June 9, 1936. O. E. BUCKLEY 2,043,346

SUBMARINE CABLE LOADING COIL

Filed July 25, 1930

FIG. 1

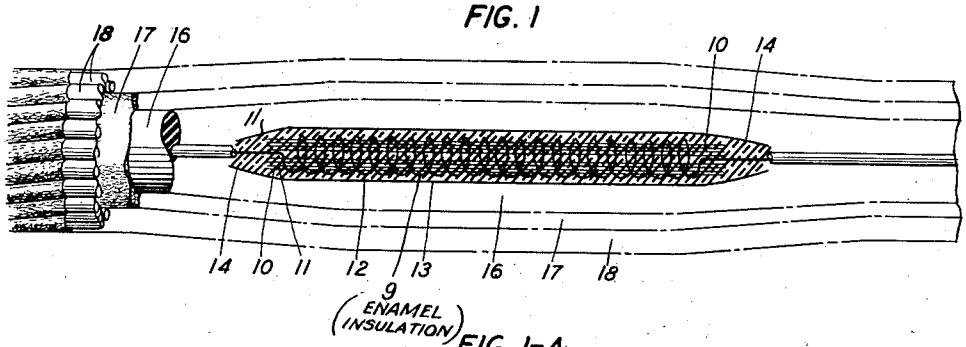


FIG. 1-A

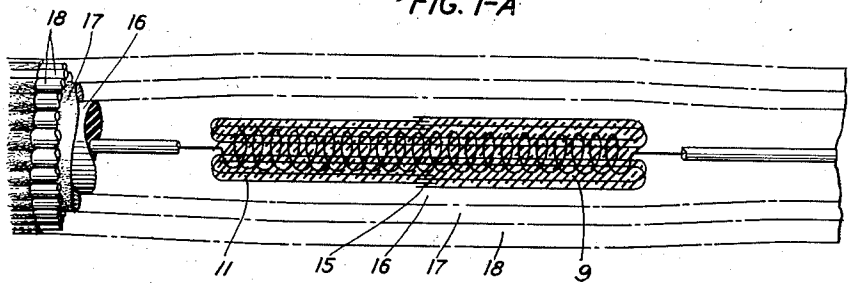


FIG. 2

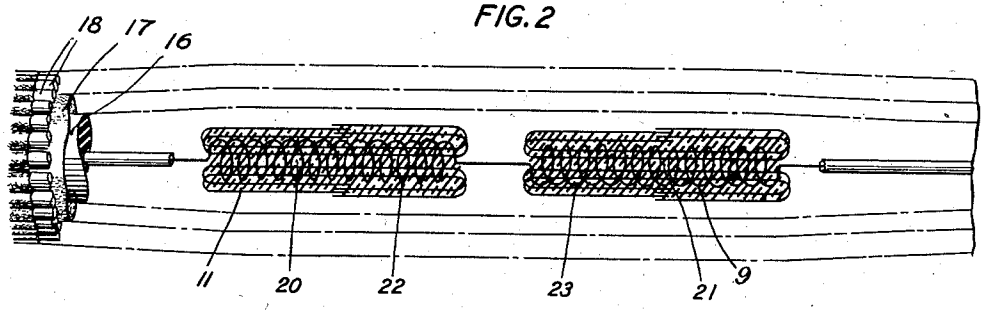
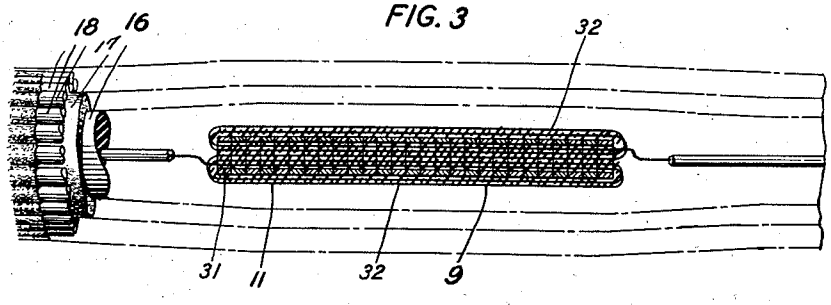


FIG. 3



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SUBMARINE CABLE LOADING COIL

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3 Claims. (Cl. 178—46)

The present invention relates to improvements in loading coils, and particularly in such coils which are to be used for loading long deep sea signaling cables.

Long deep sea signaling cables (cables to be laid in water about 2000 or more meters deep) heretofore have usually been loaded continuously, because the insertion of loading coils into a cable to be laid in such depth presents considerable mechanical and other difficulties. These difficulties are due to the bulk of the loading coils, to their weight, lack of flexibility, lack of ability to withstand the great water pressure, etc.

An object of the present invention is to provide a loading coil which may be safely submerged to the greatest depths encountered in laying transoceanic cables with the same ease and expediency as the cable proper.

Another object of the invention is to provide a loading coil for long deep sea signaling cables which, after laying, has sufficiently high inductance, sufficiently low resistance and sufficiently constant permeability for the ranges of current and frequencies involved in submarine cable signaling, to permit a considerable reduction of attenuation and of distortion of signaling currents transmitted over long deep sea cables loaded with such coils.

A further object of the invention is to provide a loading coil which will prevent extraneous disturbances from interfering with the intelligibilty of signals transmitted over signaling cables loaded therewith.

These and other objects of the invention which will appear below are attained and the above mentioned difficulties are avoided by giving the loading coil substantially the same diameter and flexibility as the cable proper, and by furthermore embodying in the coil a core made of a magnetic material having relatively high magnetic permeability, high constancy permeability, low hysteresis loss and high resistivity. Materials which are particularly suitable are alloys of nickel, iron and cobalt with or without other elements to increase the resistivity. The manufacture and heat treatment of these materials are not described in detail herein since they are not a part of this invention. A complete description of the compositions is contained in G. W. Elmen's U. S. Patent Nos. 1,715,541, 1,715,646, and 1,715,647, all dated June 4, 1929.

The invention is described and disclosed in more detail in the accompanying drawing in which identical reference characters indicate similar parts.

Fig. 1 represents a schematic view partly in longitudinal section of one embodiment of the invention;

Fig. 1—A shows a modification of Fig. 1;

Fig. 2 represents a longitudinal section of a schematic view of a different embodiment of the invention; and

Fig. 3 represents a longitudinal section of a schematic view of another embodiment of the invention.

Referring more particularly to Fig. 1 an elongated core of magnetic material is formed by a great number (a few only are shown) of fine wires 10 of magnetic material of the composition mentioned above. The core has a ratio of length to diameter of about 20 or more. The core thus constituted is vacuum impregnated with a suitable insulating material such as melted rubber 11 and is surrounded by copper wire 12 which is insulated, preferably with non-hydroscopic material such as enamel 9. Preferably also, the insulated copper wire is applied loosely, in order to be susceptible of longitudinal and transverse displacements upon bending, so that the resulting coil is made flexible. In order to obtain the desired inductance, the size of the wire of the winding and the winding space may be increased or decreased. A magnetic circuit of low magnetic reluctance is provided for the coil by surrounding the core and winding with a layer of magnetic material 13 of the kind used in the core itself. By extending this layer considerably beyond the ends of the coil, as shown at 14, in addition to increasing the inductance, there is provided a magnetic shield which tends to prevent the coil from picking up extraneous disturbances. Such a protective shield is the more desirable since in the proximity of coils having solenoidal windings such as are shown in Figs. 1, 1—A, and 2, the electro-magnetic field spreads out farther into the sea water than at other points along the cable and since thus the points of location of the loading coils are more likely to become sources of troublesome interference. Instead of thus extending the magnetic material over the ends of the loading coil the wires may be bent back upon themselves at the ends of the loading coil to form a continuous loop, the wires of which just touch each other or slightly overlap at the junction point 15, as is shown in a modification of the embodiment of Fig. 1 which is illustrated in Fig. 1—A. In both constructions, the cable insulation 16 is surrounded by a layer of jute 17 which serves as a proper bedding for the usual armor wires 18. The cable insulation

16 is extended over the coil and joined to the insulation of the conductor to form a continuous insulating cover.

Fig. 2 shows an embodiment of the invention which prevents the pick-up of external disturbances by using, instead of a single coil such as that shown in Fig. 1, two shorter coils 20 and 21, which may have substantially no mutual coupling between them and have copper wires 22 and 23 respectively which are wound oppositely. In this manner the coil windings which are in close proxmity to each other are subjected to approximately the same intensities of disturbances and consequently the effects of these disturbances upon the cable are minimized. Apart from this the construction of the cable coil shown in Fig. 2 is substantially identical with that of Fig. 1 and Fig. 1—A.

Fig. 3 depicts an embodiment of the invention in which the loading core comprises a plurality of rings 31 of magnetic material arranged coaxially with their axes in line with that of the cable. In this embodiment the coil winding 32 passes through the center of the core rings and around the outside so that each turn of the winding includes all of the core rings.

What is claimed is:

1. A submarine cable coil comprising an elongated body of subdivided magnetic material, a conductor interlinked therewith, pressure equalizing material surrounding and permeating the magnetic material and the conductor, a main layer of plastic insulation laid directly about the pressure equalizating material, and a bedding of textile fibers and armor laid upon the insulation.

2. A submarine cable loaded coil comprising a core having a plurality of toroidal rings of magnetic material arranged coaxially with their axes co-linear with the axis of said cable, a winding each turn of which includes all of said core rings passing through the center and around the outside of said rings connected in series with said cable, a pressure equalizing material surrounding and permeating said windings and core, a main layer of plastic insulation laid directly about said pressure equalizing material, and a bedding of textile fibres and armor surrounding said insulation material.

3. The combination with a single conductor submarine cable of a loading coil unit comprising two similar colinear coil sections arranged immediately adjacent one to the other, each of said sections comprising an individual core and a single winding so wound thereupon, so connected directly in series with the winding upon the other core and with said conductor and so oriented with respect to said other winding that the magnetic field produced by current flowing in one section is opposite to the magnetic field produced by the same current flowing in the other section and additional shielding means for reducing the effect of external electrical and magnetic disturbances in said loading coil unit.

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