21, 1934 4 Sheets-Sheet 2

Fig. 7.

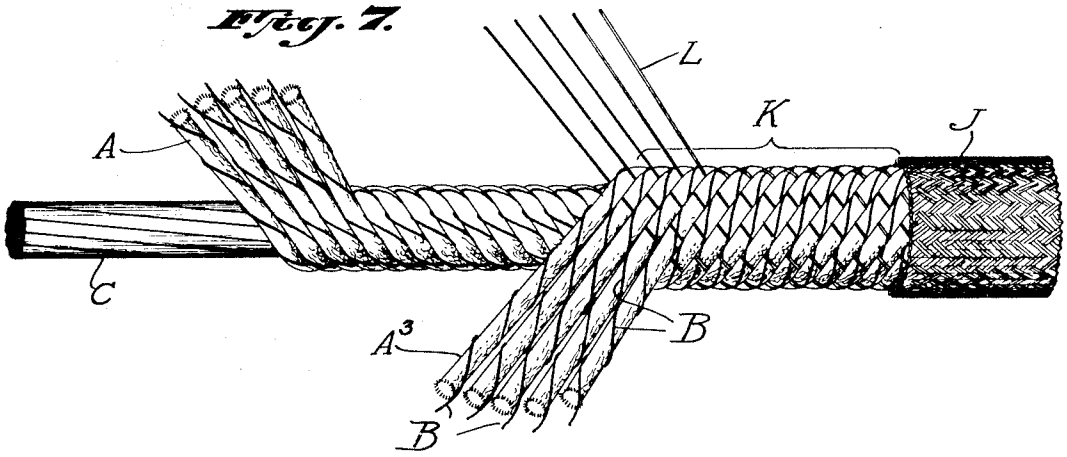


Fig. 8.

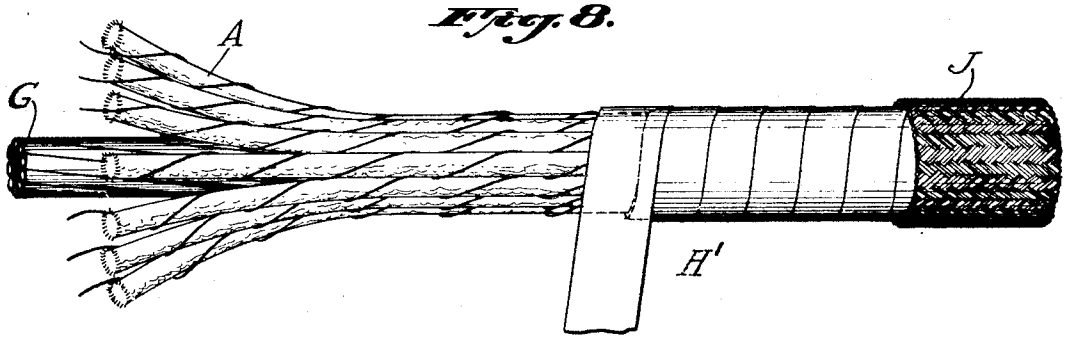


Fig. 9.

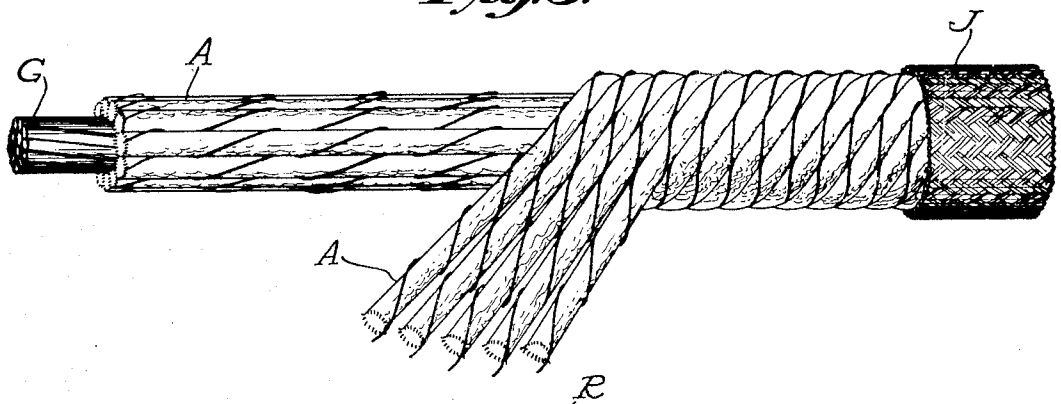
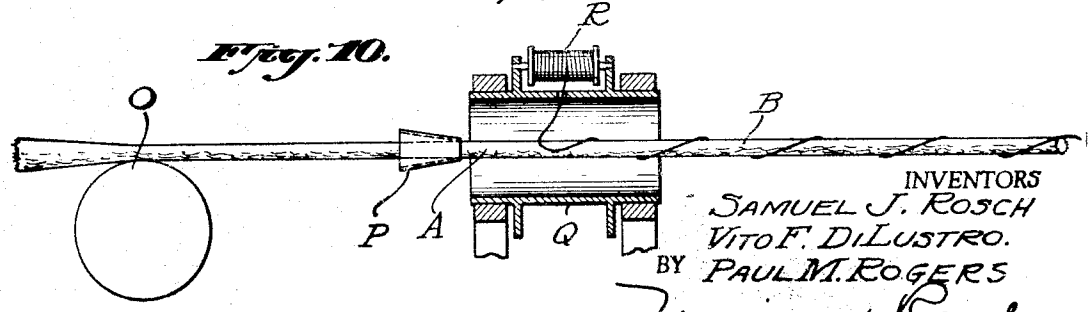


Fig. 10.



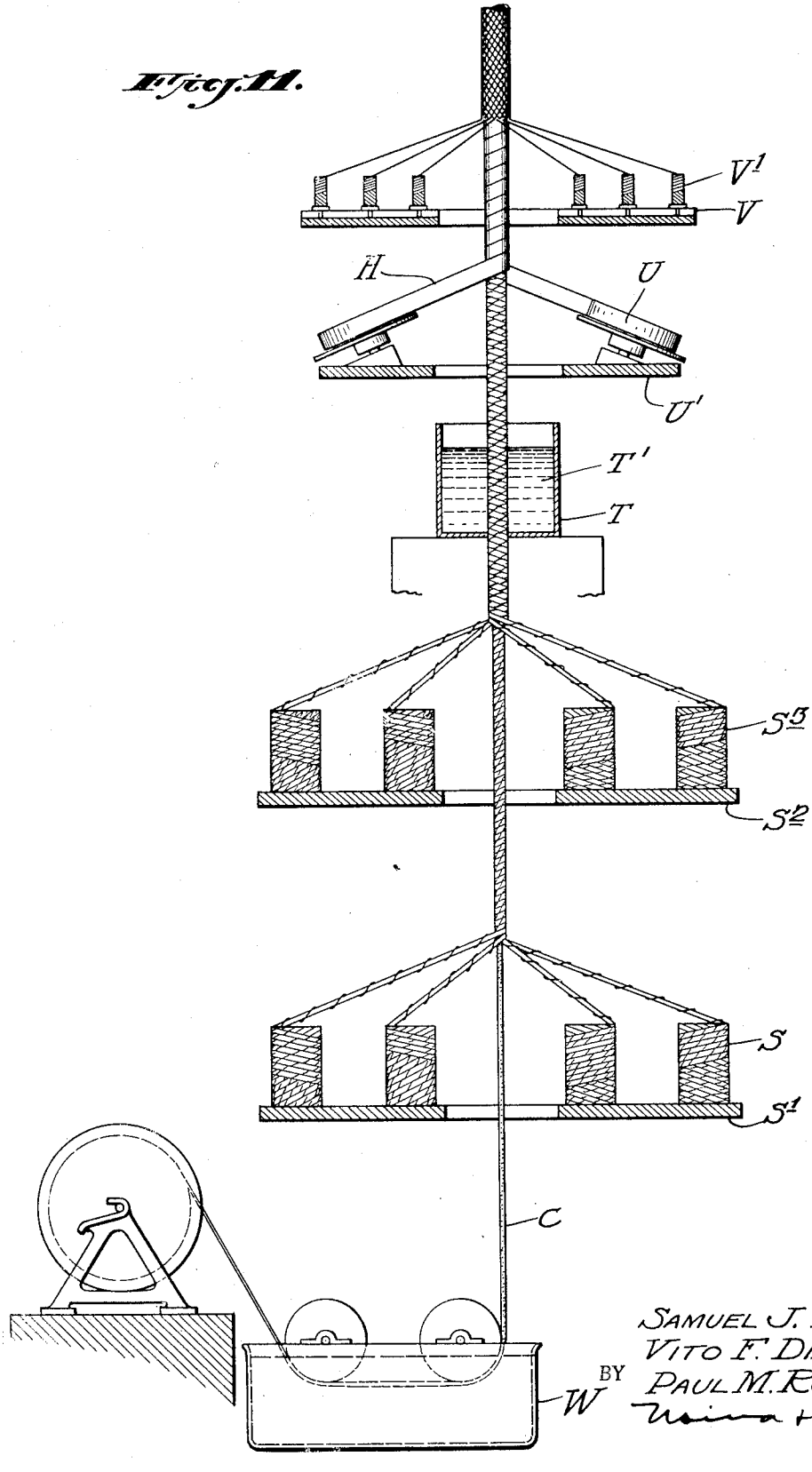
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INSULATED CONDUCTOR AND METHOD OF MAKING SAME

Filed April 21, 1934 4 Sheets-Sheet 3

Fig. 11.



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July 20, 1937. S. J. ROSCH ET AL 2,087,303

INSULATED CONDUCTOR AND METHOD OF MAKING SAME

Filed April 21, 1934 4 Sheets-Sheet 4

Fig. 12.

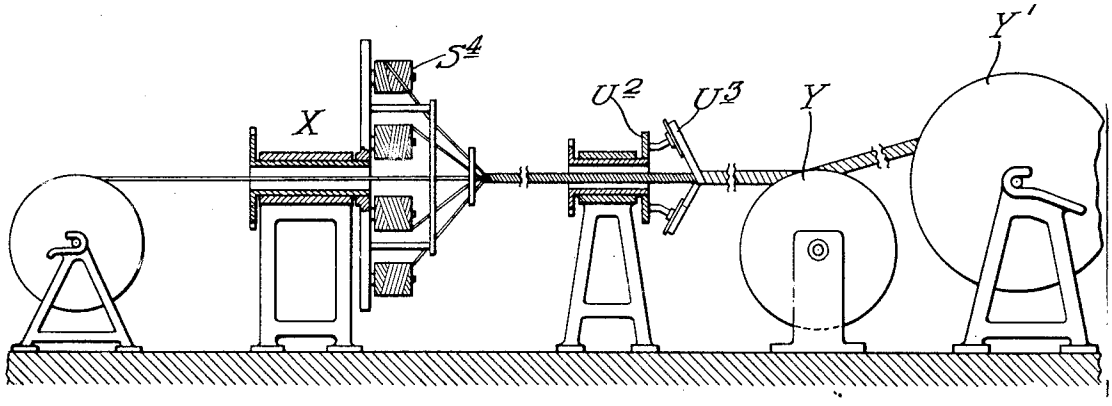
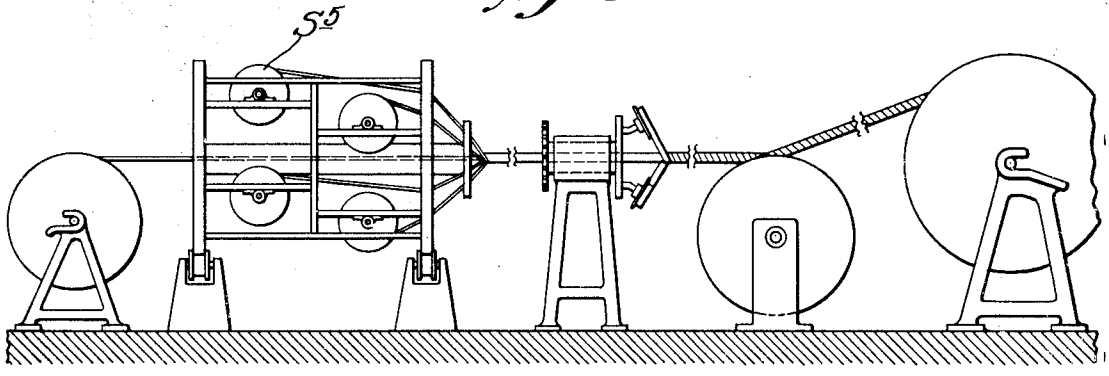


Fig. 13.



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Patented July 20, 1937 2,087,303

UNITED STATES PATENT OFFICE

2,087,303

INSULATED CONDUCTOR AND METHOD OF MAKING SAME

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Application April 21, 1934, Serial No. 721,656

18 Claims. (Cl. 173—264)

This invention relates to electric conductors and particularly to a novel form of insulated covering therefor and the method of applying such covering to a conductor. A characteristic feature relates particularly to the use of fluffy fibrous material, such as crude or carded cotton, sisal, jute, asbestos, or other fluffy carded or uncarded, or relatively crude fibrous material having little or no inherent tensile strength but provided with a reinforcing member helically embracing the exterior thereof.

Heretofore, it has been suggested to build up fibres around a central filamentary supporting thread, such thread extending substantially axially of the fibres. Such an interior thread or reinforcement is located in the center of the mass of fibres and obviously does not embrace them and will not serve to prevent the outermost fibres of the body from tending to fluff outwardly. Another suggestion in the prior art is the application of longitudinally extending filamentary threads, which are adhesively secured to the fibrous mass.

A further old idea has been to build up the fibres about an adhesively coated longitudinal supporting thread by rolling or advancing the fibres about the thread. In applying such old fibrous materials, it has heretofore been suggested to mat them about the conductor by wrapping about the insulated conductor, thus formed, one or more twines or threads in various angles or directions, such threads, however, being on the outside of the assemblage including the conductor and the fibrous mass.

While loose fibrous materials have heretofore been applied to or incorporated in the insulating structure of electric conductors, our invention differs from the teachings of the prior art in material respects and novel and unobvious advantages are secured by incorporating our novel features, as will be apparent from the following disclosure. One important aspect of the present invention over the interior centrally located or exteriorly longitudinally extending reinforced fibres heretofore used is that our exterior helical reinforcement exerts a confining action on the fibres. Moreover, the exterior spiral or helical arrangement of our reinforcement endows the sliver, roving, or loose spun yarn, or other fibrous material with a greater over-all tensile strength than would be the case with the straight longitudinal interior or exterior reinforcements heretofore used. This is because the reinforcement, which we employ, in the nature of a coarse pitched helix around the loose fibres, can stand a greater extent of pull without breaking for a given size of reinforcing thread in view of the fact that part of the lengthwise pulling component of the force applied is resolved more or less into a constricting or compressing force on the relatively loose fluffy fibres.

Hence, there is less tendency for our improved reinforcement to break. Thus, the reinforced fibrous mass which we employ can withstand much greater elongation without rupturing or disintegrating than can the old fibrous slivers or masses of the prior art, in which the reinforcements extend longitudinally either interiorly or exteriorly of the mass.

Our outer helical reinforcement also acts to prevent part of the fibrous mass from forming a fluffy accumulation, which would eventually later cause the member to break, when applied to the conductor by the serving machine or other instrumentality used.

The use of the outer helical reinforcement about the loose fibres is important also in the method of applying the relatively loose fibrous material to the conductor. In applying slivers or roving, of necessity a certain amount of tension is exerted on the work. The use of our external and helically reinforced fibrous mass enables us to apply the same by the use of existing mechanism without making drastic alterations thereto. During the application of the fibrous mass to the conductor, the helical reinforcing thread keeps the fluffy fibres within proper bounds and when tension is applied to the reinforced mass the helical thread exerts a constricting action on the fibres. Our novel helical reinforcement also enables us to impregnate the loose fibrous mass prior to its application to the conductor by passage through a liquid bath. The exterior embracing reinforcement contributes materially to the success of such impregnation by preventing the loose wet or saturated fibres from pulling apart. Thus, the presence of this exterior helical reinforcement performs important functions differing from the functions performed by the reinforcements of the prior art.

In short, the constricting action of our outer spiral reinforcement gives rise to three important, novel and unobvious advantages, namely, it increases the ability of the fibres to withstand tensile strain, it mats down and holds the loose fibres within such restricted confines that they will not fluff outwardly to an extent which would interfere with the operations or steps required to apply the fibrous mass to the conductor, and it

makes it practical to impregnate the fibrous mass prior to its application to the conductor.

The above and other features of the invention will be apparent from the following detailed description when read in connection with the accompanying drawings and will be defined with particularity in the appended claims.

In the drawings—

Fig. 1 is an enlarged view of a sliver or body of fibres reinforced in accordance with our invention; Fig. 2 is a similar view illustrating a short length of reinforced slubber roving; Fig. 3 may be regarded as illustrative of a mass of fibres such as a sliver, roving or the like with an exterior reinforcement of flat fibrous tape such as paper or a narrow relatively thin limp textile material; Fig. 4 is an enlarged view of a conductor having an insulated covering embodying our invention, parts being broken away in the interest of clearness; Figs. 5, 6, 7, 8 and 9 illustrate various modified embodiments of the invention; Fig. 10 is a diagrammatic view illustrating a step in the method of applying the helical reinforcement to loose fibres; Fig. 11 is a somewhat diagrammatic view illustrating certain steps in the method of applying reinforced fibres to a conductor; Figs. 12 and 13 illustrate modifications of certain steps in the method of carrying out the invention.

Referring in detail to the drawings, Figs. 1 to 9 inclusive illustrate conductors having coverings in which the fibrous mass embodying our invention forms an important element.

In Fig. 1, A represents an elongated body or mass of loose fibres, such as cotton, jute, asbestos, sisal or the like. This loose or fluffy mass, in our invention, is surrounded by one or more helical reinforcements, such as indicated at B. These reinforcements may all be of the same inclination or may have one or more reinforcements progressing helically in one direction around the mass and another reinforcement B′ progressing in the opposite direction around the mass. In short, we may employ either a single right hand helix or a right hand and a left hand reinforcing helical body.

The mass of fibres illustrated at A in Fig. 1 may be regarded either as a sliver or roving of carded fibres or as a piece of ribbon lap, such ribbon lap differing from a sliver or roving in size and degree of coarseness of the fibres by the reason of two or more slivers being superposed on each other. Or, the body of loose fibres A may be regarded as a length of material formed by longitudinally slitting a wide blanket or web of picker lap. Such picker lap differs from sliver or roving in that it is uncarded and is a more crude product having been freed of its major impurities.

Instead of using relatively crude material, such as those referred to, we may use a mass of fibres, which have had a slight twist imparted thereto, such as a mass known as a slubber roving. Such slubber roving is indicated at A′ in Fig. 2. This will carry our improved outer helical reinforcement, indicated at B^2.

In the alternative feature illustrated in Fig. 3, I have shown a mass of fibrous material A^2 surrounded by an outer helical reinforcement B^3, which may be regarded as a relatively narrow strip of paper, or textile fabric, such as cambric or the like.

For convenience of description, the mass of fibrous material will be hereinafter referred to as a sliver. But, it is to be understood that this term applies to either a crude or carded fibrous mass, such as produced from ribbon lap, picker lap, or other processed or unprocessed fibres. In all cases, the mass of fibres will be reinforced by one or more helical members, as above indicated.

Fig. 4 illustrates an embodiment of the invention wherein the conductor C is wrapped with a sliver A. This sliver may have been previously impregnated with an insulating or water-proofing material or the sliver may first be wrapped about the conductor and then the same passed through a bath. Over the covering thus provided, there may be an outer jacket, such as indicated at E, in the form of a braid of cotton or the like. The helical reinforcement B embracing the sliver greatly facilitates the application of the sliver to the conductor, as will appear hereinafter in the description of the method of applying the same to the conductor.

Fig. 5 illustrates an embodiment of our invention, wherein the conductor C is provided with two layers of slivers, one layer being indicated by the letter F and the other by the letter G. Over the layers of these slivers, there may be applied a fibrous tape, such as indicated at H and over this there will be a braided or other outer jacket J. The layers F and G formed of reinforced slivers may be saturated with suitable insulating or weather-proofing compounds and the wrapping of tape H will serve as a barrier or dam to prevent the escape of an insulating compound, due for example to the heating of the conductor.

In the embodiment of the invention shown in Fig. 6, the conductor C is first wrapped with a layer of helically reinforced slivers A and over this there is provided a jacket K, formed of similar helical reinforced slivers A, which are interbraided with thread-like strands L. This jacket K is thus formed of the relatively bulky reinforced fibrous strands A^3 and the fine thread-like strands L, which cross the slivers A^3. Over the jacket K, we provide a wrapping of fibrous tape M, which in this instance may be perforated and the assemblage is enclosed in an outer braided jacket J of conventional form. The construction illustrated in Fig. 7 is substantially the same as that illustrated in Fig. 6, except that the tape M is omitted. The corresponding parts are identified by reference characters similar to those used in Fig. 6.

Instead of wrapping the reinforced sliver or slivers around the conductor G, we may, as indicated in Fig. 8, provide one or more layers of reinforced slivers A, which extend longitudinally of the conductor G and over such longitudinal reinforced slivers, we will provide a wrapping of tape, such as indicated at H′ and over this there will be a conventional jacket J.

A further alternative is illustrated in Fig. 9, wherein a plurality of helically reinforced slivers A surround the conductor G and over these there is a layer of helically wrapped slivers A, which are enclosed by a conventional braid J.

Referring now to our improved method, we provide a suitable length or sliver of fibrous material such as fluffy cotton, asbestos fibres, sisal, or jute fibres, or combinations of the same, or any type of loosely formed fibres or fibrous material, which are capable of reinforcement by prespiralling or helically winding one or more reinforcing threads around such fibres. Fig. 10 diagrammatically shows the step for reinforcing the fibres. In this figure, the fibrous material coming from the doffer roll O of a carding machine may be led through a trumpet or former P, so as to form a sliver or roving A. As the sliver

leaves the trumpet, the reinforcement B is applied to the exterior thereof. For this purpose, we have conventionally illustrated a flier Q carrying a cop or spool R of reinforcing thread. The application of the reinforcing thread in this manner serves to increase the tensile strength of the sliver or roving to such an extent that the fibres thereof will not disintegrate or pull apart when tension is applied. The helical reinforcement thus applied greatly facilitates the application of the sliver or roving to the exterior of the cable.

The sliver or roving is then wound on suitable spools, bobbins or cops. Such cops, as indicated at S in Fig. 11, are mounted on a flier S', which is rotated by suitable mechanism so as to wrap the reinforced sliver or roving about the conductor C. The flier S' may thus apply the wrapping such as indicated at F in Fig. 5. The thus wrapped conductor will progress through another flier S^2 carrying cops or bobbins S^3 constituting supplies for a similar reinforced sliver which will apply the second wrapping, such as indicated at G in Fig. 5. This second wrapping may be wrapped in a direction opposite to the first wrapping. The thus wrapped conductor will then pass through a suitable tank T carrying a liquid impregnating compound, indicated at T'. After passage through the impregnating tank, the wrapped and impregnated conductor will have paper or fibrous tape H applied thereto, such tape being fed from tape supply reels U carried by a taping head U'. After the application of the tape, the thus covered conductor will pass through the center of the flier V of a braiding machine carrying a plurality of cops V' of suitable thread for forming the braid on the wrapped and taped conductor.

Prior to the first wrapping of the reinforced sliver about the conductor C, the latter, if desired, may be passed through a tank W carrying an adhesive, in which case the first wrapping of slivers would be adhesively united to the conductor.

Instead of applying the impregnating compound to the reinforced slivers by passage through a tank T', as above described, we also contemplate saturating the slivers before wrapping them around the conductor and such presaturating or loose fibrous material will be permissible in view of the fact that the sliver is reinforced by the exterior helical member and thus the wetted fibres will not pull apart and disintegrate under the influence or the tension exerted during the operation of winding or wrapping them about the conductor.

We have illustrated the tape H wrapped helically around the reinforced sliver wrappings. But, we also contemplate, in some cases, folding or applying such paper or similar tape longitudinally about the insulated conductor.

The method of producing a conductor, such as illustrated in Figs. 6 and 7, will differ from that described in connection with Fig. 11, in that some of the fliers on the braiding machine will carry bobbins or cops of reinforced relatively bulky slivers and other cops or bobbins of relatively thinner threads, so that the braiding operation will interweave the slivers A with the threads L. The thus formed braid may be impregnated by passage through the tank carrying suitable insulating or weather-proofing compounds, as will be understood.

In some cases, instead of forming the insulation braid of relatively bulky reinforced slivers, such as A^3, with the thinner threads L, as in Figs. 6 and 7, we also contemplate forming the insulated covering as a braid, in which all component crossing strands are in the form of slivers, each embraced by an outer helical reinforcing thread, such as indicated at B. The presence of such an outer reinforcing thread B, which has been prespiraled about the fluffy fibrous sliver, makes it practical to handle such sliver in conventional braiding machines, because the reinforced sliver can be passed through or around the usual metal guides of a braiding machine. And in a braiding operation, because of the presence of the prespiraled exterior reinforcing thread B, the fibres will not fluff out to an extent to jamb in the guides and they will not pull apart. The exterior helical disposition of this thread around the exterior of the sliver is of importance because when the sliver is bent around the guides in different directions on the braiding machine the exterior thread largely takes the strain occasioned by the braiding operation. The interiorly or straight exterior reinforced slivers heretofore used could not be successfully handled on conventional types of braiding machine, insofar as we are aware, because they would not permit of bending around the guides in different directions, or the fluffing out of such old slivers would cause their breakage due to sticking in the guides.

Instead of feeding the conductor vertically, and applying the reinforced sliver by the use of known types of braiding machines, in which the carriers have been adapted for the operation, we may employ a spinning head such as illustrated diagrammatically in Fig. 12, this head, indicated at X, carrying a plurality of spools or cops S^4. When this type of mechanism is used, the wrapping of tape may be applied by means of a planetary taping head, indicated diagrammatically at U^2, carrying a plurality of tape supply reels U^3. The conductor thus wrapped may be advanced through the machine by the usual draw-off capstan Y and the material accumulated on a take-up reel Y'. Or, instead of using the spinning head of the character shown in Fig. 12, the reinforced slivers may be applied by a conventional type of stranding machine, such as diagrammatically shown in Fig. 3, this stranding machine carrying a plurality of supply reels S^5, the material being fed therefrom through the suitable guides, in much the same manner as the strands are fed through a cabling machine to the core member of the cable.

While we have described quite specifically certain conductors embodying the invention and various definite steps and sequences of steps in applying the reinforced sliver to the conductor, it is to be understood that the drawings and the detailed description are to be interpreted in an illustrative rather than a limiting sense since various modifications and substitutions of equivalents may be made by those skilled in the art without departing from the invention as defined in the appended claims.

What we claim is:—

1. In the manufacture of insulated conductors, the method which comprises providing an elongated mass of loosely associated fibres of low inherent tensile strength, applying a helical thread-like reinforcement about the exterior thereof and enclosing a conductor with a covering composed of such exteriorly pre-reinforced fibrous mass.

2. In the manufacture of insulated conductors, the method which comprises providing a sliver applying an exterior helical reinforcement

about the exterior thereof and covering a conductor with such pre-reinforced sliver.

3. In the manufacture of insulated conductors, the method which comprises providing a relatively bulky sliver of fibrous material and applying a thread-like helical exterior reinforcement thereto, interweaving such reinforced sliver with relatively less bulky thread-like members about a conductor.

4. In the manufacture of insulated conductors, the method which comprises providing an elongated mass of loosely associated fibres of low inherent tensile strength, applying a helical thread-like reinforcement about the exterior thereof, impregnating the thus pre-reinforced mass and then applying it to the conductor.

5. In the manufacture of insulated conductors, the method which comprises providing an elongated mass of loosely associated fibres of low inherent tensile strength, applying a helical thread-like reinforcement about the exterior thereof, feeding such pre-reinforced mass through a bath of impregnating material and applying the thus impregnated mass to a conductor.

6. In the manufacture of insulated conductors, the method which comprises providing a plurality of relatively bulky elongated masses of fibrous material and before assembling the masses with the conductor applying a helical exterior reinforcement to each of said masses, interweaving such pre-reinforced masses with relatively less bulky thread-like members about a conductor and impregnating the covered conductor thus formed.

7. In the manufacture of insulated conductors, the method which comprises providing a plurality of relatively bulky elongated masses of fibrous material and before assembling the masses with the conductor applying a helical exterior thread-like reinforcement around each mass, interweaving such pre-reinforced masses with relatively less bulky thread-like members about a conductor and impregnating the covered conductor thus formed, applying a tape thereover and enclosing the assemblage in an outer jacket.

8. In the manufacture of insulated conductors, the method which comprises carding a fibrous material and forming a sliver therefrom, before assembling the latter with the conductor applying a helical thread-like reinforcement about the exterior thereof and enclosing a conductor with a covering composed of such exteriorly reinforced sliver.

9. In the manufacture of insulated conductors, the method which comprises carding fibrous material and forming a sliver therefrom, before assembling the latter with the conductor applying a coarse pitched helical reinforcement about the exterior thereof, and wrapping such exteriorly reinforced sliver about a conductor.

10. In the manufacture of insulated conductors, the method which comprises carding fibrous material and forming a sliver therefrom, before assembling the latter with the conductor applying an exterior helical reinforcing thread thereto, applying a plurality of longitudinally extending pieces of such reinforced sliver lengthwise of a conductor and applying an outer covering to secure them to the conductor.

11. An electric conductor surrounded by a covering including an elongated mass of fibres constituting a sliver and reinforced by an outer member, which progresses helically around the exterior surface of the sliver.

12. An electric conductor surrounded by a covering including a sliver which is embraced by a reinforcing thread, which progresses helically around the exterior surface of the sliver.

13. An electric conductor surrounded by a covering including a plurality of convolutions of a sliver each of which carries an outer helical reinforcement.

14. An electric conductor surrounded by a covering including a plurality of convolutions of a sliver which carries an outer reinforcing thread which progresses helically around the exterior thereof for augmenting the tensile strength of the fibres of said sliver.

15. An electric conductor surrounded by a covering including a plurality of longitudinaliy extending slivers, each embraced by an individual exterior helical reinforcement thread and an outer jacket enclosing such slivers.

16. An electric conductor surrounded by a covering including a sliver which is embraced by an individual helical reinforcing thread, said sliver being impregnated with an insulating material, an outer jacket and a wrapping of tape between the jacket and said sliver covering.

17. An electric conductor surrounded by a covering comprising a relatively bulky sliver having an individual outer helical reinforcing thread and being interwoven with a much less bulky thread.

18. An electric conductor having a plurality of longitudinally extending slivers covering an exterior thereof, each of said slivers having an individual outer helical thread-like reinforcement, and a wrapping of similarly reinforced slivers around said longitudinally extending slivers and an outer jacket enveloping the assemblage.

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