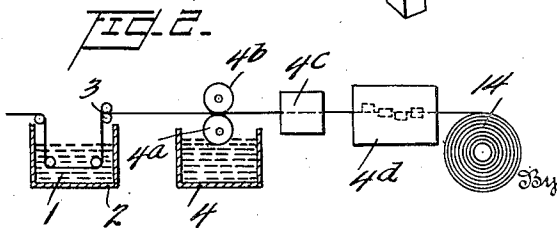
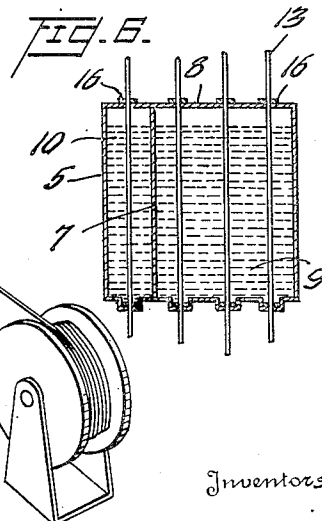
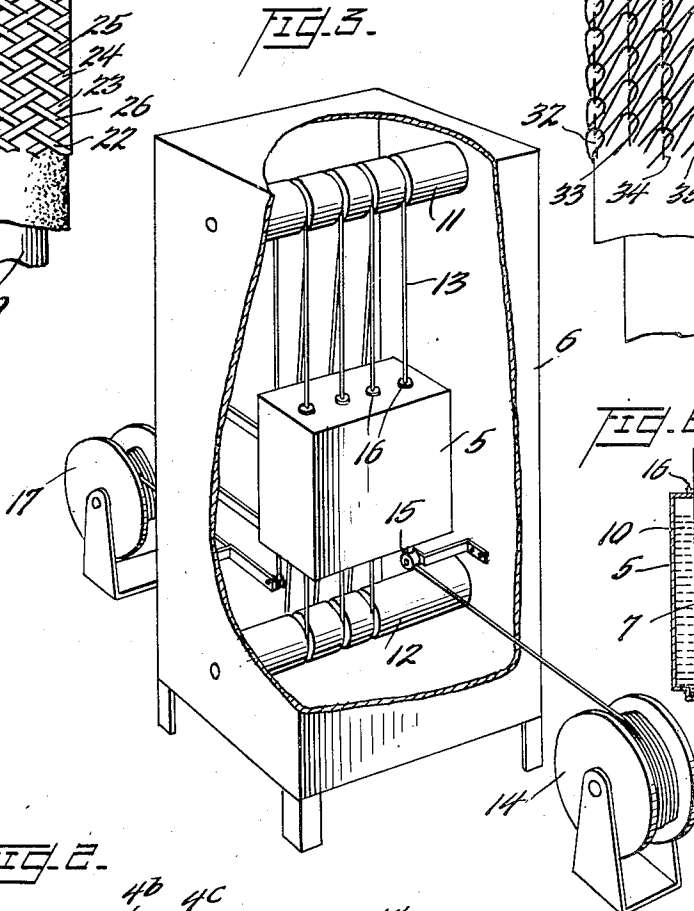
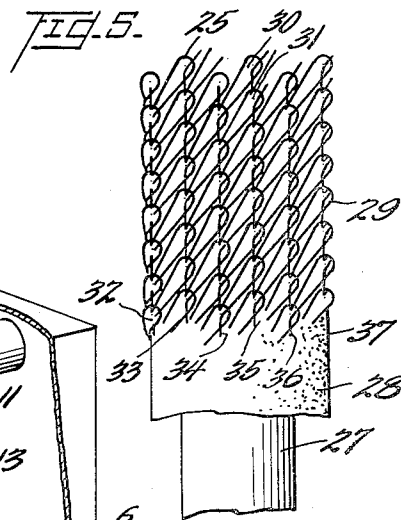
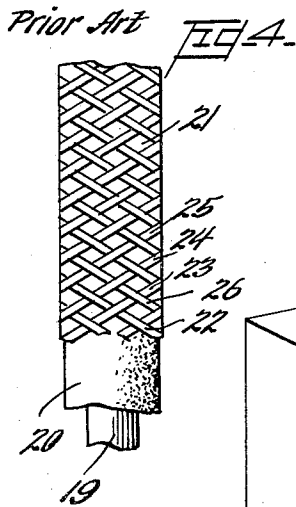
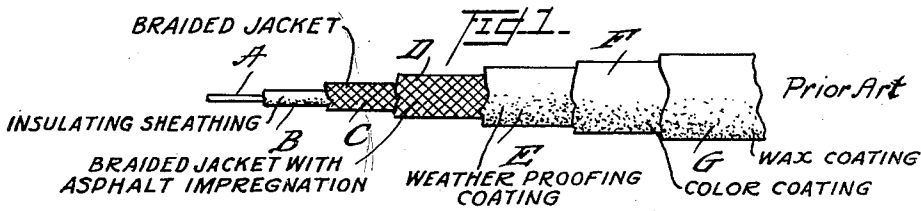


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METHOD OF MANUFACTURING ELECTRICAL CONDUCTORS
HAVING KNITTED PROTECTIVE JACKETS
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METHOD OF MANUFACTURING ELECTRICAL CONDUCTORS HAVING A KNITTED PROTECTIVE JACKET

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The present invention relates primarily to improvements in insulated conductors provided with an insulating covering, the conductor core also carrying a loosely knitted tubular fibrous jacket or sheath, this being in contradistinction to prior art conductor cores which are provided with jackets which are tightly and securely braided around the conductor core.

The substitution of a knitted fibrous jacket, and particularly of the character herein disclosed, for a tightly braided jacket has made it necessary to provide a special saturant for the tubular knitted jacket, said saturant functioning to adequately bond the tubular knitted fabric sheath to the insulating medium of the conductor core and further to bond threads of the fibrous sheath one to the other so that upon the bending or flexing of the electrical conductor, the insulating covering is not exposed to the air or to a deteriorating atmospheric influence. The saturant composition is applied in a liquid state to the tubular knitted fibrous sheath and cools to a soft pliable adhesive condition. After the conductor core has been so treated, it may be further processed to apply a flame proofing coating of stearine pitch and then a color coating, all as well known in the prior art.

It is the primary object of the present invention to provide a method of manufacturing an electrical conductor having a conductor wire, and insulating jacket thereon, and thereafter a tubular knitted protective jacket, said method comprising heating a saturant to substantially remove therefrom all volatile matter, impregnating the knitted jacket with the so-treated saturant and adhesively uniting the knitted jacket to the insulated jacket while adhesively uniting the threads of the knitted jacket together so that upon subjecting the so-treated conductor to substantial stresses, the insulating jacket is not exposed to deteriorating atmospheric conditions, said saturant being preferably a plastic resin saturant and, in some cases, having in admixture therewith a thermoplastic cellulose ether compatible with the resin.

It is a further object of the present invention to maintain the saturant or adhesive during the impregnating step at a temperature varying between about 180° F. and about 350° F. The invention will be illustrated in connection with the accompanying drawing, in which:

Figure 1 is a plan view showing a conductor provided with a prior art braided jacket, the latter being impregnated with an asphalt water proofing composition.

Figure 2 is a diagrammatic representation of the saturating, finishing and polishing apparatus.

Figure 3 is a perspective elevation of a device in which electric conductors made in accordance

with the present invention may be coated with a color coating composition and thereafter dried.

Figure 4 is a plan view illustrating in detail the structure of a tubular braided jacket.

Figure 5 is an enlarged view of a conductor provided with a knitted jacket formed of a group of interconnected wales extending spirally around the insulating sheath.

Figure 6 is a detail showing the applicator pot. Referring to Fig. 1, the copper wire, identified by the latter A, carries an insulating sheathing B which is preferably rubber, but which may be any material that will insulate the copper wire. This conductor core is provided with a braided jacket C which is impregnated with the usual water proofing saturant or compound D, an asphalt composition being normally used for this purpose. After the tubular braided jacket has been treated with the saturant, there is then usually applied a coating E of a flame retarding and weather proofing material, said coating preferably being stearine pitch or a mixture of stearine pitch and other elements, as well known in the prior art. It is quite customary to cover the stearine pitch coating E with a color coating F. Thereafter, if desired, there is applied over the color coating F, a wax-like coating G.

An electrical conductor produced as above set forth and using a tubular braided fabric jacket has proved satisfactory when united to the insulating coating of the conductor core by means of an asphalt water proofing saturant. Recently, however, instead of manufacturing the electrical conductor with a braided jacket, it has been manufactured with a knitted loosely woven tubular threaded fabric jacket. The use of a knitted jacket, and particularly of the character herein set forth, has certain advantages; namely, rapid production and lower cost. One knitting machine can do the work of from six to ten braiding machines, and therefore from the standpoint of production capacity, the production of electrical conductors with knitted jackets is highly advantageous. Further, the use of the knitted jacket, and particularly of the character herein set forth, enables cotton of lower tensile strength to be used than has hitherto been used in the production of braided tubular protective fibrous jackets. However, the use of the knitted jacket has presented quite a problem in that on flexing, bending and twisting of the conductor carrying said knitted jacket, said jacket being impregnated with the prior art asphalt saturating composition, the threads of the knitted jacket did not adhere one to the other and did not adhere sufficiently to the insulating rubber sheath, which was just below the jacket, to prevent said rubber sheath from being exposed to the action of the atmosphere, thereby causing rapid deterioration of the rubber

insulating medium of the conductor core and impairment of the insulating properties of the conductor. The apparatus used in saturating the knitted jacket of the conductor core of the present invention and in applying the flame proofing 5 stearine pitch and the subsequent color coating composition is shown in Fig. 2. The electrical conductor is provided with a naturally occurring or synthetic vulcanized rubber insulating covering 28 and a tubular jacket 29, as shown in Fig. 5. 10 This electrical conductor is passed through the saturant 1 present in tank 2, the saturant medium in said tank being preferably maintained in the tank at a temperature of about 300° F., although this saturant liquid may vary in temperature between 180 to 350° F., depending upon the specific composition of the saturant. The excess saturant medium is removed from the knitted fabric jacket by means of squeezing rolls 3. There is then applied to the saturated knitted jacket a finishing coating which may be of any suitable character but which is preferably a flame proofing and a weather proofing coating, as typified by the prior art coatings of this character, and particularly stearine pitch. The latter is applied by means of a wheel 4a rotating in a bath of stearine pitch present in the vessel 4, said stearine pitch being preferably heated to 300° F. The amount of stearine pitch which is applied to the conductor is regulated by the size of the opening between the rolls 4a and 4b. While the thickness of the stearine pitch coating may vary considerably depending on circumstances, it is usually between 1 to 1½ thousandths of an inch thick. It may be somewhat greater or even somewhat less. Talc or an equivalent medium is then applied to the fairly hot stearine pitch coating from the container 4c, said talc serving to diminish the tendency of the conductor core to stick to itself when it is wound on the reel 14. The stearine coated conductor core to which the talc has been applied is then passed through a polishing device 4d for the purpose of smoothing and cylindrically shaping the conductor core to its final form prior to the application of the color coating. The polishing device is generally water cooled by means of ordinary city water so that the coatings of the conductor may be, chilled and solidified at this stage of manufacture. Normally, the saturant tank 2 contains about 1000 pounds of saturant, and since the saturating step and the entire process is preferably a continuous one, the saturant tank is continuously replenished with melted saturant from a preheating tank which is preferably maintained at or about the temperature of the saturant in the saturant tank. One of the functions of the preheating tank is to drive off from the saturant before the latter is applied to the knitted jacket, all of the volatile matter that can be driven off at a temperature in the neighborhood of 250 to 350 or 400° F.

It is to be noted that no volatile medium or solvent is present in the saturant composition. If a volatile solvent were present, such as naphtha, benzol, alcohol, or the like, it would be necessary to allow the volatile solvent to evaporate from the saturated knitted jacket before the saturant could assume its final soft and pliable state. This would prohibit rapid manufacture since considerable time would have to elapse between the application of the saturant composition to the knitted tubular jacket, and the application of the finishing coat and its subsequent polishing. While the speed of travel of the conductor core through the saturant bath and the finishing bath may

vary, the conductor core is preferably passed through these baths at a rate varying between 200 to 350 feet per minute. The speed of travel is not critical.

The color coating composition is applied to the conductor in the coating and drying apparatus shown in Fig. 3, said apparatus comprising an applicator pot 5 suitably located in a tower 6, said applicator pot being provided with a partition 7 whereby there is formed a compartment 8 adapted to contain the color coating composition 9 and a wax coating compartment adapted to contain a waxing material 10. Suitable upper and lower guide rolls 11 and 12 are provided, the wire 13 passing from the pay-off reel 14 under guide roll 18 and through the coating solution 9 present in the applicator pot 5. The wire 13 passes through the coating composition 9, through the wiping gasket 16, around the upper roll 11, then back and down around the lower roll 12; then through the coating composition 9 a second time; and, if necessary, through the coating composition a third time. Thereafter, the coated and dried wire passes through the waxing compartment 10 and then to the re-wind reel 17. The tower 10 is preferably, although not necessarily, an air conditioned chamber. That is, the chamber may be controlled from the standpoint of temperature and from the standpoint of humidity.

The differences in structure between a braided jacket and a knitted tubular jacket will be clearly understood from a consideration of Figs. 4 and 5. Referring to Fig. 4, the copper or aluminum wire 19 carries the rubber insulating covering 20, and the latter is provided with a tubular braided jacket 21. It is to be noted that the thread 22, a thread of the right to the left course, passing around the conductor core, passes under the thread 23 and over the thread 24 of the left to the right course, and under thread 25. Thread 26 of the right to the left course passes over thread 23, under thread 24, and over thread 25. The threads of one course may pass over one thread of the opposite course, under two threads, then over one thread, and then under two threads. There may be other variations of this over and under structure, but in any case, it is necessary for the threads to pass completely around the conductor core. Since a braided structure of this type sets comparatively tightly on the rubber covered wire, the conductor and the conductor core may be bent and flexed without the braided jacket being so displaced as to permit the exposure of the rubber when, as has been customary, the tubular braided jacket is impregnated with an asphalt saturating solution, then covered with a flame proofing stearine pitch, color coated, and waxed to produce the well known insulated conductor of the prior art.

Referring to Fig. 5, the wire 27 is provided with a rubber or prior art equivalent insulating covering 28, the latter being provided with a knitted jacket 29 which is formed of a group of interconnected wales 30 and 31 which extend spirally around the wire 27 and the insulated covering 28 of the conductor core. The courses 32, 33, 34, 35, 36 and 37 extend longitudinally of the conductor core. In such and similar knitted jackets, the knitting structure being capable of considerable variation so long as the tubular knitted structure is formed of wales extending spirally around the conductor core, the successive threads of the wales having interconnected loops. Each thread, instead of being wrapped around the conductor core, is laid along it with a loop around the next thread or a second adjoining thread.

However, since the threads are not wrapped around the conductor and are not bound under or tightly tied to each other, the entire knitted structure is a relatively loose one, and when the conductor is bent or flexed, the insulating cover of the conductor core, as for example, rubber, pushes through the jacket and is exposed. Stated differently, the fibrous jacket of the prior art was braided, woven or wrapped around the conductor, and each thread of the jacket encircled the conductor. The fibrous jacket of the present invention is a knitted jacket comprising interknitted courses of loops, the separate threads being laid along the conductor and not encircling the conductor. The pattern of this knit is subject to wide variation depending upon the number of thread supplies, the number of needles, the disposition of the needles in the knitting machine, and the like, and nothing in this disclosure is intended to limit the invention to any one pattern of knitting, for the invention serves equally well with any pattern of knitted fibrous jacket.

However, it is desired to point out that the present invention is particularly suitable for the treatment of knitted jackets as set forth in Stover Patents Nos. 2,240,058 and 2,276,523, and the tubular knitted coverings therein disclosed are by reference made a part of the present disclosure so that it may be clearly indicated that the saturant composition of the present invention may be applied to a variety of knitted jackets, including those formed from a plurality of spirally extending interconnected wales, the threads of said wales having interconnected loops.

The present invention is directed to the solution of the problem presented by the use of knitted jackets, and particularly those of the character herein set forth, in the production of electrical conductors and similar articles. It has been ascertained that the exposure of the rubber covering to atmospheric influences on the bending, flexing and twisting of the conductor core in a completed electrical conductor can be prevented if the tubular knitted jacket is caused to adhere to the rubber and the threads of the knitted jacket are caused to adhere to each other since, when this condition is satisfied, on the electrical conductor and the core being flexed, twisted or bent, the protective knitted jacket does not permit the rubber insulating sheath to become exposed and therefore impairment of the insulating properties of the rubber sheath and of the electric conductor is prevented.

It is desired to point out that with the introduction of the knitted tubular threaded jacket, the prior art procedure was followed; namely, the fibrous jacket was saturated with asphalt and finished with a finished coating of stearine pitch. Thereafter, the stearine pitch coating was provided with a color coating, as for example, a cellulose base compound or an alcoholic soluble gum compound, as is well known in the art. When this procedure was followed, and an asphalt saturating composition was used, it was discovered that the asphalt saturant did not cause the tubular knitted jacket to stick to the insulating sheath which it covered, and, further, that the asphalt did not possess sufficient adhesive properties to cause the threads of the knitted jacket to stick one to the other when the so impregnated electrical core was bent, flexed and twisted. After long experimentation, it was ascertained that the electrical conductor and its core could

be bent, flexed and twisted even when it carried the new knitted tubular protective jacket without exposing the underlying rubber sheath provided the tubular knitted jacket, and particularly that of the character herein disclosed, was treated with a saturating medium which would securely attach the loosely-held knitted tubular fabric to the underlying tubular sheath and which would also function to adhesively unite the threads of the tubular knitted jacket one to the other when the saturant solidified to an adhesive soft pliable state.

The knitted jacket, after being treated with the saturant of the present invention, then receives a finishing coat which may be the prior art stearine pitch. Thereafter, the conductor is provided with a color coat.

Broadly stated, the saturating composition may be any material which is a liquid above 130 to 140° F., is capable of penetrating in and through the tubular knitted jacket, and on cooling assumes a soft pliable adhesive state, and bonds the tubular knitted jacket to the insulating sheath underlying it, and, further, bonds the threads of the knitted jacket one to the other, all in such a manner that when the conductor and its core is bent, flexed and/or twisted, the underlying insulating sheath will not be exposed to atmospheric influence. The saturating composition, when in a liquid or molten state, penetrates into the threads of the knitted tubular jacket and through the threads so that the jacket and individual portions thereof will be held over its entire under surface to the upper surface of the rubber insulating sheath, or the two will be held together by spots of adhesive in a manner similar to the spot welding of one metal to another. When the saturant is cooled, it possesses, at room temperature, adhesive properties which tend to bind the tubular knitted jacket to the rubber insulating sheath, and tend to bind the threads of the jacket one to the other.

The saturant base of the saturant composition is applied to the tubular knitted jacket by immersing or passing the conductor core through a bath of the saturant composition which is maintained in a thin fluid state. Naturally, the temperature necessary to maintain the saturant in this condition will vary, but usually it varies between 260 to 350° F., but may be as low as 180° F. It is desirable to keep the impregnating temperature of the saturant composition as low as possible consistent with a liquid state because at elevated temperatures, the rubber insulating sheath or other insulating medium may be slightly damaged. The saturating composition should be sufficiently liquid to penetrate the knitted jacket while having no deleterious effect on the insulating sheath, which is preferably rubber, but which, as pointed out, may be any other prior art material having insulating properties, and with the shortage of rubber, any of the equivalents of rubber may be used. The saturant composition cools from a temperature range of between 260 to 300° F. to a soft, pliable state characterized by the property, in its solid state, of causing the fibrous sheath to adhere to the rubber insulator and the various threads of the sheath to adhere one to the other.

The saturant composition may have as its saturant base a natural or synthetic gum or resin, a cellulose ester or ether, chlorinated rubber, and the like, provided these materials have sufficient plasticity so that upon cooling from the temperature of application to normal room temperature

or thereabouts, the composition not only acts as an adhesive in the manner set forth, but is also sufficiently soft and pliable to permit the electrical conductor to be bent, flexed and/or twisted without causing the tubular knitted jacket to separate from the rubber insulating coating and/or without causing the threads of the knitted tubular jacket to separate from each other. If the saturant base does not possess sufficient plasticity to function as specified, then there is added to the saturant composition a plasticizer, which term as herein used includes the vegetable oils. The composite saturant composition will then possess the proper physical characteristics which will enable it to set to a soft and pliable state.

It has been ascertained that particularly satisfactory results can be produced by using natural gums or natural or synthetic resins. Among the natural resins which may be used are rosin, Pontianac, Manila gum, kauri, Congo, sandarac, shellac, dammar, ester gum, lime hardened rosin, and the like. Among the synthetic resins which may be used are the phenol aldehyde condensation products, including phenol formaldehyde condensation products, furfural condensation resins, urea and thiourea aldehyde condensation products including urea and thiourea formaldehyde products, and alkyd resins including the glyptals. The alkyd resins constitute the condensation product of a polyhydric alcohol and a poly basic acid. The glyptal resin is an example of an alkyd resin, said glyptal resin being a condensation product of glycerol and phthalic anhydride. Benzyl and styrene resins may be used, said resins being produced by polymerizing styrene or benzyl benzene. These resins, in many of their forms, are clear and colorless. Chlorinated rubber known under the trade name of "Pliofilm," synthetic rubber compositions, and Paracoumarone-indene resins may also be used. Acrolein and acrylic acid resins which are on the market under the trade name of "Lucite" may also be used. Few of the gums or esters form sufficiently plastic adhesives to be used without the addition of an agent acting as plasticizer and imparting to or augmenting the adhesive properties of the saturant. For example, it has been found that while ester gum may be used as a base of the saturating compound, it is highly desirable to add thereto a material which will increase the adhesive properties thereof and plasticize it. Such a material is the mineral, vegetable, or animal oil. Among the oils which may be combined with the ester gum or similar base are petroleum derivatives including lubricating oil, paraffin, vegetable oil such as castor oil, linseed oil, soya bean oil, corn oil, China-wood oil, oiticica oil, coconut oil, rapeseed oil, and the like. Fish oil is a representative of a suitable animal oil. The plasticizing and adhesive increasing agent may also be organic compounds, as, for example, esters of phosphoric acid or esters of phthalic acid. The chlorinated polynuclear aromatic hydrocarbons also function well in the above capacity.

It is quite desirable that the saturant composition have no deleterious action on the underlying rubber insulation of the conductor and that the saturant still retain its pliable and adhesive state after being applied to the fibrous knitted jacket. The saturant may solidify to a sticky or non-sticky state.

The following are examples of suitable saturant compositions:

Example 1

	Per cent
Ester gum.....	77.2
Soya bean oil.....	22.8

Example 2

	Per cent
Paracoumarone-indene resin.....	54.3
Menhaden oil.....	16.7

Example 3

	Per cent
Asphalt.....	61.2
Paracoumarone-indene resin.....	15.4
Cotton seed oil.....	23.4

Example 4

	Per cent
Ethyl cellulose.....	54
Soya bean oil.....	46

Example 5

	Per cent
Lime hardened rosin.....	64
Ethyl cellulose.....	7
Castor oil.....	29

Example 6

	Per cent
Phenol formaldehyde resin.....	73
Linseed oil.....	25
Anti-oxidant.....	2

Example 7

	Per cent
Alkyd resin.....	37
Petroleum oil.....	9
Ester of phthalic acid.....	4

Example 8

	Per cent
Manila gum.....	67
Tricresyl phosphate.....	13

Example 9

	Per cent
Shellac.....	54
Urea formaldehyde resin.....	31
Dibutyl phthalate.....	15

From the standpoint of expense, ester gum is the most desirable saturant base to use and in order to plasticize the gum, it is desirable that there be present in the saturant composition a suitable plasticizer. The vegetable oils, and particularly soya bean oil, have given very satisfactory results. The ester gum may be produced by melting ordinary rosin in a kettle with the required amount of glycerine. The molten ester gum may be allowed to cool, or, if desired, the saturant composition may be produced by adding to the molten ester gum a plasticizing constituent which also preferably imparts to the saturant composition adhesive properties. The acid number of the ester gum used in carrying out the present invention is not critical; it may be low or high, but the physical hardness or brittleness of the ester gum determines the kind and amount of plasticizer which may be used. In some cases, instead of using ester gum, rosin itself, or lime hardened rosin may be used. While the plasticizing constituent of the saturant composition is preferably a non-drying or semi-drying oil so that the composite saturant composition will not lose its soft pliable adhesive condition after being applied to the knitted jacket, a drying oil may be used, as for example, linseed oil or China-wood oil provided an anti-oxidant is present in the saturant composition to substantially prevent or inhibit oxidation of the drying oil. It is desirable

that the saturant composition retain its soft pliable adhesive state after being applied to the knitted jacket.

Referring to Example 4, it is to be noted that the saturant base is stated to be ethyl cellulose. Instead of using ethyl cellulose as the saturant base, any thermoplastic cellulose ether may be used, provided the cellulose ether forms a flexible solidified coating and retains these physical properties under heat or extreme cold. The cellulose ether which is used in the saturant base should also be compatible with gums, resins and oils. The ethyl cellulose ether is used because this derivative is easily and readily available and, further, it forms a tougher and harder film than any of the other cellulose ethers. It has a very low burning rate and is free from discoloration from sunlight. The ethyl ether set forth in Example 4 may be replaced in whole or in part by any one or a mixture of thermoplastic cellulose ethers having the properties above set forth. These cellulose ethers include propyl cellulose, butyl cellulose, benzol cellulose, ethyl benzol cellulose, ethyl propyl cellulose, methy butyl cellulose, and the like. The term "thermoplastic cellulose ether" is intended to designate those cellulose ethers which at room temperature and slightly above are solid and which melt to a liquid at elevated temperatures. The saturant composition may contain a gum or resin in conjunction with a cellulose ether of the kind above referred to, and especially ethyl cellulose. As indicated in Example 5, the saturant base contains a predominating quantity of a resin; namely, a lime hardened resin, and a relatively small proportion of a cellulose ether. However, it is not intended to limit the invention to a saturant base in which the resin predominates over the cellulose ether. The reverse may be true, and the cellulose ether predominate over the resin. Where necessary, the plasticizer may be present in the saturant composition in an amount varying between 2% to about 50% based on the weight of the composite saturant composition. The plasticizers are present in the respective examples in the following amounts: Example 1, 23%; Example 2, 17%; Example 3, 23%; Example 4, 46%; Example 5, 29%; Example 6, 25%; Example 7, 13%; Example 8, 13%; and Example 9, 15%.

The saturant base as shown in Example 9 may consist of a natural resin illustrated by shellac and a synthetic resin illustrated by a urea formaldehyde resin. Obviously, for the shellac, other natural resins may be substituted, and other synthetic resins may be substituted for the urea formaldehyde resin.

Referring to Example 7, it is to be noted that the saturant base comprises an alkyd resin, the term "alkyd" designating a well known type of resin. It is within the province of the present invention to mix the alkyd resin with a cellulose ether of the type herein described, the latter being present in a predominating proportion or the alkyd resin being present in a predominating proportion and the cellulose ether present in a minor proportion.

The examples given are merely illustrative of saturant compositions which may be used to carry out the invention. Having once pointed out the problem to be solved and its solution, those skilled in the art will be able to formulate equivalent saturant compositions for filling the basic requirements herein set forth.

The proportions set forth in the above examples are by way of illustration and not by way

of limitation. The various ingredients may be varied considerably and still come within the spirit of the present invention. The physical characteristics of the saturant; namely, its ductility, its tensile strength, its adhesiveness, its ability to penetrate into and through the knitted fabric jacket, its capacity to retain these characteristics for a considerable period of time, its thermal nature including its liquidity at above 130° F. and its ability to be maintained in a solid state at temperatures below 130° F., are the factors which determine the usefulness of the saturant base in carrying out the present invention, and therefore any combination of materials which possesses the properties herein set forth including gums, resins and cellulose ethers with or without a plasticizer such as oil or those of the character set forth in the examples, may be satisfactorily used.

The stearine pitch which may be used as the finishing coat to be applied over the knitted jacket which has been saturated with the above disclosed saturant composition, typifies the residue which remains in the retorts from which it is distilled by vacuum distillation, such free fatty acids as stearic, palmitic, oleic, myristic, and the like, such as may be obtained from oleo stearine, lard, oil, cotton seed, soya bean oil, corn oil, and the like, after said materials have been hydrolyzed for the recovery of their glycerol content. This residual pitch is a solid, jet black in color, containing free carbon in suspension, and is a highly polymerized condensed residue of a rubbery-like nature, which becomes tacky and flows at slightly elevated temperatures.

Of course, such a material may be mixed with asphalt or wax, or with both of these ingredients together with a filler-content, such as a mineral filler.

While rubber has been set forth as the insulating covering for the electrical wire which may be copper, or aluminum, or any other electrical conductive wire, any equivalents of the rubber may be used provided the equivalent material has comparable insulating properties. Naturally, the synthetic vulcanizable rubbers may be used, as, for example, that derived from butadiene, isoprene, dimethyl butadiene, or other homologs or analogs of butadiene.

It is desired to point out that any suitable color coating composition may be applied over the finishing coat. Examples of satisfactory color coating compositions are as follows:

Table 1.

	Per cent
Metallic red oxide.....	33.33
Film scrap or cellulose nitrate.....	7.82
Shellac	.78
Acetone	56.97
Methyl alcohol.....	.94
Beta naphthol.....	.16

Table 2

	Per cent
Chrome green	5.5
Yellow iron oxide.....	8.5
Titanium dioxide.....	3.6
Lamp black.....	.93
Prussia blue	.93
Film scrap	8.8
Camphor	.28
Shellac	3.42
Methyl alcohol.....	2.97
Beta naphthol.....	.14
Acetone	64.93

Table 3

	Per cent
Metallic red oxide.....	27.5
Filmscrap or cellulose nitrate.....	8.7
Shellac	1.2
Acetone	61.03
Methyl alcohol.....	1.41
Beta naphthol.....	.16

Table 4

	Per cent
American whiting.....	9.65
Asbestine	5.60
Red iron oxide.....	15.30
Filmscrap	7.15
Alkyd resin.....	3.28
Aluminum stearate.....	0.87
Beta naphthol.....	0.005
Hydrogenated petroleum fraction.....	7.95
Acetone	50.195

Table 5

	Per cent
Titanium dioxide.....	37.0
Ferric oxide yellow.....	1.83
Lead chromate.....	7.08
Red iron oxide.....	1.25
Filmscrap	5.16
Alkyd resin.....	3.96
Maleic anhydride resin.....	2.475
Blown castor oil.....	1.83
Methyl acetate.....	33.40
Methyl alcohol.....	5.91
Beta naphthol.....	0.005

While the stearine pitch coating may be used as the finishing coat, the tubular knitted jacket carrying the saturant herein disclosed may be provided with any suitable finishing coat irrespective of whether it has flame proofing and/or weather proofing properties, and said coating may be provided with the usual color coating.

The present invention resides not only in the provision of a new and novel electrical conductor, but also in the method of manufacturing the conductor. While the invention is of particular value in the manufacture of electrical conductors, it is recognized that the basic principles of the invention may be applied where it is desirable to provide a base material adapted to be bent and/or flexed and/or twisted, said basic material having a primary covering therefor and a knitted jacket of any shape covering said primary covering, said jacket being formed of interconnected wales, the successive threads of said wales having interconnected loops. The knitted jacket may be impregnated with the soft pliable adhesive saturant composition herein set forth to adhesively unite the knitted jacket to the primary covering and to also adhesively unite the threads of the jacket together so that upon bending and/or flexing and/or twisting of the base material, the primary covering, irrespective of whether or not it has insulating properties, is not exposed to deteriorating atmospheric influence.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising heating a saturant to substantially remove therefrom all volatile matter, impregnating said knitted jacket with said saturant and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together

so that upon subjecting the so-treated conductor to substantial stresses the insulating jacket is not exposed to deteriorating atmospheric conditions.

2. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising heating a plastic resin saturant to substantially remove therefrom all volatile matter, impregnating said knitted jacket with said saturant and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together so that upon subjecting the so-treated conductor to substantial stresses the insulating jacket is not exposed to deteriorating atmospheric conditions.

3. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising heating a saturant to substantially remove therefrom all volatile components, maintaining the so-treated saturant at a temperature varying between 180° F. to 350° F., impregnating said knitted jacket with said heated saturant free of volatile components and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together so that upon subjecting the so-treated conductor to substantial stresses the insulating jacket is not exposed to deteriorating atmospheric conditions.

4. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising heating a plastic resin saturant to substantially remove therefrom all volatile components, maintaining the so-treated saturant at a temperature varying between 180° F. to 350° F., impregnating said knitted jacket with said plastic resin saturant free of volatile components and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together so that upon subjecting the so-treated conductor to substantial stresses the insulating jacket is not exposed to deteriorating atmospheric conditions.

5. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising heating a plastic saturant containing a resin in admixture with a thermoplastic cellulose ether until substantially all of the volatile components thereof are removed, impregnating said knitted jacket with said plastic saturant and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together so that upon subjecting the so-treated conductor to substantial stresses the insulating jacket is not exposed to deteriorating atmospheric conditions.

6. The method of manufacturing an electrical conductor having a conductor wire, an insulating jacket thereon, and thereover a tubular knitted protective jacket comprising treating said knitted jacket with a saturant containing a resin and a thermoplastic cellulose ether compatible with said resin, said saturant being sufficiently liquid to penetrate the knitted jacket while exerting little deleterious effect on the insulating jacket thereunder and adhesively uniting the knitted jacket to the insulating jacket while adhesively uniting the threads of the knitted jacket together so that

upon subjecting the so-treated conductor to stresses the insulating jacket is not exposed to deteriorating atmospheric conditions, and applying a flame-proofing coating to the so-treated knitted jacket.

7. The method of manufacturing an electrical conductor having a conducting core, comprising applying directly to said core a vulcanized rubber insulating jacket and applying directly over said insulating jacket a single relatively loose knitted tubular jacket only, impregnating said knitted jacket with a hot non-vulcanizable liquid adhesive maintained at a temperature varying be-

5 tween 180° and 350° F. and which sets by cooling only to a soft pliable solid adhesive state and in its set state has sufficient adhesiveness to adhesively unite the threads of the knitted jacket together and hold the knitted jacket in adhesive
10 contact with the insulating jacket to prevent the latter from being exposed to deteriorating atmospheric influences upon bending, flexing and twisting of the conductor, and directly cooling the so-impregnated jacket in the absence of any heating step.

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