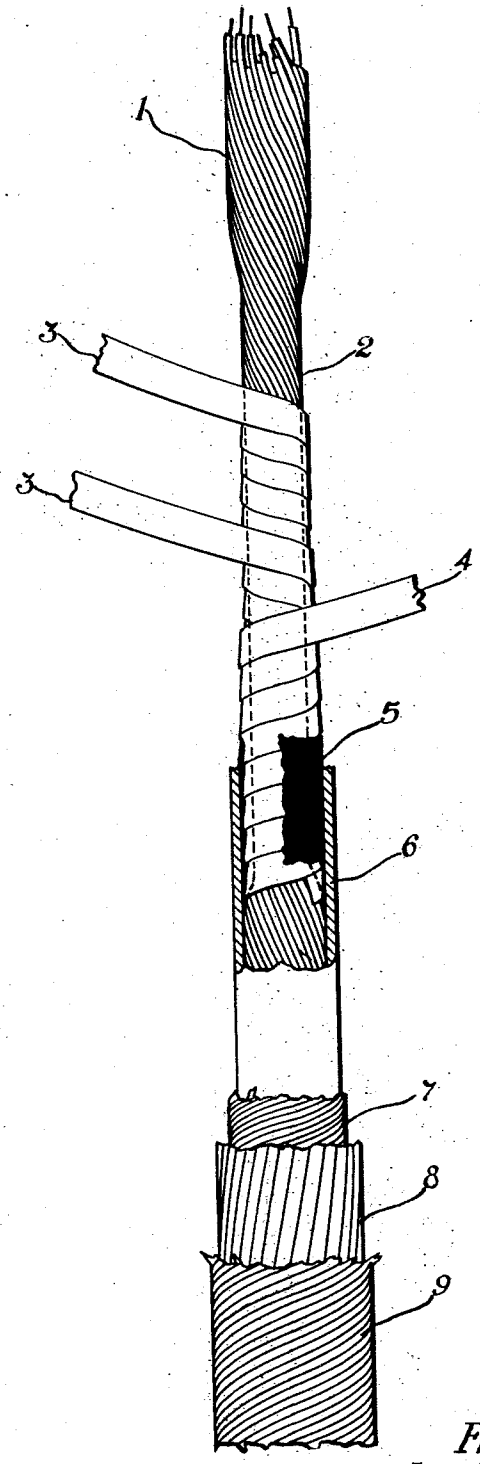
Jan. 3, 1928. 1,654,546

F. S. MALM

ELECTRIC CABLE

Filed April 6, 1923



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Patented Jan. 3, 1928. 1,654,546

UNITED STATES PATENT OFFICE.

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ELECTRIC CABLE.

Application filed April 6, 1923. Serial No. 630,201.

This invention relates in general to electric cables, and more particularly to improvements in submarine cables.

The usual custom in submarine cables having paper or similar fibrous insulation is to provide a relatively large amount of insulation which is compressed as much as is mechanically possible without injuring the insulation during the stranding process. This compact form is used in order that as much resistance as possible may be offered to the flow of water in the event of a break in the sheathing and that the cable may be taken up and repaired before a substantial length thereof is ruined.

It has been suggested that by inserting plugs at intervals in under-water cables, the same effect can be effected. The value of a plug lies chiefly in the fact that with its use a much more efficient cable may be designed and constructed, for except at the actual plugging point, the cable may be made much less compact and therefore more efficient from a transmission standpoint than the type above mentioned. The cable can also be made with less insulating paper and of smaller diameter than is ordinarily possible.

It is the object of the invention to provide a cable plug of this type which is inexpensive, easy to produce, and efficient in service.

In accordance with this object the present invention contemplates administering two treatments to that portion of the cable core where the plug is to be made. The first treatment consists in subjecting this portion of the cable core to a relatively thin waterproofing compound which will thoroughly impregnate and waterproof the paper or other fibrous insulating material. The second treatment consists in subjecting this portion of the core to a relatively heavy waterproofing compound which will fill all of the interstices between the individual strands constituting the core.

Plugs made in accordance with this invention will also be of considerable value in land cables as well as in submarine cables when the plugs are placed in the ends of the cables out of which wires are extended to terminals or for connection with other wires. The plugs in such cases will seal the ends of the cables so as to exclude air and moisture, which is present in air, from entering the cores of the cables and thus impairing the insulation of the wires within the cables.

The invention will be more clearly understood from a consideration of the following description taken in connection with the accompanying drawings, in which conductors 1 are covered in the usual manner with paper insulating material. A section 2 of the cable core, preferably of from twelve to twenty-four inches in length, is subjected in any suitable manner to a relatively thin waterproofing material which will completely impregnate the paper insulation covering the individual conductors constituting the core. The waterproofing material may be of any suitable type, preferably one that will flow freely and saturate the paper insulation at temperatures of approximately 230° F. and shall not become hard and brittle at temperatures as low as approximately 32° F. A material which has been found to produce good results comprises rosin oil and rosin in approximately the proportions of 25 per cent of the former to 75 per cent of the latter, the compound being prepared by heating and stirring until a uniform mixture is produced.

After the section of the cable core has been treated with the impregnating compound above described, the surplus of the compound is permitted to drain off. This section of the core is then subjected to a relatively heavy waterproofing material which is much more viscous than the material used in the first treatment. This heavy material will fill all of the interstices between the various conductors forming the stranded core. The compound used for this purpose should be of such a character as to flow comparatively freely at a temperature of 230° F. in order to fill the interstices of the cable and should not become hard and brittle at temperatures as low as approximately 32° F. Very good success has been had using a compound for this purpose comprising the following ingredients in approximately the proportions stated:

	Per cent.
Rosin oil	25
Rosin	5
Asphaltum	70

After impregnating the section of the core which is to form the plug with the waterproofing compound above described, this section of the core is wrapped one or more times with elastic rubber tape 3 with suffi-

cient tension accumulatively applied to the tape to bind the cable core into a very compact mass. After the core has been closely confined at this point by means of the rubber tape 3 it is further wrapped with an adhesive impregnated fabric tape 4 of any suitable character. A filling material is then used to build up the diameter of the core to approximately that desired. The filling material may be of any suitable type which will be of a character to seal the space between the outside of the fabric tape 4 and the inside of the lead sheath when the said sheath is applied thereto. Preferably I employ for this purpose material of the type described and fully disclosed in my co-pending application, Serial No. 631,360, filed April 11, 1923.

According to the disclosure of the aforementioned copending application, a satisfactory adhesive compound of this type may comprise a plastic gum, an adhesive material which also has a softening action upon the plastic gum, and a fibrous filling material to give the compound a relatively high viscosity. The fibers intermingle and accumulate in any small passages through which the compound may have a tendency to flow and thus obstruct the free flow thereof.

The plastic gum may be crude or plantation rubber, gutta percha, balata, pontianac, or the like. Preferably I employ washed and dried crude or plantation rubber softened with rosin and rosin oil which are also adhesive materials, the mixture being filled with asbestos fibers. Asbestos fibers are preferably employed since the compound may be subjected to temperatures as high as 250° F., especially where the compound is used as an adhesive and sealing material in the manufacture of cable plugs.

I find that a satisfactory compound may be made using the following materials in the proportions stated:

	Per cent.
Washed and dried crude rubber or plantation rubber	59
Rosin oil	6
Rosin	23
Asbestos fibers	12
	100

A compound embodying these ingredients in the proportions shown will remain tacky and adhesive from temperatures ranging between about 32° F. and 250° F. or at any temperature to which it is subjected during its use in cable plugs. Its consistency is such that it will adhere to metallic surfaces even where such surfaces have a comparatively high polish.

The foregoing described adhesive compound is of such character that the heat of the lead covering 6 when applied is sufficient to cause the said material, indicated in the drawings by the reference numeral 5, to flow into a homogeneous mass to completely fill the spaces between the core and sheath and to adhere to the adjacent surfaces thereof. When the lead sheath is in place, the usual hemp covering 7, the steel armor 8, and the outer jute covering 9 are applied in the standard manner.

What is claimed is:

1. The method of making a plug in a cable having a stranded core the individual strands of which are insulated with fibrous material, which consists in subjecting a section of the cable core to two waterproofing materials, one more viscous than the other, and subsequently compressing the treated section sufficiently to cause one of the waterproofing materials to fill the interstices of the insulating material and the core.

2. The method of making a plug in a cable comprising a stranded core, the individual strands of which are insulated with fibrous material, which consists in subjecting a section of the cable core to a waterproofing material which will impregnate the fibrous insulating material, subjecting the said section of the core to another waterproofing material, and subsequently compressing the said section of the core sufficiently to cause the last mentioned waterproofing material to fill the spaces between the individual conductors of the stranded core.

3. The method of making a plug in a cable comprising a stranded core, the individual strands of which are insulated with fibrous material, which consists in subjecting a section of the cable core to a relatively thin waterproofing material which will impregnate the said fibrous insulation, then subjecting the said section to a relatively heavy waterproofing material, and then compressing the core sufficiently to cause the last mentioned waterproofing material to fill the spaces between the individual strands of the stranded core.

4. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material impregnated with a waterproofing material, a second waterproofing material being so disposed as to fill substantially all of the spaces between the individual conductors constituting the stranded core.

5. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material being impregnated with a waterproofing material, a waterproofing material more viscous than the first mentioned material being so disposed as to fill substantially all of the spaces between the individual conductors constituting the stranded core.

6. In an electric cable, a plurality of con-

ductors, fibrous insulating material covering each of said conductors individually, said insulating material being impregnated with a waterproofing material, waterproofing material more viscous than the waterproofing material first mentioned being disposed between the individual conductors constituting the stranded core, and said conductors being compressed so that said last mentioned waterproofing material fills substantially all of the interstices between the conductors constituting the stranded core.

7. In an electric cable, a core comprising a plurality of conductors, fibrous insulating material covering each of said conductors individually, a metallic sheath surrounding said core, and an adhesive material filling the spaces between said core and said sheath and adhering to the surface of the said sheath.

8. In an electric cable, a core comprising a plurality of conductors, fibrous insulating material covering each of said conductors individually, a metallic sheath surrounding said core, and an adhesive material filling the spaces between said core and said sheath and adhering to the adjacent surfaces thereof.

9. In an electric cable, a plug comprising a plurality of closely confined individually insulated conductors, the diameter of the core of said plug being smaller than that of the adjacent portions of the cable core, a metallic sheath disposed about said plug, and an adhesive and homogeneous material disposed between said plug and said sheath to build up said plug to fit said sheath and fill all spaces therebetween, said material adhering to the adjacent surfaces of the plug and sheath.

10. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material being impregnated with a waterproofing material, a waterproofing material more viscous than the first mentioned material being so disposed as to fill substantially all of the spaces between the individual conductors, a metallic sheath surrounding the conductors, and an adhesive material filling the spaces between said core and said sheath and adhering to the adjacent surfaces thereof.

11. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said insulating material being impregnated with a waterproofing material, waterproofing material more viscous than the waterproofing material first mentioned being disposed between the individual conductors, said conductors being compressed so that said last mentioned waterproofing material fills substantially all of the interstices between the conductors, a metallic sheath surrounding the conductors, and an adhesive material filling the spaces between said conductors and said sheath and adhering to the adjacent surfaces thereof.

12. The method of making a plug in a cable having a stranded core the individual strands of which are insulated with fibrous material, which consists in subjecting a section of the cable conductors to two waterproofing materials, one more viscous than the other, and subsequently wrapping the treated section of the cable in such manner as to compress the section sufficiently to cause one of the waterproofing materials to fill the interstices between the individual strands of the stranded core.

13. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material being impregnated with a waterproofing material, a waterproofing material more viscous than the first mentioned material being so disposed as to fill substantially all of the spaces between the individual conductors, and a compressing wrapper over the treated conductors.

14. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material being impregnated with a waterproofing material, a waterproofing material more viscous than the first mentioned material being so disposed as to fill substantially all of the spaces between the individual conductors, and an elastic compressing wrapper over the treated conductors.

15. In an electric cable, a plurality of conductors, fibrous insulating material covering each of said conductors individually, said fibrous material being impregnated with a waterproofing material, a waterproofing material more viscous than the first mentioned material being so disposed as a fill substantially all of the spaces between the individual conductors, a compressing wrapping around the treated conductors, a metallic sheath surrounding the wrapping, and an adhesive material filling the space between the wrapping and the sheath and adhering to the adjacent surfaces thereof.

In witness whereof, I hereunto subscribe my name this 27 day of March A. D., 1923.

FRANK SIGFRID MALM.