April 26, 1932. W. FONDILLER 1,855,571

CONTINUOUSLY LOADED CONDUCTOR

Filed April 26, 1928

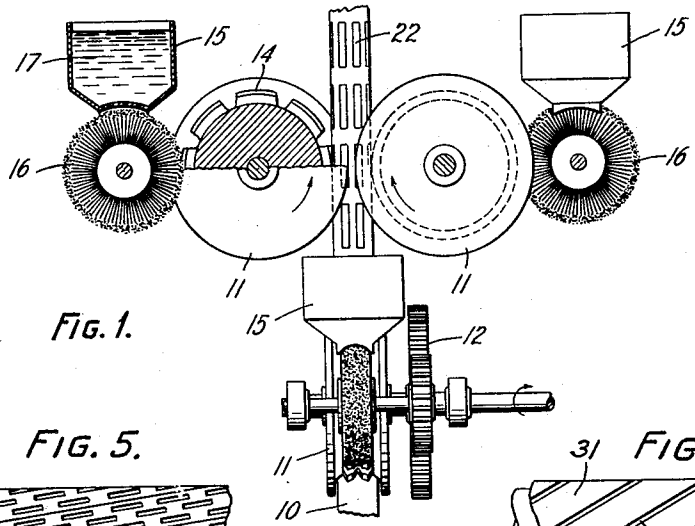


FIG. 1.

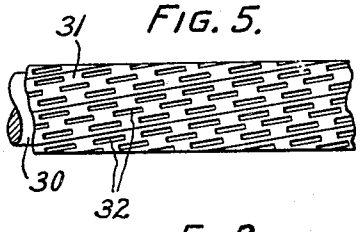


FIG. 5.

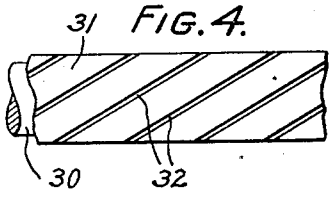


FIG. 4.

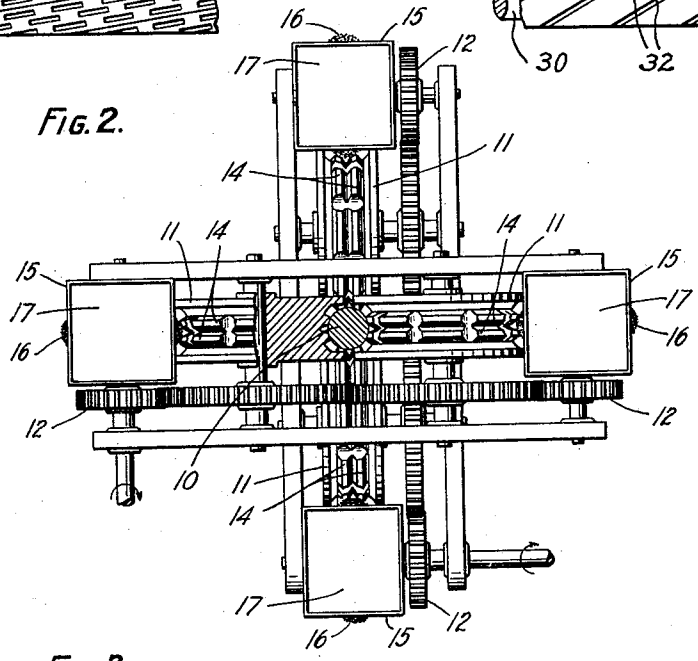
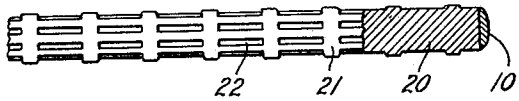


FIG. 2.

FIG. 3.



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UNITED STATES PATENT OFFICE

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CONTINUOUSLY LOADED CONDUCTOR

Application filed April 26, 1928. Serial No. 272,881.

The present invention relates to improvements in continuously loaded conductors.

A general object of the invention is to improve the transmission characteristics of continuously loaded signaling conductors.

A specific object of the invention is to increase the stability of the inductance of continuously loaded signaling conductors under the action of large disturbing magnetizing forces.

A further object of the invention is to apply magnetic loading material to a conductor in such a fashion that eddy current losses in said loading material are substantially decreased.

A feature of the invention is a continuously loaded signaling conductor in which the inductance per unit of length may be easily adjusted by means of a suitable combination of the number and width of air gaps introduced into the magnetic circuit of the loading material.

In accordance with the invention these objects are attained, in a preferred embodiment, by using any known method of electrolytic plating for depositing a sheath of loading material on the conductor, but so treating the conductor before depositing the loading material that the loading material will be deposited in the form of discontinuous areas, such as a succession of rings or spirals of loading material separated from each other by air gaps, or preferably in the form of a continuous sheath having a number of air gaps symmetrically spaced with respect to the circumference of the conductor.

One method of practising the present invention will now be described and the operation explained in connection with the drawings, in which;

Fig. 1 is a side view of the apparatus and the cable during the treatment in accordance with the invention;

Fig. 2 is a top view of the cable and apparatus;

Fig. 3 is a view in elevation of the conductor having the loading material applied thereto;

Fig. 4 is a view in elevation of a portion of the conductor having the loading material applied in spirals by electrolytic deposition with narrow spiral gaps in between the spirals of loading material; and Fig. 5 is a side view of a conductor continuously loaded with strips of magnetic material having apertures therein.

In accordance with the invention the stranded or single wire copper conductor 10 after being passed through a pickling bath (not shown) is propelled upward by means of four rotating rolls 11 driven by gears 12. Each roll 11 is provided with two circular rows of tooth like rectangular projections 14 as shown in Fig. 2; the rolls are so adjusted that only the projections 11 come in contact with the copper conductor 11. Four tanks 15 contain viscous insulating varnish 17 which oozes through the bottom and is wiped off by brushes 16. The friction between the toothlike projections 14 of rolls 11 and the bristles of brushes 16 is sufficient to rotate the brushes during the rotation of the rolls and to cause the insulating varnish to adhere to the front surfaces of the projections. Thus during the rotation of the four rolls eight rectangular symmetrically spaced islands of insulating varnish are imprinted upon the copper conductor. In its upward motion the treated conductor is passed through a heated zone whereby the insulating varnish is dried. The conductor is then ready to be passed into an electrolytic bath for the purpose of depositing any suitable type of loading material upon it. The metal or alloy will be deposited only upon the metallic surfaces while the insulated surfaces will not be plated. Instead of the rectangular form of air gaps any other form of air gaps such as ring-like gaps or gaps having the form of a continuous spiral may be easily produced by the methods of the present invention.

It may be desirable or necessary to heat treat the conductor after the plating operation is completed. This treatment may be effected in the ordinary manner. The insulating varnish will be removed by combustion during the subsequent heat treatment.

Fig. 3 depicts partly a side elevation, partly a longitudinal section, of a finished conductor produced by the methods de-

scribed above. The central copper conductor 20 has deposited on it the layer of loading material 21 the continuity of which is interrupted by gaps 22.

In the modified arrangement in Fig. 4 the conductor 30 has applied thereto spiral portions 31 of magnetic material applied electrolytically with spaces 32 in between the spirals of magnetic material, these spaces constituting air-gaps.

Conductors treated and loaded in accordance with this invention find a field of application in multiplexing of lines (as by carrier frequency) and in compositing of lines (in simultaneous telephony and telegraphy) where it is very advantageous to have a high degree of magnetic stability both during and after the application of large disturbing magnetizing forces. A high magnetic stability avoids impedance irregularities caused by the effects of various magnetizing forces, a condition which from the standpoint of repeater operation is highly undesirable.

The subdivision of the loading material in accordance with the invention tends to cause its magnetic and electrical properties to be improved by such subdivision; for example, the eddy current losses will be reduced and the inductance of the loaded conductor caused to vary less with changes in current flowing through the conductor.

The methods of the present invention also provide an easy means to accurately control the inductance per unit of length of a cable, since the amount of loading material deposited may be easily changed from point to point along the conductor during the deposition. For this purpose an inductance measuring instrument may be connected to the conductor during the electroplating operation, whereby the progress of the loading may be followed.

Although this invention has been described with reference to a particular process, applicant does not intend to be limited thereto. The objects of the invention may obviously be attained by loading the conductor mechanically instead of electrolytically, for instance, by longitudinally applying thereto strips of loading material by passing the conductor through rolls forming the loading material about it in the form of a cylindrical envelope, or by serving the conductor with one or more layers of loading material in the form of tape or wire, the loading material in both cases having provided therein non-magnetic gaps in accordance with the purposes and principles of the invention. Fig. 5 shows such modified construction of conductor; conductor 30 has applied to it strips or tapes of loading material 31, these tapes being provided with perforations or air-gaps 32. The perforations in the tapes may be made by any suitable method, for example, by punching before the tapes are applied to the conductor.

The term "tape" in the appended claims is intended to cover all equivalents of tape, such as strips of wire, for instance.

What is claimed is:

1. An electrical conductor loaded with magnetic material distributed thereon characterized in this, that the magnetic material consists of discrete strips having numerous openings in the strips which constitute air-gaps.

2. An electrical conductor having electroplated thereon magnetic material in the form of a pattern, the unplated portions separating the plated portions.

3. An electrical conductor having electromagnetic loading material electroplated thereon upon distributed portions constituting less than the whole surface of said conductor.

4. A conductor in accordance with claim 3, characterized in this that the form or area of the plated portions is varied along the conductor in a manner to cause desired variations in the inductance per unit length of the conductor.

5. An electrical conductor having applied to its surface electromagnetic material with non-magnetic gaps between the portions of electromagnetic material in the form of a pattern, whereby lines of magnetic force extending circumferentially around at least certain portions of the conductor and at right angles to the axis thereof intersect non-magnetic gaps.

In witness whereof, I hereunto subscribe my name this 19th day of April, 1928.

WILLIAM FONDILLER.