

April 29, 1930.

G. A. ANDEREGG

1,756,274

SIGNALING CONDUCTOR

Filed Dec. 28, 1926

Fig. 1.

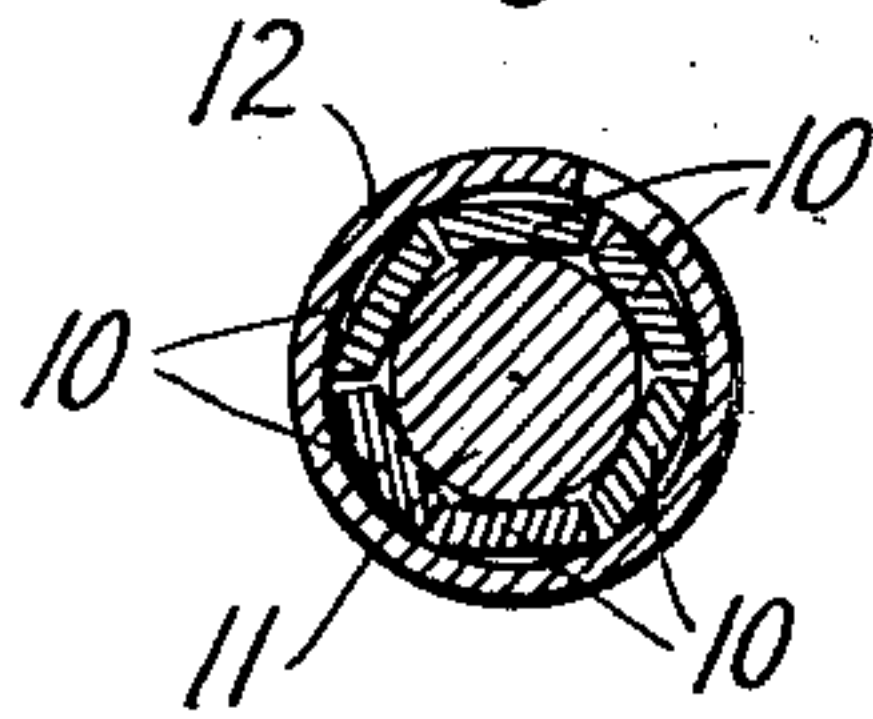


Fig. 2

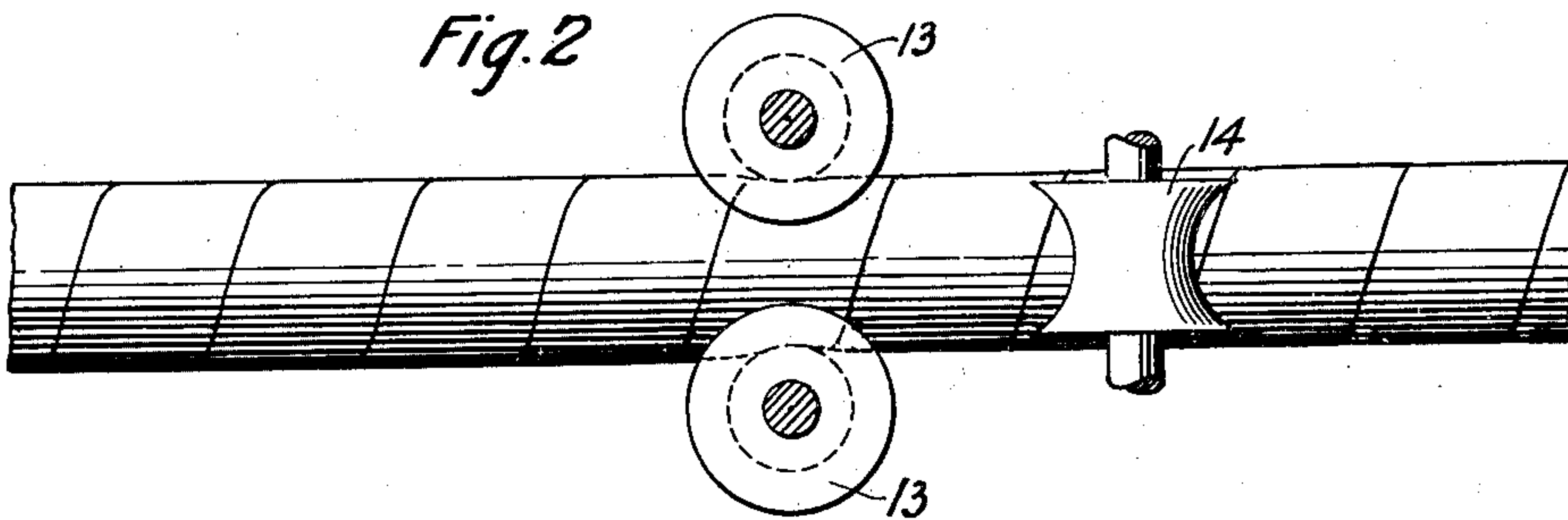


Fig. 3.

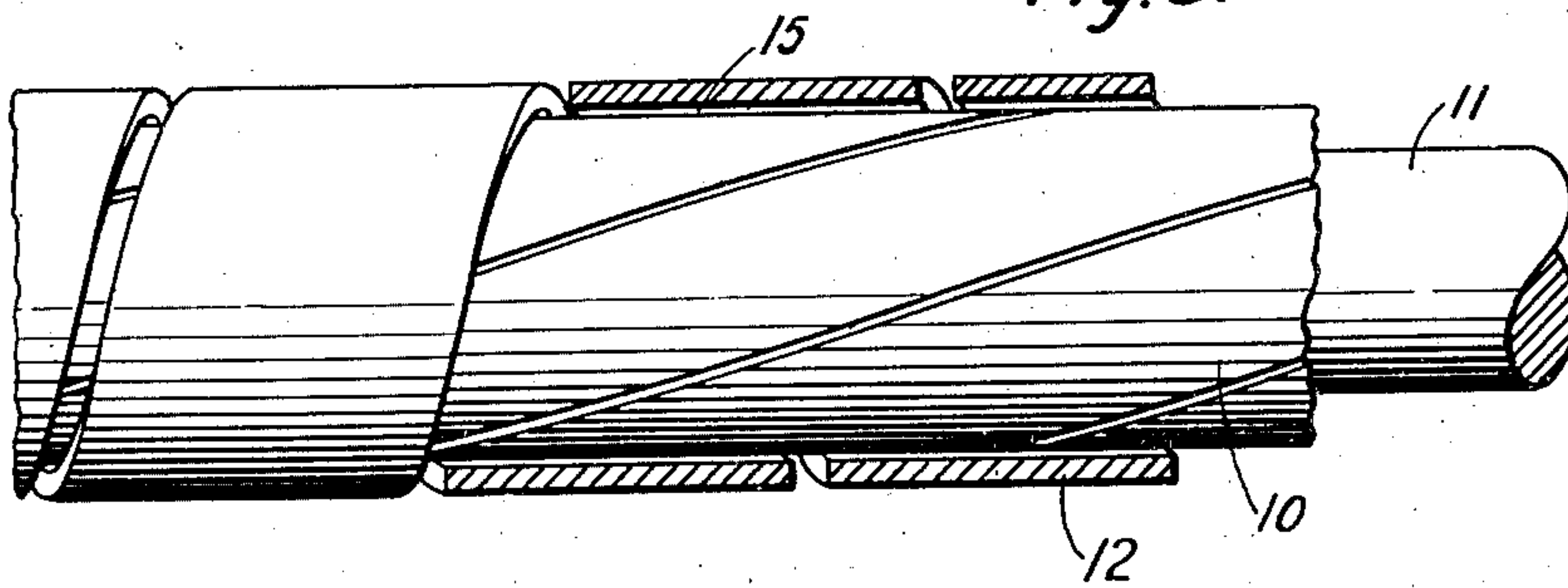
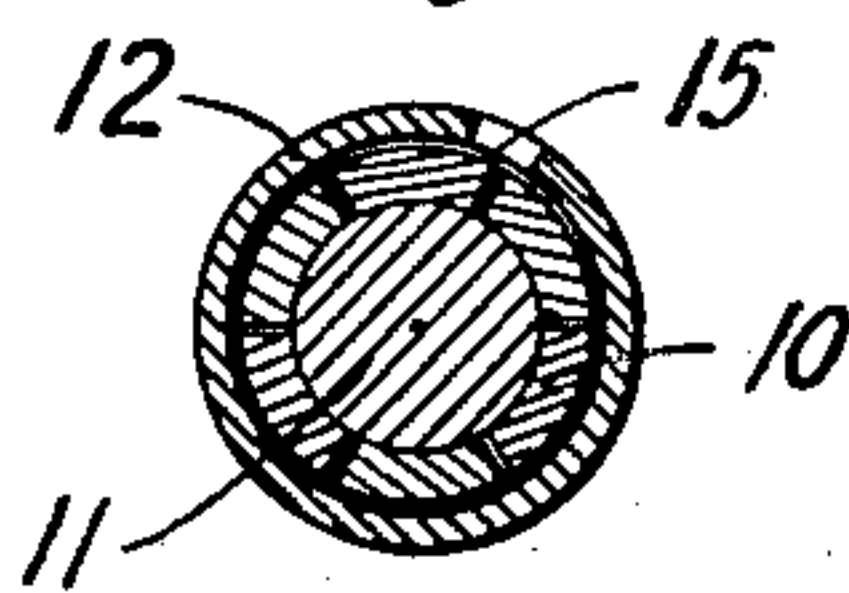


Fig. 4



Inventor:
Gustavus A. Anderegg
by E. V. Lingo
Attorney

UNITED STATES PATENT OFFICE

GUSTAVUS A. ANDEREGG, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

SIGNALING CONDUCTOR

Application filed December 28, 1926, Serial No. 157,442, and in Great Britain June 15, 1926.

This invention relates to loaded conductors and more particularly to conductors which are loaded with a uniform covering of magnetic material.

5 The object of the invention is to obtain a slight spacing of the magnetic covering from the conductor to permit the loaded conductor to be heat-treated without deleterious effects which are present when no spacing is provided. In the attainment of this object the
10 usual form of conductor comprising a central copper wire overlaid with spiralled copper tapes, is employed, but these tapes are only in partial contact with the central wire
15 and, after the loading material has been laid on in the usual manner, force is applied outside of the loading material to change the shape of the copper tapes to conform more closely to that of the central wire, thus reducing the effective diameter of the stranded
20 copper conductor. The applied force is insufficient to produce a set or permanent deformation in the loading material. As an example of the form which the copper tapes
25 may take before the force is applied, may be mentioned an arcuate cross-sectional form with a radius of curvature greater than that of the central wire so that the edges of the
30 tapes stand off from the surface of the central wire.

Various magnetic materials have been proposed for inductive loading. In the continuous form of loading, the usual procedure is to form the material into wire or tape, which is
35 then wound around the conductor to form a continuous layer of magnetic material. Among the most suitable materials for loading are certain alloys including metals of the magnetic group, notably nickel and iron, in
40 various proportions, with or without other ingredients. In order to obtain high permeability, or constancy of permeability, or certain other desirable characteristics in alloys of this sort, it is found to be necessary or
45 at least desirable, to subject the material, after it has been applied to the conductor, to a heat treatment. It has been found for example that if loading material comprising about 78½% nickel and 21½%
50 iron is wound tightly on the conductor its

permeability after heat treatment may be very much less than if the material is spaced from the conductor. Various explanations have been proposed to account for this observed effect. It has been suggested that
55 stresses which adversely affect the permeability of the loading material are set up due to the unequal expansion or contraction of the conducting and loading materials during the heat treatment or subsequent cooling. It has
60 also been suggested that during the heat treatment adhesion takes place between the copper conductor and the loading material which sets up stresses which adversely affect the permeability of the loading material.
65

It has been found that this undesirable effect may be reduced, and indeed substantially eliminated, if some provision is made to provide a small space between the loading material and the conductor during heat treatment
70 or to prevent the conductor and loading material from being forced into intimate contact during heat treatment.

It is common practice in making a loaded conductor to provide a central conducting
75 wire, with a circular cross-section, and to strand upon the periphery of the wire a plurality of flat tapes. The whole is usually rolled so that the flat tapes are pressed into contact with the central wire and the composite conductor is given a substantially circular
80 periphery. The loading material, in the form of wire or tape, is wound about the stranded conductor.

One embodiment of the invention selected
85 for purposes of illustration is shown in the accompanying drawing in which:

Fig. 1 illustrates in cross-section the initial relative positions of the strands and the magnetic tape on the central wire;
90

Fig. 2 shows the preferred method of forcing the copper strands into contact with the central wire by passing between rollers;

Fig. 3 is an enlarged view of a section of
95 the conductor with portions cut away to clearly illustrate the invention; and

Fig. 4 shows in cross-section the composite conductor with the copper strands conforming to the surface of the central wire there-
100

by providing an air space between the strands and the magnetic tape.

Referring to Fig. 1 of the drawing, a plurality of conducting strands 10 are applied spirally and relatively loosely to a cylindrical central wire 11 to form the conducting element of a loaded signaling conductor. The conducting strands 10 are slightly arcuated before being applied to the central wire 11 so that their inner surfaces have a radius of curvature greater than the surface of the cylindrical central wire, whereby the conducting strands are out of contact with the central wire along their edges. A layer of magnetic material 12 preferably of a nickel-iron alloy in the form of a tape is wound over the conducting strands 10 to form the composite conductor.

Any suitable number of copper tapes, for example four or six, may of course be employed, and the width of these should be chosen so as to allow room for them when they are forced to conform more closely to the central wire.

The conducting strands 10 are then forced by any suitable means into more complete contact with the central wire. One method of accomplishing this result is shown in Fig. 2 in which one pair of opposed, grooved rollers 13 and a second pair of opposed rollers 14, one of which is shown, arranged at right angles to the rollers 13, force the copper strands into conformity with the central wire, thereby providing a space 15 between the strands and the loading material 12 as shown in Figs. 3 and 4. The loading tape 12 assumes a loosened position around the conductor because of its springy character, while the soft copper strands remain in more complete contact with the central wire 10. This arrangement provides sufficient space for the expansion and contraction of the conducting element of the conductor during the subsequent heat treatment and cooling process without seriously affecting the magnetic properties of the loading material.

While the above description relates to a specific embodiment of the invention, various other modifications may be devised to accomplish the same result, and the invention is only to be limited within the scope of the appended claims.

What is claimed is:

1. The method of producing a signaling conductor having an inner conducting portion and a metallic covering fitting said portion loosely, which comprises forming the conducting portion with external projecting portions, applying the covering over said projecting portions, and subsequently loosening the covering by deforming the projecting portions.

2. The method of producing a signaling conductor having an inner conducting portion and a metallic covering fitting said por-

tion loosely, which comprises forming the conducting portion to have a non-cylindrical surface, applying the covering thereto, and subsequently deforming the conducting portion to attain a more nearly cylindrical surface.

3. The method of producing a signaling conductor having an inner portion and a metallic covering fitting said inner portion loosely, which comprises associating a plurality of strands together so that the adjacent surfaces of said strands are only in partial contact to form said inner portion, applying the covering over said associated strands, and subsequently deforming at least one of the strands so that their contact surfaces are increased and the diameter of the metallic covering is not permanently changed.

4. The method of producing a signaling conductor having a plurality of inner strands and a metallic covering fitting said inner strands loosely, which comprises forming the inner strands of a plurality of tape-like strands wrapped on a central strand so that the adjacent surfaces of the applied strands and the central strand are only in partial contact, applying the covering over said associated strands, and subsequently loosening the covering by deforming the layer of strands on the central strand whereby the contact between said adjacent surfaces is increased.

5. The method of producing a signaling conductor having an inner conducting core and a metallic covering fitting said core loosely, which comprises forming the inner conducting core with appreciable air spaces therein, applying the covering by wrapping a tape helically and tightly on said core, and subsequently reducing the effective diameter of said core by applying force to said covering.

6. The method of producing a signaling conductor having an inner conducting core and a metallic covering fitting said core loosely, which comprises forming the inner conducting core with projecting portions which may be deformed comparatively easily, applying the covering by wrapping helically thereabout a tape which is less easily deformed, and subsequently deforming said core without permanently deforming the covering.

7. The method of loading a signaling conductor with loading material which requires heat treatment to give it a desired electrical or magnetic characteristic, which consists in wrapping around a central strand a plurality of metallic strands to form a surface presenting spiralled ridges, wrapping the loading material around said surface, and subsequently changing the diameter of said spiralled ridges, whereby the loading material is loosened.

8. The method of loading a signaling conductor with magnetic material which requires heat treatment to give it a desired electrical or magnetic characteristic, which consists in forming a flat conducting strand so that it will not conform to the surface of a central strand upon which it is to be wrapped, wrapping said conducting strand about said central strand, wrapping the loading material around said conductor, and subsequently forcing said conducting strand to more closely conform to the central strand by the application of force to said wrapped conductor, whereby the loading material is loosened.

9. The method of loading a signaling conductor with magnetic material which requires heat treatment to give it a desired electrical or magnetic characteristic, said magnetic material being subject to adhesion to said conductor during the heat treatment, which consists in wrapping a plurality of arcuated strands helically on a cylindrical strand, said strands being arcuated insufficiently to conform to the surface of the cylindrical strand, winding a layer of magnetic material over the strands, and subsequently compressing the signaling conductor to force the strands into conformity with the surface of the cylindrical strand, thereby providing a space between the strands and the magnetic material.

10. The method of producing a signaling conductor which comprises forming a plurality of conducting tapes and wrapping said tapes about a central conductor, thereby forming a non-cylindrical surface, then applying a metallic covering tightly about said conducting tapes and subsequently deforming said conducting tapes to conform comparatively closely to said central conductor, thereby loosening said metallic covering.

11. The method of producing a composite conductor having a conducting core and a metallic covering loosely fitting said core which comprises forming said core so that its effective diameter may be reduced without changing its length, applying said metallic covering to the core by wrapping a metallic strand helically and tightly thereon, and subsequently applying a force to the covered conductor to reduce its effective diameter without changing the pitch of said metallic strand.

12. The method of producing a signaling conductor having an inner conducting portion and a metallic covering fitting said portion loosely, which comprises forming the conducting portion with external projecting portions, applying the covering over said projecting portions, and subsequently loosening the covering by rolling down said projecting portions.

13. The method of producing a signaling conductor having an inner conducting core and a metallic covering fitting said core loosely,

ly, which comprises forming the inner conducting core with projecting portions which may be deformed comparatively easily, applying the covering by wrapping helically about said core a tape which is less easily deformed, and subsequently deforming said core without permanently deforming the covering by passing the covered conductor between pressure rollers.

14. The method of loading a signaling conductor with magnetic material which requires heat treatment to give it a desired electrical or magnetic characteristic, said magnetic material being subject to adhesion to said conductor during the heat treatment, which comprises wrapping a plurality of arcuated strands helically on a cylindrical strand, said strands being arcuated insufficiently to conform to the surface of the cylindrical strand, winding a layer of the magnetic material over the strands, and subsequently passing the loaded conductor between a pair of pressure rollers to force the strands into conformity with the surface of the cylindrical strand thereby providing a space between the strands and the magnetic material.

15. The method of producing a signaling conductor, which comprises forming a plurality of conducting tapes and wrapping said tapes about a central conductor, thereby forming a non-cylindrical surface, then applying a metallic covering tightly about said conducting tapes and subsequently rolling down said conducting tapes to conform comparatively closely to said central conductor thereby loosening said metallic covering.

In witness whereof, I hereunto subscribe my name this 24th day of December, A. D. 1926.

GUSTAVUS A. ANDEREGG.