

July 4, 1939.

W. E. COOK

2,164,904

INSULATED WIRE AND METHOD OF MAKING SAME

Filed Nov. 22, 1935

Fig. 1.

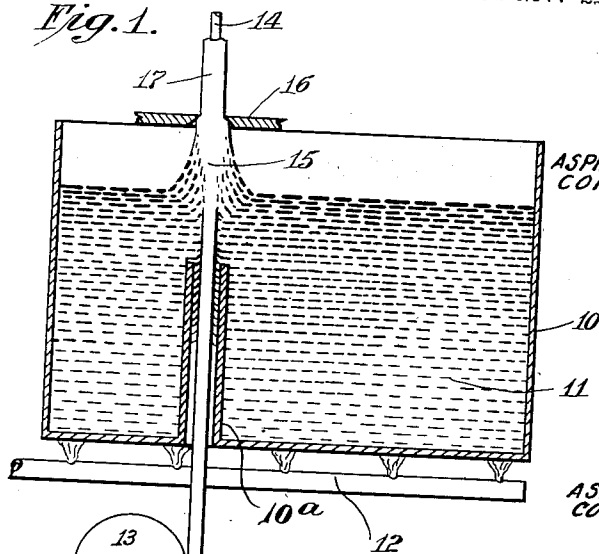


Fig. 2.

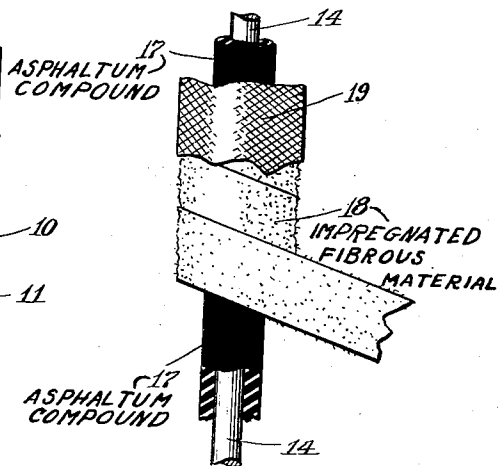


Fig. 3.

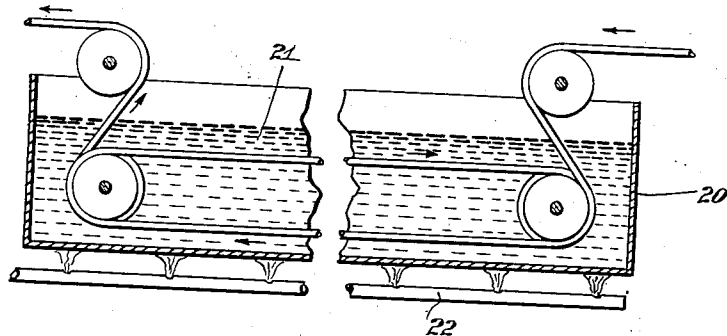


Fig. 4.

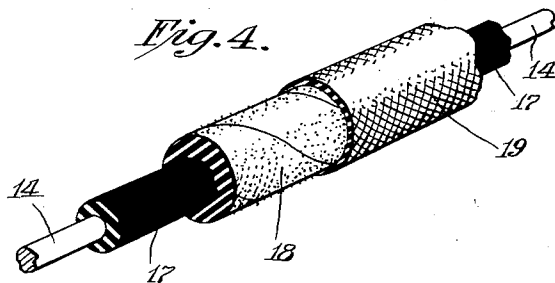
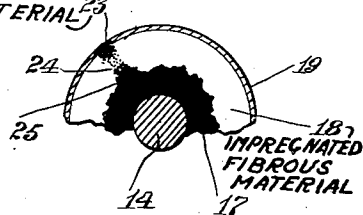


Fig. 5.



William E. Cook

INVENTOR

James P. Whitworth
ATTORNEY.

UNITED STATES PATENT OFFICE

2,164,904

INSULATED WIRE AND METHOD OF
MAKING SAME

William E. Cook, West New Brighton, N. Y.

Application November 22, 1935, Serial No. 51,009

12 Claims. (Cl. 174-121)

The invention relates to insulated wire and to the method of making same, and more particularly to a conductor wire of the type having an insulating surfacing including a covering of cotton sliver or other similar fibrous material, saturated or filled with asphaltum or other insulating composition, and to the method of producing such a wire.

Prior to my invention, insulated conductor wire of the type to which the invention relates, has been extensively used with highly satisfactory results. Such wires have a heavy insulating covering including a body of sliver, this body usually being inclosed by an outside braid. The sliver and the braid are saturated with asphaltum, or an insulating compound containing asphaltum prior to the application to the wire of a finishing wax coating and the polishing and final sizing of the wire.

The usual method of applying the sliver to the wire is by spirally winding it upon the bare wire, the wire sometimes being coated with a thin stratum of soft adhesive prior to the application of the sliver thereto for the purpose of securing a bond between the sliver and the wire adequate to avoid displacement of the sliver along the wire during the earlier stages of its manufacture.

While the type of insulated wire above referred to is entirely satisfactory under many conditions of use, the insulation may blow or juncture when currents at voltages in excess of 1500 to 2000 are impressed upon the wire.

By experimentation in an effort to determine the causes of the blowing or puncturing of the insulation, I have found certain conditions which in my opinion are responsible, which conditions result from an imperfect saturation of the sliver with the heated asphaltum or asphaltum compound while in the saturating tank.

While the asphaltum compound at temperatures of between 250 and 275 degrees F. is highly fluid or of low viscosity, it nevertheless contains a high percentage of heavy constituents in suspension in an oil vehicle. During the saturating period, there is a sort of filtration action tending toward a progressively lessened density of the asphaltum filler from the outer surface of the sliver covering inwardly. The inner portion of this sliver covering readily absorbs the oily vehicle of the compound, but the percentage of the heavier constituents of the compound which penetrates to this portion of the covering is relatively less than towards the outer surface of the covering. Irrespective of the length of time during which a covered wire is subjected to a saturating bath, there

appears to be a variance in the quantity of the heavier constituents of the asphaltum in different portions of the insulating covering. This I attribute to the fact that with an increase in the viscosity of the compound, due to its contact with the sliver covering while the latter is at a relatively much lower temperature than the bath, the cells and interstices in the covering adjacent the outer surface thereof become filled or choked with such heavy constituents, so that only the lighter constituents, such as oils, penetrate to the inside of the sliver coating.

It may, however, be due entirely to the filling or choking of the interstices in the covering sliver by the heavy constituents of the asphaltum without regard to any change in the viscosity of the bath and the separation of the oil from the heavier constituents of the compound by capillary attraction.

If a wire be cut and examined, the insulation will be found to be black toward the outer surface thereof, but a deep brown toward the inner portion of the insulating body as compared with black towards the outer surface of said insulation.

The above indicates clearly that the inner portion of the insulation is not properly filled with the heavy constituents of the asphaltum compound resulting in a lower insulating value close to the wire. I attribute the blowing out or puncturing of the wire at voltages above referred to, to a lack of uniformity in the distribution of the heavy constituents of asphaltum throughout the entire mass of the absorbent coating of sliver and particularly to the failure of such heavy constituents to penetrate the mass of sliver in sufficient volume to adjacent the conductor wire.

The partial saturation of the inner part of the body of the insulation by the lighter constituents of the asphaltum results in an absence of density of the insulation where it is most effective when wires are used for the conduction of high tension currents.

With an ordinary triple braid, asphaltum saturated insulation, the heat from the sun softens the asphaltum sufficiently to cause it to gradually settle in the braid toward the bottom of a strung wire, thus causing the drying out of the upper part of the covering for the wire.

In insulation in which cotton sliver or similar freely absorbent material is used, this tendency of the asphaltum to concentrate toward the bottom of the insulation is very much less than with triple braid wires, but is present to a limited extent. Irrespective of the character of the body of the insulation, during summer heat, there is a tend-

ency of the asphaltum to move away from the wire throughout a considerable portion of the insulating body, so that the insulating properties of the covering for the wire become less effective after several years of use.

It has long been attempted to fill the absorbent covering of the wires with an asphaltum compound more effectively than can be secured by subjecting the covered wire to a bath of asphaltum at a temperature sufficiently high to make it highly fluid, and to supersede capillary attraction by mechanical means for forcing the molten asphaltum through the sliver body of the insulation. Such methods, however, have not proven satisfactory and have been abandoned.

With the above conditions in mind, I have produced an insulated wire wherein the wire is enveloped by a closely adherent mass of asphaltum surrounded by an asphaltum impregnated fibrous body embedded in the outer surface of the inner asphaltum stratum. In this manner, I secure an insulating body containing asphaltum, the heavier constituents of the asphaltum having the greatest density closely adjacent the wire, and toward the outer surface of the insulating coating. In this manner, it is possible to produce wires capable of carrying high voltage currents without danger of blowing or puncturing the insulation. With this construction of wire, the softening of the asphaltum from the heat of the sun or other conditions, has little or no tendency to cause a material creeping of the inner asphaltum stratum or absorption of any material part thereof by the sliver body, and such heat will not, under any circumstances, be sufficiently high to reduce the viscosity of the asphaltum stratum about the wire to an extent to permit any material absorption of the heavy constituents of the asphaltum by the sliver body. Any such softening of the asphaltum can, at the most, result in increased density of the asphaltum with which the inner part of the sliver body is impregnated, without any dispersion of the major part of the asphaltum stratum. This holds true whether heating of the asphaltum occurs during the production of the wire or after it is strung.

The method of producing the wire is such that the outer portion of the inner stratum of asphaltum can be combined with the inner part of the sliver covering, either by slight absorption or by impressing the sliver within the stratum, which is of high viscosity and of high melting point, during the application of the sliver to the wire coated with the inner stratum of the asphaltum.

The product resulting from the method of the invention is characterized by a layer of closely adherent asphaltum composition entirely surrounding the wire irrespective of a possible limited penetration of the surrounding sliver by this stratum, so that the portion of the insulation engaging the wire is continuous, as distinguished from that irregularity which is present when fibrous material engages the wire, even though this fibrous material is partially saturated with an asphaltum compound or an oily constituent of said compound. I attribute the high efficiency of a wire embodying the invention to the presence of this continuous stratum of asphaltum and to the incorporation in the surrounding sliver body adjacent this inner stratum, of an asphaltum compound of substantially maximum viscosity.

The method followed is such as to permit the

application to a bare wire of the superimposed strata of an asphaltum compound of the maximum density, and a sliver body inclosing such asphaltum stratum by a continuous operation and the confining of the sliver body by a braid, or other confining means, prior to the subjection of the covered wire to a bath of asphaltum compound for the purpose of impregnating the sliver body in a manner to increase its non-conductivity, destroy its absorptiveness and increase the life of the wire, particularly when used in outdoor work.

The invention consists primarily in an insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of fibrous material having its inner part combined with said asphaltum compound stratum, said fibrous body being impregnated with an asphaltum compound, whereby the greatest density of the asphaltum compound will be in said stratum about the wire; and in such other novel characteristics and the novel steps and practices used in making the wire, all as hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawing,

Fig. 1 illustrates the first step in the method of producing a wire embodying the invention;

Fig. 2, the condition of the wire following the application of the sliver strip and the covering braid thereto;

Fig. 3, the step of impregnating the fibrous covering, or the final stage preparatory to the application of the finishing wax and the final sizing of the wire;

Fig. 4 shows a finished wire, broken away upon parallel planes; and

Fig. 5 is a view illustrating the varying density of the asphaltum compound in the finished wire.

Like numerals refer to like parts throughout the several views.

In Fig. 1 of the drawing, I have shown a tank containing a bath of an asphaltum compound, which bath is heated in any desired manner as shown conventionally by the burner. Below the tank is a guide roller about which the conductor wire passes before passing through a tube opening into the tank.

The wire, before being passed through the tube, is at normal factory temperatures and the bath is maintained at a temperature which will ensure high viscosity of the asphaltum compound. The melting point of the compound of the bath is high as compared with the melting point of compounds ordinarily used in producing cotton sliver covered wires. Satisfactory results can be secured with a compound having a melting point within a range of from 260° to 300° F.

In passing through the bath, the wire picks up the highly viscous asphaltum compound which is carried along in a mass by the wire, before passing through a stripper plate for reducing and substantially equalizing the thickness of the inner stratum to that desired.

It may be desirable, under some conditions, to coat the wire with an adhesive film, indicated by the stippled portion of the wire in Fig. 1, in order to ensure the desired close adherence of the asphaltum to the wire, but with a highly viscous compound and the passing of a cold wire through the bath there is a strong tendency of the asphaltum to readily bond to the wire, par-

ticularly as the asphaltum will tend to set rapidly after leaving the stripper plate 16. It is desirable to provide for a length of run of the wire to ensure a proper setting of the compound before

5 applying the absorbent covering.

After leaving the stripper plate 16, the wire, with the inner stratum of asphaltum compound having a high melting point and high viscosity, is passed through an ordinary sliver covering

10 machine by which the sliver 18 is spirally wound about the inner stratum 17. The compound may still be soft or tacky during this stage in the production of the wire, but this is not particularly desirable nor necessary.

15 While I have shown the invention in connection with a spirally sliver 18, it is obvious that other well known means of applying sliver strips to the wire may be employed and that confining strands may be applied to the sliver so as to hold

20 it compacted while the wire is in the saturating tank before the outer braid 19 is applied to the wire.

The particular manner of applying the body of fibrous absorbent material to the wire is im-

25 material to the invention, as is the use of a confining binding prior to the application of the outer braid thereto. In some wires the outer braid is dispensed with and binding strands are used in lieu thereof. An outer braid, however,

30 results in a better appearance in the wire and is highly efficient in confining the compacted sliver and in controlling the outside diameter of the wire.

After the confining strands have been applied

35 to the outside of the sliver, the wire is passed through an impregnating or saturating bath in a tank 20, said bath being indicated at 21. This bath is of an asphaltum composition of much

lower viscosity than the bath 11 and may have a

40 melting point within a range of from 180° to 200° F. I have found compositions having higher melting points to be less desirable than those having a melting point within the range stated.

Cotton sliver is a poor conductor of heat but is

45 highly absorbent, and, with an asphaltum compound, the melting point of which is within the temperature range stated, the bath 21 may be brought to a higher temperature so as to make

the compound so highly fluid that it is readily

50 absorbed by the cotton sliver. The heavier constituents may be filtered from the vehicle of the asphaltum compound to an extent to thoroughly fill or impregnate the sliver body toward the

outer surface in a manner to cause the filling

55 or impregnation of the inner part of the sliver body by capillary attraction alone. While the compound will penetrate throughout the sliver body, if sufficient time be allowed in the bath, nevertheless the density of the filler becomes

60 progressively less toward the inside of the sliver body, and this portion of the body will therefore have more pronounced characteristics of a

matted fibre than toward the outside of the body.

With this condition alone, there is a lack of

65 continuity in the contacting area of the wire and of the covering sliver. By interposing a stratum of asphaltum compound between the sliver and the wire, continuity of contact is not only as-

sured, but the major portion of the stratum has

70 substantially uniform thickness and density and the effective insulating property of the covering sliver is enhanced by the filling of the interstices adjacent the inner surface of the sliver by the asphaltum of the intermediate stratum.

75 It will be noted that the saturation or im-

pregnation temperature of the bath 21 may be higher than the melting point of the asphaltum composition of the inner stratum, so that during the impregnation of the sliver, this inner stratum may become somewhat softened so as to permit

5 the fibres of the sliver to penetrate same and thus afford a maximum density adjacent both surfaces of the sliver. After the covered wire leaves the impregnation bath 21 the usual water coating, polishing and final sizing is given to the wire in

10 the usual manner. The asphaltum compound sets rapidly after leaving the bath, and while it never becomes hard, it nevertheless becomes sufficiently hard to permit of the finishing operation above referred to.

15 Any desired means of heating the bath 21 may be used, a conventional gas heater being shown at 22.

The finished wire consists of a conductor wire

20 14 having an insulating cover, which cover includes a stratum 17 composed solely of an asphaltum compound. This stratum 17 is in continuous contact with, and closely adherent to, the

conductor wire. Inclosing the inner stratum is a

25 body 18 of fibrous material, such as cotton sliver, the inner portion of the body of sliver being combined with the asphaltum compound stratum

17 and the entire body being impregnated in the manner described with an asphaltum compound.

The greatest density of the asphaltum com-

30 pound is about the wire and in contact therewith.

The density of the asphaltum compound with

which the sliver is saturated or impregnated may

35 vary at different portions of the body of sliver covering. That portion toward the outer surface contains asphaltum of the greatest density, or

has a higher percentage of the heavier constituents of the compound, as indicated at 23 in

Fig. 5, the density of the asphaltum being lower

40 in that portion indicated at 24 beyond the central portion of the body. That portion indicated at

25, which is imbedded in, or is combined with, the inner stratum 17, has a density comparable

to that toward the outer surface of the sliver

45 covering, and greater than the intervening portions of the body.

With a wire made in accordance with the in-

vention, the inner stratum 17 precludes all possi-

50 bility of the presence of voids, however small, closely adjacent the conductor wire, thus securing in the wire all of the weatherproofing and

insulating properties commonly found in the asphaltum impregnated sliver coated wires, with

an added protecting stratum between such sliver

55 coating and the wire itself. It also guards against the presence of moisture in the sliver reaching the wire.

The thickness of the inner stratum of asphaltum composition may be varied according to the

60 potential of the current passing along the conductor wire, but for currents of high voltages, a thickness range of from $\frac{1}{16}$ to $\frac{1}{8}$ of an inch of asphaltum in the inner stratum is adequate, this

stratum being about one-half the thickness of

65 the impregnated sliver covering. The thickness of the sliver body may have the same range. Greater thickness of each stratum may be used, if desired.

The asphaltum composition of the inner stratum 17 has a melting point relatively higher than

the asphaltum composition with which the sliver is impregnated, so as to avoid the melting of

70 this stratum during the step of impregnating the sliver.

75

In a wire as herein described, the tendency of the asphaltum in the sliver covering to creep when subjected to heat from the sun or other sources is no greater than with the ordinary asphaltum composition impregnated sliver coated wire, and any softening of the inner stratum 17 will have no effect in destroying the continuity of the material of this stratum in relation to its contact with the conductor wire. Under no circumstances will the stratum 17 become sufficiently fluid to permit absorption of any substantial portion thereof by the inner part of the sliver, notwithstanding that this portion of the sliver is not as fully impregnated as the outer portion thereof, except insofar as it has been filled by the outer portion of the stratum 17 in the manner above described.

Since the stratum 17 is closely confined by the sliver covering, and the asphaltum composition of this stratum and the asphaltum composition with which the sliver is impregnated remain plastic, bending of the wire will not fracture any part of the covering and the asphaltum will readily adjust itself to conditions resulting from bending or sagging of the wire.

A wire embodying the invention may be readily cut, stripped and spliced, although the density and plasticity of the inner stratum may require a more thorough scraping of the wire when making the splice.

Tests of a wire embodying the invention have shown that the use of an asphaltum stratum 17 alone, will prevent the blowing or puncturing of the insulation at voltages well above those which cause the blowing or puncturing of a wire having an insulation impregnated sliver alone, and that by combining in the wire, the stratum 17 and the sliver impregnated stratum 18, the effectiveness of the insulation, so far as avoiding blow holes or punctures is concerned, is from three to four times as great as with the use of an asphaltum stratum alone, and from eight to ten times as great as with the use of impregnated sliver covering alone. The above results were attained with a stratum 17 of the same thickness in each instance and with an impregnated sliver covering of the same thickness in each instance.

The use of a covering stratum of asphaltum alone is commercially impracticable.

The character of the asphaltum or the asphaltum compound used for the inner stratum 17 and for impregnating the stratum 18 of sliver or other absorbent material may be varied, it being essential, however, that that used in the stratum 17 have relatively higher viscosity and a relatively higher melting point than that used for impregnating the stratum of impregnated absorbent material. The thickness of each stratum is largely a matter of choice, there being no fixed standard as to thickness.

It is not my intention to limit the invention to the precise details of construction shown in the accompanying drawing, nor to the agencies used in carrying on the method of producing such wire, as such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:

1. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of fibrous material having its inner

part combined with said asphaltum compound stratum, said fibrous body being impregnated with an asphaltum compound, whereby the greatest density of the asphaltum compound will be in said stratum about the wire.

2. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of fibrous material having its inner part combined with said asphaltum compound stratum, said fibrous body being impregnated with an asphaltum compound of relatively lower viscosity and having a relatively lower melting point than the asphaltum compound in said inner stratum, whereby the greatest density of the asphaltum compound will be in said stratum about the wire.

3. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of cotton sliver having its inner part combined with said asphaltum compound stratum, said sliver body being impregnated with an asphaltum compound, whereby the greatest density of the asphaltum compound will be in said stratum about the wire.

4. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of cotton sliver having its inner part combined with said asphaltum compound stratum, said sliver body being impregnated with an asphaltum compound of relatively lower viscosity and having a relatively lower melting point than the asphaltum compound in said inner stratum, whereby the greatest density of the asphaltum compound will be in said stratum about the wire.

5. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, and an inclosing body of spirally wound cotton sliver having its inner part combined with said asphaltum compound stratum, said sliver body being impregnated with an asphaltum compound, whereby the greatest density of the asphaltum compound will be in said stratum about the wire.

6. An insulated wire consisting of a conductor wire and an insulating cover therefor, embodying therein an inner stratum of an asphaltum compound in continuous contact with, and closely adherent to, said conductor wire, an inclosing body of spirally wound cotton sliver having its inner part combined with said asphaltum compound stratum, said sliver body being impregnated with an asphaltum compound, whereby the greatest density of the asphaltum compound will be in said stratum about the wire, an outer braid confining said sliver body and impregnated with the same asphaltum compound stratum as said sliver body, and a finishing surfacing upon the braid.

7. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, whereby said asphaltum will be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it

is warm with a confining body of absorbent, fibrous material, and saturating said body of absorbent, fibrous material with an asphaltum compound of lower viscosity and having a lower melting point, than the asphaltum compound applied to the wire.

8. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, whereby said asphaltum will be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it is warm with a confining body of absorbent, fibrous material, and applying covering braid to said body of absorbent, fibrous material, saturating said body of absorbent, fibrous material and said braid with an asphaltum compound of lower viscosity and having a lower melting point, than the asphaltum compound applied to the wire.

9. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, whereby said asphaltum will be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it is warm with a confining body of spirally wound cotton sliver, and saturating said body of sliver with an asphaltum compound of lower viscosity and having a lower melting point, than the asphaltum compound applied to the wire.

10. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, whereby said asphaltum will

be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it is warm with a confining body of spirally wound cotton sliver, and applying covering braid to said body of sliver, saturating said body of sliver and said braid with an asphaltum compound of lower viscosity and having a lower melting point, than the asphaltum compound applied to the wire.

11. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, having a melting point of about 300° F., whereby said asphaltum will be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it is warm with a confining body of absorbent, fibrous material, and saturating said body of absorbent, fibrous material with an asphaltum compound of lower viscosity and having a melting point within a range of from 180° to 200° F.

12. The herein described method of making insulated wire consisting in passing a conductor wire through a hot bath of a highly viscous asphaltum compound, having a melting point of about 300° F., whereby said asphaltum will be accumulated upon said wire in a stratum in continuous contact with, and in close adherence to the wire, covering said stratum while it is warm with a confining body of spirally wound cotton sliver, and saturating said body of sliver with an asphaltum compound of lower viscosity and having a melting point within a range of from 180° to 200° F.

WILLIAM E. COOK.