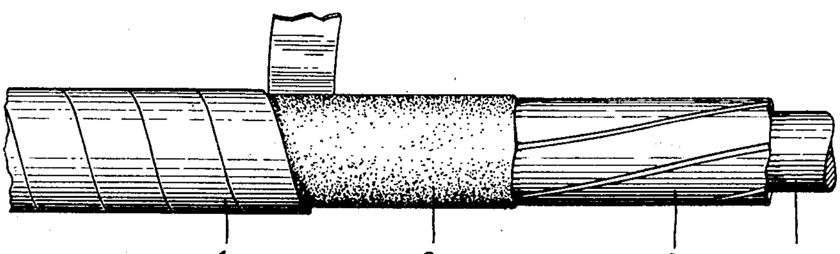
July 19, 1932. W. C. ELLIS 1,868,315

CONTINUOUSLY LOADED CONDUCTOR

Filed June 9, 1931



INVENTOR
W. C. ELLIS
BY J. W. Schmied
ATTORNEY

Patented July 19, 1932

1,868,315

UNITED STATES PATENT OFFICE

WILLIAM C. ELLIS, OF ROCKVILLE CENTER, NEW YORK, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

CONTINUOUSLY LOADED CONDUCTOR

Application filed June 9, 1931. Serial No. 543,244.

The present invention relates to the manufacture of continuously loaded electric cables.

The object of the invention is to provide an effective method of overcoming the well-known difficulties arising during the annealing to which the loaded conductor is usually subject after loading, particularly when it is loaded with materials such as iron-nickel, and iron-nickel-cobalt alloys and their derivatives. The problem to be solved is essentially that of providing looseness of the magnetic loading material from the copper or like conductor upon which it is usually wound in tape or wire form. Such looseness allows for the relative expansibility of the copper as compared with that of the magnetic material, which would otherwise cause undesirable stresses in the magnetic material when the conductor is annealed and cooled, whereby the magnetic properties of the loading material would be seriously impaired.

Prior to the present invention, various proposals have been advanced to overcome the difficulty. The prior proposals have covered such expedients as the application of paper, varnish, or other combustible carbonaceous materials or thread strands or wires of fusible material over the core and under the magnetic material, the paper, threads, or wire thus applied perishing either by combustion or fusion while the loaded core is being heated up to annealing temperature, thereby leaving the loading material so slack on the core that undesirable stresses between the two are impossible. It has also been proposed to loosen the loading by means of a refractory powder which is initially caused to adhere to the conductor by means of a volatile liquid binder which is driven off by heating to 400° C. before the core acquires its annealing temperature, and in accordance with still another proposal, gutta percha has been applied to the core under the loading material, which material melts during the annealing. It has also been proposed to use self-oxidizing materials or materials combined with oxidizing substances to be removed by chemical reaction under the influence of heat. It has also been proposed to employ as spacing materials soluble substances and dissolve them out by solvents prior to the heat treating process.

All the above suggestions have the drawback that after annealing the cable a more or less injurious or disturbing residue is left between the magnetic loading material and the core, or is left on the conductor after the treatment to remove the spacer by the use of solvents. It also appears to be desirable, if possible, to avoid employing an energetic chemical reaction to remove the spacing material since there is always danger of damaging the conductor or the loading. Application of solvents is inconvenient and expensive.

To avoid all of these several difficulties, in accordance with the present invention a volatile material substantially solid at room temperature is applied over the conductor and under the magnetic loading material and, if desired, between the layers of the magnetic loading material if there are several, the solid substance being such as will become vaporized before the annealing of the conductor or in the initial stages of the annealing.

A suitable substance is paraffin wax of which most samples melt at 40° to 80° C. and which volatilizes at about 300° C. This material may be readily applied to the conductor as required and in controllable thickness by drawing the unloaded conductor through a bath of molten wax at the requisite speed. The wax cools rapidly in air forming a substantial separator over which the magnetic material can be applied by any usual or suitable method.

Special means or methods may be employed to remove the vapors of the spacing material more rapidly and completely. When the loaded conductor is heated up during annealing, for example, in a continuous annealing tube, the wax will boil off at temperatures below 400° C. and the vapors may be swept out by the stream of nitrogen in which the conductor is annealed, for example, as set forth in the specification of United States Letters Patent 1,586,897 granted June 1, 1926 to Harris, leaving the loading material desirably loose. Practically no residue will be left behind on the conductor after the wax has been driven off, and all vapors and gases will be swept out the cool end of the annealing tube thus reducing the probability of injury to the copper conductor at higher temperatures.

Another substance useful as a spacing material is paradichlorbenzene. This substance melts at 53° C. and evaporates at a relatively low temperature. In fact it evaporates in a considerable period of time at room temperature, and consequently when it is used and the loaded conductors are laid aside for several days or weeks, substantially all the spacing material will have disappeared from the conductor. Other suitable substances are naphthalene, camphor, halowax (a mixture of chlorinated napthalenes melting at about 80° C. and boiling at about 280° C. to 364° C.), benzoic acid, melting at about 121° C. and boiling at about 249° C., phthallic anhydride, diphenyl, and other waxes of low boiling point such as parawax.

Waxes tend to adhere to the conductor more readily when it is passed through a bath of the molten material than do most crystalline materials. Paraffin wax, for example, adheres and cools readily to form a smooth adherent coating on the conductor. Many crystalline materials, however, when their boiling and melting points are suitable adhere well to the copper conductor, and serve the purpose.

The molten material may be applied entirely around the surface of the conductor or to one side only. It may also be applied to the under side of the magnetic loading tape before laying the tape on the conductor. The conductor may be passed by suitable means through a bath of the molten material, thence to the serving machine for applying the magnetic tape and then stored on a reel or led immediately to the heat treating furnace.

The drawing illustrates a loaded conductor with parts broken away to show the several layers prior to subjecting the conductor to the heat treating process.

In the drawing the central conductor consists of copper wire 1 surrounded by the usual flat tapes 2. On the external surface of the tapes 2 is covered or otherwise simply applied a layer 3 of material of the kind hereinbefore described, for example, napthalene, camphor or paradichlorbenzene. In the early stages of the heat treatment the layer 3 will evaporate and leave the loading material 4 in a desirable loose and unstrained condition.

What is claimed is:

1. A process of manufacturing an article such as a continuously loaded submarine cable, comprising a central conductor and a wrapping or wrappings about the conductor of material which it is required to maintain relatively loosely on the conductor during a heating process, characterized by the application to the conductor and under or between the wrapping or wrappings of a volatile material substantially solid at room temperatures which vaporizes at temperatures around 300° C. or below.

2. A process for manufacturing a continuously loaded conductor according to claim 1 in which the conductor is annealed by being heated to about 900° C., characterized by the application to the conductor under the magnetic loading material of a volatile solid which completely vaporizes before the temperature of the conductor has reached 400° C.

3. A process according to claim 1 in which the volatile material applied to the conductor is paraffin wax.

4. A process according to claim 1 in which the volatile material applied to the conductor is a cyclic hydrocarbon (including derivatives) which is solid at room temperature and evaporates below 400° C. at atmospheric pressure.

5. A process according to claim 1 in which the volatile material is a paraffin hydrocarbon (including derivatives) which is solid at room temperature and evaporating around or below 400° C.

6. A process according to claim 1 in which the volatile material is paraffin.

7. A process according to claim 1 in which the substance applied to the conductor is paradichlorbenzene.

8. A process according to claim 1 in which a stream of gas is utilized to carry off the vapors of the volatile solid from the high temperature zone of the heating to which the conductor is subjected.

9. A process according to claim 1 in which the evaporation of solid material is largely accomplished in an atmosphere consisting principally of nitrogen.

10. A process in accordance with claim 1 in which the volatile material is selected from the group of organic substances which are solid but tend to evaporate slowly at high room temperatures.

In witness whereof, I hereunto subscribe my name this 3d day of June, 1931.

WILLIAM C. ELLIS.