Jan. 24, 1933. B. H. REEVES 1,895,400

INSULATED CONDUCTOR AND METHOD OF MAKING THE SAME

Filed Aug. 20, 1926 2 Sheets-Sheet 1

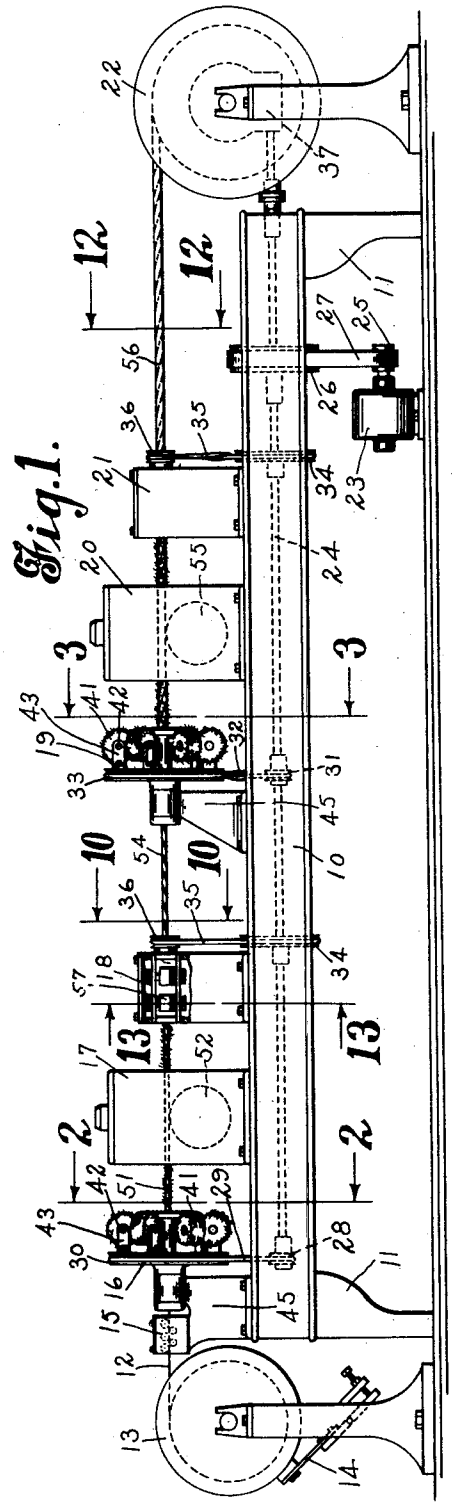


Fig. 1.

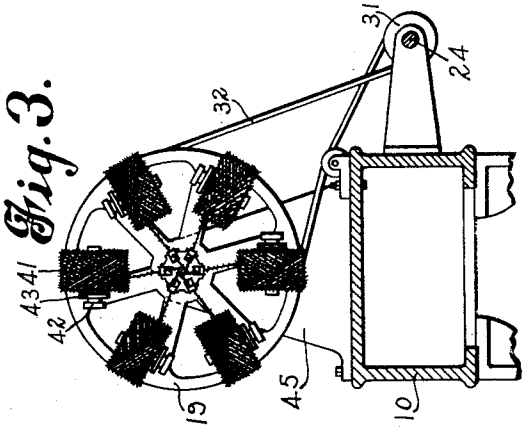


Fig. 3.

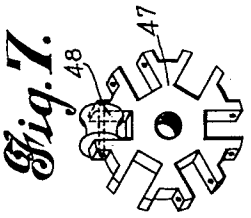


Fig. 7.

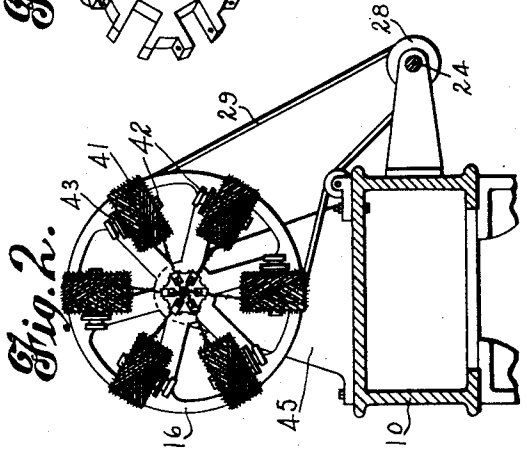


Fig. 2.

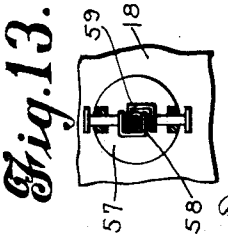


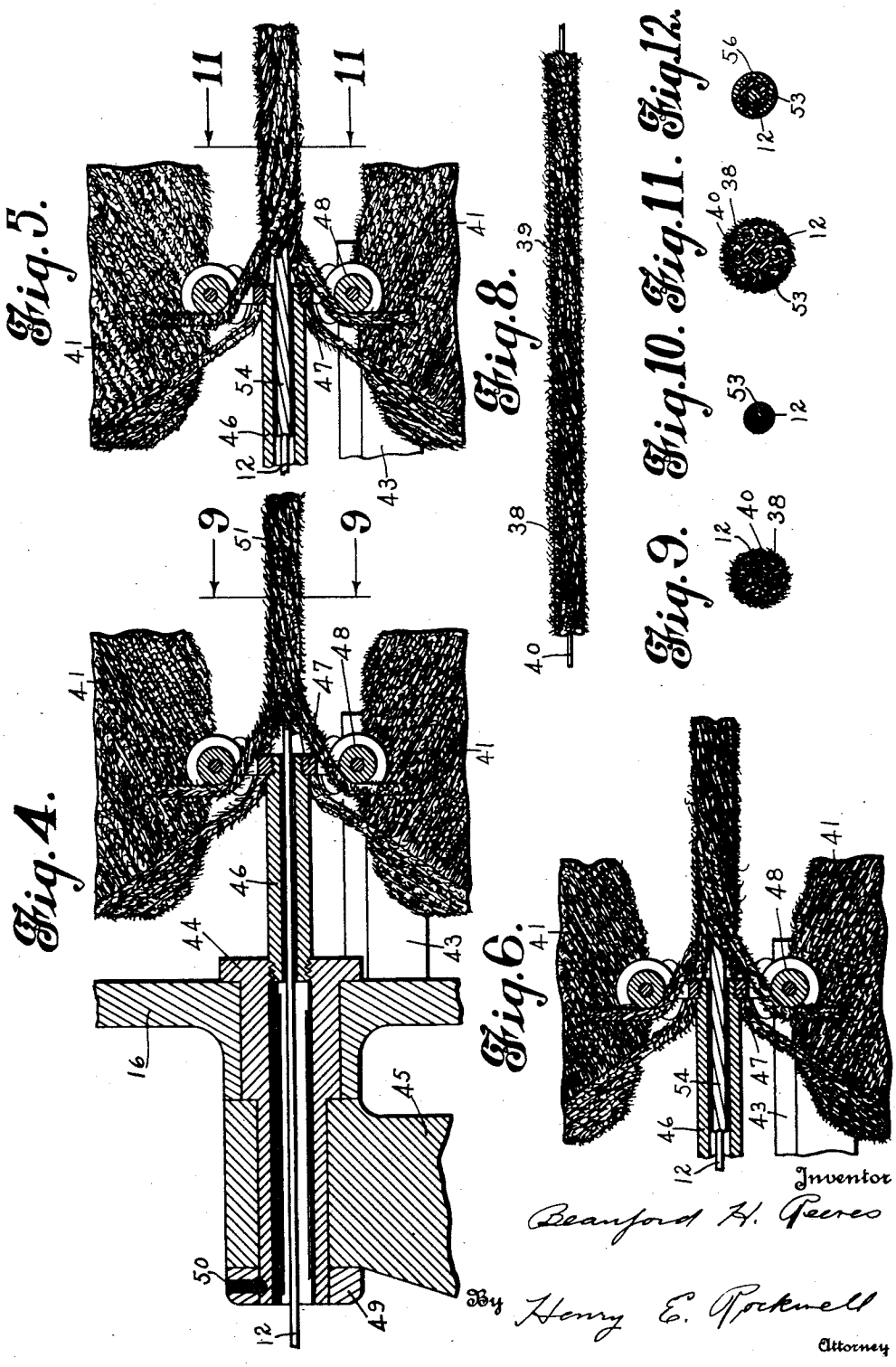
Fig. 13.

Inventor
Beauford H. Reeves
By Henry E. Rockwell
Attorney

Jan. 24, 1933. B. H. REEVES 1,895,400

INSULATED CONDUCTOR AND METHOD OF MAKING THE SAME

Filed Aug. 20, 1926 2 Sheets-Sheet 2



Patented Jan. 24, 1933

1,895,400

UNITED STATES PATENT OFFICE

BEAUFORD H. REEVES, OF NEW HAVEN, CONNECTICUT, ASSIGNOR TO ROCKBESTOS PRODUCTS CORPORATION, OF NEW HAVEN, CONNECTICUT

INSULATED CONDUCTOR AND METHOD OF MAKING THE SAME

Application filed August 20, 1926. Serial No. 130,550.

This invention relates to insulated electrical conductors and to the method of insulating the same. More especially the invention relates to an insulated conductor wherein the insulation material generally consists of intermingled and thoroughly matted fibres of asbestos or the like, applied to a conductor in the form of untwisted asbestos sliver generally composed of loose intermingled fibres of asbestos or the like, which are preferably reinforced by a thread or the like, and to the method of applying the same to the conductor.

The principal object of the invention is to provide an insulating covering for a conductor, which will possess relatively high electrical and heat insulating values.

Another object of this invention is to provide an insulating covering for a conductor, which will be generally in the form of a continuous one-piece structure, composed of fibres of asbestos or the like, thoroughly intermingled and matted into a relatively dense mass uniformly spread about the conductor and of sufficient flexibility to allow for the retention of all its electrical and heat insulating qualities and its continuity under all conditions of use.

Still another object of this invention is to provide such an insulating covering which will have, in addition to the above advantages, the further advantage of being mechanically strong whereby it is adapted to withstand rough usage of a character liable to cause breaks in ordinary insulation and of being of a non-absorbing nature whereby the effect of moisture is negligible.

A still further object of this invention is to develop an improved method of forming or making an insulating covering of the above character for a conductor.

Another object of this invention is to develop a method of making or forming such an insulating covering directly upon the conductor, in such a manner, that regardless of the length of the conductor the covering thereof will be of a generally continuous one-piece structure.

Other objects of this invention are to provide an insulating covering and to develop a method of making the same whereby the operations used in the making thereof can be readily and economically effected in such a manner that the above advantages and efficiency of the covering will be retained, and the cost of the product materially reduced.

To these and other ends the invention consists in the novel features, combinations of parts, and methods and operations in the making and forming thereof, to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a side elevation of more or less diagrammatical nature of a device adapted to form or make the insulating covering, embodying the features of this invention and by the methods and operations thereof;

Fig. 2 is a section on line 2—2 of Fig. 1;

Fig. 3 is a section on line 3—3 of Fig. 1;

Fig. 4 is a vertical section on an enlarged scale, illustrating one of the operations for forming the insulating covering of this invention;

Fig. 5 is a section similar to Fig. 4, illustrating another operation in the forming of an insulating covering;

Fig. 6 is a view somewhat similar to Fig. 5, illustrating an operation in making a somewhat modified form of covering;

Fig. 7 is a detail of one of the parts of the device;

Fig. 8 is a view showing a portion of asbestos or like sliver used in forming the insulating covering of this invention;

Fig. 9 is a section on line 9—9 of Fig. 4;

Fig. 10 is a section on line 10—10 of Fig. 1;

Fig. 11 is a section on line 11—11 of Fig. 5;

Fig. 12 is a section on line 12—12 of Fig. 1, and

Fig. 13 is a section on line 13—13 of Fig. 1.

The machine illustrated in Fig. 1 comprises a frame 10, supported on standards 11, upon which is mounted a number of cooperating devices adapted to form an insulating covering for a conductor. The particular and detailed construction of the devices shown in Fig. 1, is illustrated and described in a copending application, Serial No. 130,551, filed August 20, 1926, which issued as Patent 1,789,881, Jan. 20, 1931, wherein the novel

features and combinations of parts thereof are pointed out and claimed. In this instance, the conductor 12 is supplied to the various devices from a reel 13 positioned adjacent one end of the frame 10. The reel 13 is provided with suitable braking means 14 to prevent the unwinding of the conductor at too great a speed.

A conductor 12, which in this instance, may be a copper wire, is first received by a suitable wire straightening device 15, which operates to remove all kinks or other unevennesses from the wire, whereby the covering will be more readily applied in an even layer thereto. Adjacent the straightening device and mounted upon the frame 10 is a rotatable head 16 having means upon the face thereof to hold a number of spools or cheeses of suitable insulating material. The product next passes to and through a suitable impregnating device 17, and thence to a smoothing device 18. The product may then be drawn through another set of similar devices, such as the rotatable head 19, the impregnator 20, and the smoothing device 21 by a power driven capstan 22 positioned adjacent the other end of the frame 10.

Power for the rotatable heads 16 and 19, the smoothing devices 18 and 21, and the capstan 22, may be supplied in any desired manner, such as by means of the electric motor 23 connected to the shaft 24, through pulleys 25 and 26 and belt 27. The rotatable head 16 is rotatably connected to shaft 24 through the pulley 28, and a belt 29, which drivingly engages the head 16 in a groove 30, formed in the periphery thereof. The rotatable head 19 is rotatably connected to shaft 24 in a similar manner through pulley 31, belt 32 engaging the groove 33 formed in the head 19. The smoothing devices are rotatably connected to the shaft 24, through similar means, such as pulleys 34, belts 35, and pulleys 36. The capstan 22 is driven through a suitable reduction gearing, (not shown) positioned at 37, which includes a well known form of change gear arrangement, (not shown) whereby the speed ratio between the capstan 22 and the shaft 24 may be varied. As illustrated in Figs. 1 to 5, inclusive, the rotatable heads 16 and 19 are arranged to rotate in opposite directions and at a substantially slower speed than the shaft 24, the smoothing devices 18 and 21 being also arranged to be driven in opposite directions but at a faster speed than the shaft 24. The modified arrangement in Fig. 6 is an illustration of the result upon the product when the rotatable heads 16 and 19 are rotated in the same direction, which is an operation that under some circumstances may be desirable.

The strand 38 illustrated in Fig. 8, is of a preferred form and suitably constructed to form an efficient insulating covering for a conductor by the methods employed in this invention. In the preferred form, the strand 38 comprises an untwisted sliver or a loose intermingled mass of asbestos or other fibres 39, suitably arranged about a reinforcing thread 40. This strand or sliver, after being formed, is collected upon suitable containers to form what is known as cheeses 41, such as shown in Figs. 1 to 6, inclusive, each cheese having suitable means whereby it may be slipped upon a spindle 42, secured by a bracket 43 upon the face of the rotatable heads 16 and 19.

The rotatable heads 16 and 19 as illustrated, are each provided with six brackets 43 upon each of which is a spindle 42, adapted to removably receive a cheese 41 of strand 38. Although an arrangement having provision for six sets of parts is shown, this is not particularly essential, inasmuch as under some conditions the number may be from one or more to more than six, the number depending largely upon the size of the conductor, the number of strands or slivers desired or required, and the thickness of the covering desired or required.

The rotatable heads 16 and 19 are each keyed or otherwise secured to a hollow spindle 44, having a bearing in uprights 45. Each hollow spindle 44 is provided with an extension 46 upon which is mounted a supporting means, such as a spider 47 having a suitable number of guide rollers 48 thereon, over which the strands 38 ride while being wound upon the conductor 12. The spindles 44 are retained in the bearings of uprights 45 by means of the collars 49, secured to the ends of the spindles by means of the set screws 50. By this construction, the spider 47 and rollers 48 are rotatable in unison with the respective heads 16 and 19.

The operation of forming an insulating covering embodying the features of this invention, for the conductor 12, requires providing a desired number of cheeses 41 of strand 38, preferably comprising loosely intermingled fibres of asbestos or like material, having a reinforcing thread 40 disposed therethrough in a generally longitudinal direction with respect to the strand, and removably mounting these cheeses or other form of strand supplying means upon a rotatable head or heads, such as 16 or 19. A supply of conductor material, such as a reel 13 of wire 12 of the required length is provided, and fed through the straightening device 15, through the hollow spindle 44, and subsequently through the other devices to the reel 22. The construction of the heads 16 and 19, whereby the cheeses 41 are readily removable from the spindles 42, allows the same to be replaced when the strand or sliver thereon is exhausted, so as not to interrupt the continuity of the covering being formed.

When the head 16 is rotated, the cheeses 41

are rotated about the conductor 12, which due to the movement of the reel 22 is being drawn longitudinally through the machine, and hence the strand or strands 38 are wound about the conductor 12 in the form of a spiral or helical winding. From the head 16, the loose strand wound conductor 51 passes through the impregnator 17, where a suitable impregnating compound is applied by the roller 52 to the same which thoroughly penetrates the strand or sliver and acts as a binder for the intermingled fibres thereof. Subsequently, the loosely covered conductor 51 passes through the smoothing device 18 (see Fig. 13), in which it is subjected to the action of centrifugal pressure devices 57 which rotate at relatively high speed about the loosely covered wire and by means of the fingers 58 and 59 which wipe or rub the same condense and smooth the same into an evenly contoured covering 53 (see Fig. 10). The covering 53 is therefore of uniform thickness and of relatively densely matted fibres of insulating material and, due to the operations just described, is in the form of substantially a one-piece casing.

It has been found that the insulating coverings of conductors wherein the coverings are formed by winding strands or the like of material upon the conductor, generally tend to open or separate between the individual coils of the windings when the covered conductor is sharply bent. This action has been partially overcome in the past, by applying an adhesive to the surface of the conductor before winding on the insulating material so as to retain it thereon, but by the improved methods of this invention the use of an adhesive for this purpose has been dispensed with. The use of untwisted sliver greatly assists in the intermingling of the fibres, especially of those disposed at the adjacent portions of adjacent coils or turns, whereby when the mass is compressed the fibres of the covering are intermingled indiscriminately in all directions, and the covering is of substantially equal density throughout. By not using an adhesive to retain the fibres adjacent the conductor thereto, the covering may be readily removed from any portion of the conductor when it is desired to connect the same with an electrical fixture or the like. This structure also assists in preventing distortion or rupture of the insulation at any point when the covered conductor is sharply bent, by permitting a limited amount of play between the covering and the conductor in an axial direction. The covering is retained on the conductor solely by the frictional engagement therebetween.

By properly arranging the mechanisms above described so that a relatively long helix is formed when the strand or sliver is wound upon the conductor, such as is clearly shown in Figs. 4, 5 and 6, there is a tendency toward a closer union between the strands, whereby this tendency of the strands to separate is prevented. The angle of the helically wound roving with respect to the longitudinal axis of the conductor, may vary between certain limits and still permit the covering to withstand the strains of bending, etc., without rupture. Preferably this angle is not more than 50 degrees nor less than 15 degrees and the amount of angularity depends largely upon the diameter of the conductor and the thickness of the covering desired or required. On very large or very small wire, for example, the angle might be as great as 70 degrees or as small as 10 degrees.

After the above operations have been performed, it may be desired to provide another like covering about the covered conductor 54. The head 19 is provided with similar cheeses 41 of strand 38, and preferably is rotated in a reverse direction than that of the head 16, so that the strand or strands will be wound upon the product 54 in a reversely directed, relatively long helix within substantially the same limits as those of the first covering, as shown in Fig. 5. This loosely wound outer covering of insulating material, preferably of asbestos, is then subjected to the action of the roller 55 of the impregnator 20, which applies impregnating compound, and then to the smoothing device 21, wherein a compact densely matted outer covering 56 (see Fig. 12) is formed. The conductor is, therefore, particularly well insulated by a covering consisting of two layers of the above described insulating material, each layer being substantially in the form of a continuous one-piece structure. Due to the immediate continuation of operations, the layers are generally bound together due to the binding effect of the impregnating compound.

When desired, the layers of the covering may be wound upon the conductor in the same direction. Such an operation is illustrated in Fig. 6. When wound in the same direction there is a tendency for the layers to more firmly adhere together to form a unitary structure. This is especially true under the following conditions. In some instances the impregnator 17 and smoothing device 18 may be omitted and the second layer of loose fibrous sliver be wound directly upon the first layer, while the first layer is still in its loose untwisted condition. Under such conditions, the fibres of the two layers will have a tendency to thoroughly intermingle and subsequently be more readily compressed into a relatively thick and dense one-piece covering, being more in the nature of a single layer than when a covering is formed according to the preferred methods described above. This is especially true when the winding of the two sets of strand or slivers is applied by rotation of the heads in the same direction.

While I have illustrated and described a

preferred form of insulating covering for a conductor, embodying the features of my invention and the preferred method of forming or making the same, I do not limit myself to the precise details shown, the sequence of operations, nor the exact operations disclosed, as many modifications and variations thereof are possible, which will lie within the spirit of the invention and the scope of the appended claims.

What I claim is:

1. The method of forming an insulating covering, which consists in wrapping a plurality of strands of untwisted fibrous slivers directly upon the uncovered surface of a core member, applying a binding compound to the sliver and smoothing the applied sliver by means of pressure to intermingle the fibres of said fibrous slivers, and thereby form a densely matted structure thereof.

2. The method of forming an insulating covering, which consists in helically winding a plurality of strands of untwisted sliver about and directly in contact with the surface of a core member, with the strands of sliver arranged in juxta-position about the core member, the helix angle of the winding being not more than 70° applying a binding compound to the sliver and then applying pressure to the sliver to compress the strands of sliver into a uniform and densely matted condition.

3. The method of forming an insulating covering, which consists in helically winding a plurality of strands of untwisted sliver composed of thread reinforced fibres of insulating material about and directly in contact with the surface of a core member with the strands of sliver arranged in juxta-position about the core member, and disposed at an angle not less than 10° to the axis of said core member applying a binding compound to the sliver and smoothing the same by a rotatable pressure applying device to condense and intermingle the fibres into a densely matted structure.

4. The method of applying a covering to a conductor, which consists in helically winding a plurality of untwisted strands of thread reinforced loosely intermingled fibres into juxta-position about and directly in contact with the conductor, applying a binding compound and then uniformly condensing the strands into a dense substantially one-piece structure.

5. The method of applying a covering to a conductor, which consists in helically winding a plurality of strands of thread reinforced loosely intermingled fibres of asbestos into juxtaposition about and directly in contact with the conductor, applying a binding compound and applying pressure to the same by a wiping motion to intermingle and press the fibres thereof into a densely matted structure.

6. The method of making a substantially one-piece insulating covering for a conductor, which comprises applying a plurality of strands of loosely intermingled fibres directly upon the surface of a core member in a generally helical winding, with the strands disposed in juxta-position about the same, applying a binding compound and simultaneously condensing the strands and intermingling the fibres of one strand with the fibres of an adjacent one.

7. The method of insulating a conductor, which comprises helically winding a plurality of strands of fibrous insulating material in which the fibres are loosely entangled upon the surface of an uncovered conductor in long helical windings, causing the free fibres of adjacent strands between the turns thereof to entangle and by a rotary pressure applying device, acting at an angle to the helix angle of the windings, entangling the free fibres at the surface of the covering while compressing the covering into a dense compact mass.

8. The method of making an insulated electrical conductor which comprises moving a suitable core member in a longitudinal direction, bringing into contact with the core member a plurality of strands of loose untwisted fibrous slivers which are laid side by side and extend generally longitudinally of the core member, each of said slivers having extending longitudinally therethrough a reinforcing thread disposed substantially centrally of a surrounding loose mass of interentangled fibres, whereby the core member is surrounded by a loose fibrous mass made up of such slivers and held in place by such threads, applying a liquid binding agent to the fibrous conductor covering, and then smoothing the covering while subjecting it to pressure so as to condense the same and create a dense homogeneous insulating sleeve surrounding the core member.

9. An insulated conductor comprising a core member comprising a conductor, said core member being bare of adhesive, and a layer of fibrous material comprising a plurality of strands of interentangled fibres laid directly upon said core member so as to be in contact with each other and extending generally longitudinally of said core member, each strand comprising indiscriminately arranged interentangled fibres surrounding and carried by a central reinforcing filamentary member extending longitudinally therethrough, the fibres of adjacent strands being interentangled throughout the depth of the layer and the fibres of the mass being treated with an impregnant and closely pressed together, said reinforcing filamentary members extending generally lengthwise of the core member in substantially parallel relation and spaced from each other circumferentially of the core member, there being in all at least

three of said reinforcing filamentary members.

10. An insulated conductor comprising a metallic core member bare of adhesive and a layer of fibrous material comprising a plurality of strands of interentangled fibres laid directly upon said metallic core member so as to be in contact therewith and with each other and disposed in long helices about the core member, each strand comprising indiscriminately arranged interentangled fibres surrounding and carried by a central reinforcing filamentary member extending longitudinally therethrough, the fibres of adjacent strands being interentangled throughout the depth of the layer and the fibres of the mass being treated with an impregnant and closely pressed together, said reinforcing filamentary members extending in substantially parallel relation to each other and being spaced from each other circumferentially of the core member, there being in all at least three of said reinforcing filamentary members.

In witness whereof, I have hereunto set my hand this 12th day of August, 1926.

BEAUFORD H. REEVES.