No. 854,562. PATENTED MAY 21, 1907.

S. G. BROWN.

ELECTRIC CONDUCTOR OR CABLE.

APPLICATION FILED OCT. 8, 1904.

Fig. 9.

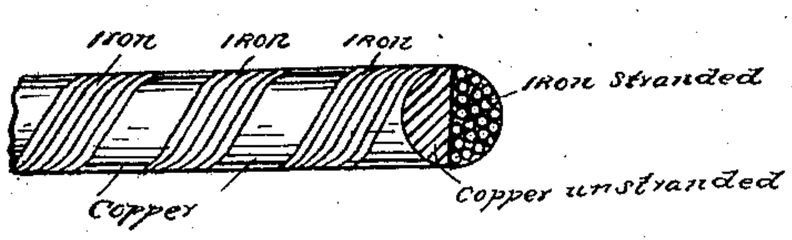


Fig. 10.

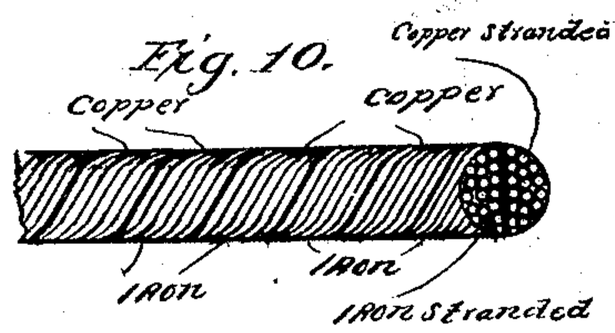


Fig. 1.

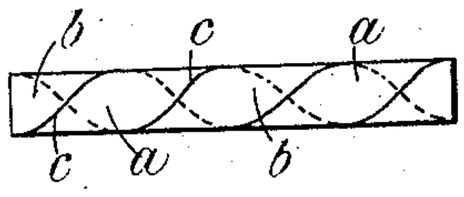
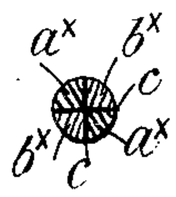


Fig. 2.

Fig. 3.



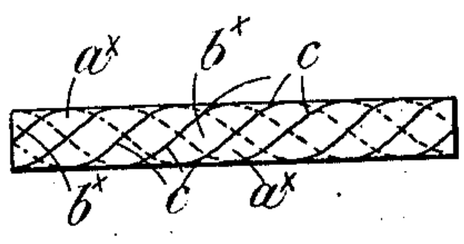
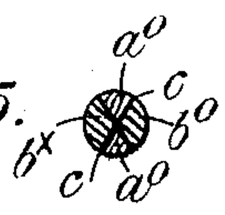


Fig. 4.

Fig. 5.



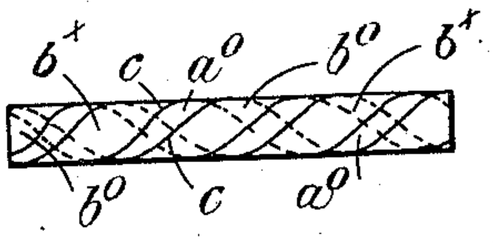
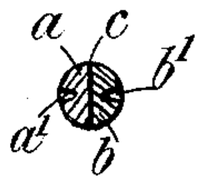


Fig. 6.

Fig. 7.



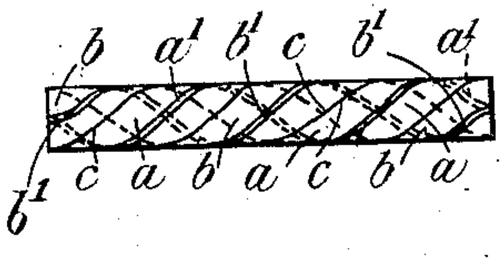


Fig. 8.

Witnesses:

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C. D. Kesler

Inventor

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By James L. Norris

Atty.

UNITED STATES PATENT OFFICE.

SIDNEY GEORGE BROWN, OF LONDON, ENGLAND.

ELECTRIC CONDUCTOR OR CABLE.

No. 854,562. Specification of Letters Patent. Patented May 21, 1907.

Application filed October 8, 1904. Serial No. 227,710.

To all whom it may concern:

Be it known that I, SIDNEY GEORGE BROWN, a subject of the King of Great Britain, residing at 4 Great Winchester street, in the city and county of London, England, electrical engineer, have invented certain new and useful Improvements Relating to Electric Conductors or Cables, of which the following is a specification.

This invention relates to an improved mode of manufacturing electric conductors or cables applicable for employment in connection with telegraphy or telephony with the objects of counteracting the effect of capacity by rendering the conductor self-inductive while not materially increasing the resistance; the speed of signaling being in consequence considerably accelerated.

According to the specification of British Letters Patent dated 18th April, 1902, No. 9040, granted to me, I proposed to construct the conductor in such a manner as to possess self-inductance continuously along its length, by forming the same of a strip disposed spirally about and insulated from a core of magnetic metal or material. According to the specification of British Letters Patent dated 11th May 1903, No. 10667, I proposed with the object of rendering the conductor self-inductive to counteract the effect of capacity without seriously diminishing its resistance to dispose the conductor centrally within a magnetic envelop or tube; insulation being placed about the conductor and the magnetic envelop. Now I have found that these extreme types of conductors are open to certain objections. For instance, in the case of a copper conductor spirally wound about a magnetic core the resistance of the copper is somewhat high, and in the case of the magnetic material enveloping the conductor the iron is totally in the electrostatic field and therefore subject to considerable induced currents.

The present invention is therefore devised with a view to avoiding or minimizing the aforesaid objections and to this end, the conductor and the iron or other magnetic material may be of approximately the same form and area in transverse section twisted together axially with an insulating medium between them; the conductor and the iron being disposed either in pairs or in any other desired manner, such, for instance, as in groups of, say, four, in which case the iron and the copper would be arranged alternately, the aim being so to assemble the copper and the iron as to insure the centers of gravity coming as close as possible.

In the accompanying drawings, which represent diagrammatically several examples of conductors constructed according to my invention; Figures 1 and 2 are respectively a transverse section and a side elevation of a construction in which the conductor and the iron are of half-wound section. Figs. 3 and 4 are respectively similar views illustrating a construction in which the conductor and the iron are of quadrantal section. Figs. 5 and 6 represent another construction showing a variation in the cross section of the conductor and the iron. Figs. 7 and 8 represent a modified form of the construction shown in Figs. 1 and 2. Figs. 9 and 10 show further modifications.

According to the construction illustrated in Figs. 1 and 2, the conductor *a* which may be copper and the magnetic metal *b* which may be iron are disposed in pairs, each of half-round section with an insulating strip or medium *c* disposed between the flat sides thereof. The pitch of the turns should be arranged according to requirements. As an example a good cable or conductor may be constructed according to this invention, employing ordinary charcoal iron, of .26 inch diameter having a copper resistance of 2.8 ohms and .03 henries per naut, the iron and copper making two complete twists per inch run of the core.

Referring to Figs. 3 and 4, the conductor is shown as composed of a group of four wires, that is to say two conductors or conducting wires $a^{\times}$ $a^{\times}$ and two iron or magnetic wires $b^{\times}$ $b^{\times}$; the cross section of each wire being quadrantal. In Figs. 5 and 6 a similar construction is shown in which the area of the copper and iron wires, a^{0} a^{0} and b^{0} b^{0} respectively varies slightly in transverse section.

The construction shown in Figs 7 and 8 is similar to that illustrated in Figs. 1 and 2 with the exception that, with a view to increasing the flexibility of the conductor, the outer side of each wire *a*, *b* is formed with a groove *a'* *b'*. The flexibility of the conductor may also be obtained by stranding as shown by Figs. 9 and 10. The conductor and the magnetic material may however be disposed in other ways as may be found necessary or desirable.

Under some conditions of working, it may

be advantageous to dispense with the insulating medium or to reduce it to the smallest possible area in transverse section. It may, moreover, be composed of the oxids of the metals.

In constructing the cable or conductor, the iron should be of a highly permeable character, and, in certain instances, an alloy may be employed composed of iron and a suitable quantity of silicon or aluminium. By means of such an alloy, the permeability and electrical resistance of the magnetic material are increased. In some cases the conductor and the iron or other magnetic material may be fastened together by soldering or other convenient means.

To duplex such a cable or line it may be convenient to employ another or similar line composed say of a conductor of copper wire and an iron wire insulated from each other but twisted together as shown by Figs. 9 and 10.

In the case of a telephone line where two conductors are used, the wires may be made to cross one another at regular intervals an iron wire of suitable shape being made to pass up and down through the openings between the wires in such a way as to have all the magnetizing forces additive.

The working out of the cable is as follows: Take as an example the New York-Fayal cable. Diameter over the copper conductor .185" diameter over the guttapercha .445" resistance when laid, 1.843 ohms per naut capacity when laid, .4134 microfarads (remains practically unaltered).

In the new improved inductive cable (segmental wire):—The copper and iron take three complete turns per inch. The center of gravity of each half section is .037" from the center, making allowance for the insulation.

$$\text{Area of copper or iron} = \frac{\pi(.0925)^2 - (.005 \times .185)}{2} = .0129 \square''$$

$$\text{Mean length} = 1\ (\pi .074)^2 + (.333)^2 = .41''$$

$$\text{Cross-section of copper or iron} = \frac{.0129 \times .333}{.41} = .0105\ \square''$$

$$\text{Resistance of copper conductor} = \frac{.000000066 \times 79000 \times 41}{.0105 \times .333} = 5.7 \text{ ohms per naut.}$$

Calculation of the self induction (C. G. S. units).

$$\text{H (magnetizing force)} = \frac{4\pi \times 1.18 \times .333}{10 \times .41} = 1.2$$

$$\text{N (number of lines of force)} = \overbrace{1.2}^{\text{H}} \times \overbrace{200}^{\mu} \overbrace{.0105}^{\substack{\text{Cross-section in} \\ \text{centimeters.}}} 6.45 = 16.2$$

$$\text{L (self induction)} = \frac{16.2 \times \overbrace{219000}^{\substack{\text{Number} \\ \text{of turns.}}}}{\substack{8. \\ 10}} = .085 \text{ henries per naut.}$$

What I claim and desire to secure by Letters Patent of the United States is:—

1. An electric conductor or cable having a copper conductor associated with iron or magnetic material the conductor and the iron being of segmental form in transverse section twisted together in an axial direction substantially as and for the purposes specified.

2. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form in transverse section twisted together in an axial direction, substantially as and for the purposes specified.

3. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form and area in transverse section, twisted together in an axial direction substantially as and for the purposes specified.

4. An electric conductor or cable having a copper conductor associated with iron or magnetic material, the conductor and the iron being of segmental form in transverse section twisted together in an axial direction with an insulating medium or dielectric between them, substantially as and for the purposes specified.

5. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form in transverse section twisted together in an axial direction with an insulating medium or dielectric between them substantially as and for the purposes specified.

6. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form and area in transverse section, twisted together in an axial direction with an insulating medium or dielectric between them, substantially as and for the purposes specified.

7. An electric conductor or cable having a copper conductor associated with iron or magnetic material each of segmental form in transverse section and adapted to admit of their being assembled so that the centers of gravity come as close as possible and twisted together in an axial direction substantially as and for the purposes specified.

8. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form in transverse section and adapted to admit of their being assembled so that the centers of gravity come as close as possible and twisted together in an axial direction substantially as and for the purposes specified.

9. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form and of such an area in transverse section as will admit of their being assembled so that the centers of gravity come as close as possible and twisted to-

gether in an axial direction, substantially as and for the purposes specified.

10. An electric conductor or cable having a copper conductor associated with iron or magnetic material each of segmental form in transverse section and adapted to admit of their being assembled so that the centers of gravity come as close as possible and twisted together in an axial direction with an insulating medium or dielectric between them, substantially as and for the purposes specified.

11. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form in transverse section and adapted to admit of their being assembled so that the centers of gravity come as close as possible and twisted together in an axial direction with an insulating medium between them, substantially as and for the purposes specified.

12. An electric conductor or cable having a copper conductor associated with iron or magnetic material of approximately the same segmental form and of such an area in transverse section as will admit of their being assembled so that the centers of gravity come as close as possible and twisted together in an axial direction, with an insulating medium between them, substantially as and for the purpose specified.

13. An electric conductor or cable comprising a conductor of copper wire of half round or segmental form in transverse section arranged with its flat side in juxtaposition to iron wire of half-round or segmental form in transverse section twisted together in an axial direction, substantially as herein described for the purposes specified.

14. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section arranged with its flat side in juxtaposition to the flat side of iron wire of half-round or segmental form in transverse section twisted together in an axial direction substantially as hereinbefore described for the purposes specified.

15. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to iron wire of highly permeable character of half-round or segmental form in transverse section twisted together in an axial direction, substantially as hereinbefore described for the purposes specified.

16. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to the flat side of iron wire of highly permeable character of half-round or segmental form in transverse section twisted together in an axial direction, substantially as herein described for the purposes specified.

17. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to iron wire of half-round or segmental form in transverse section and an interposed insulating strip or medium twisted together in an axial direction substantially as herein described for the purposes specified.

18. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to the flat side of iron wire of half-round or segmental form in transverse section and an interposed insulating strip or medium twisted together in an axial direction, substantially as herein described for the purposes specified.

19. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to the iron wire of highly permeable character of half-round or segmental form in transverse section and an interposed insulating strip or medium twisted together in an axial direction, substantially as herein described for the purposes specified.

20. An electric conductor or cable comprising a conductor of copper wire of half-round or segmental form in transverse section having its flat side arranged in juxtaposition to the flat side of iron wire of highly permeable character of half-round or segmental form in transverse section and an interposed insulating strip or medium twisted together in an axial direction, substantially as herein described for the purposes specified.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses this twenty third day of September, 1904.

SIDNEY GEORGE BROWN.

Witnesses:
T. SELBY WARDLE,
F. J. RAPSON.