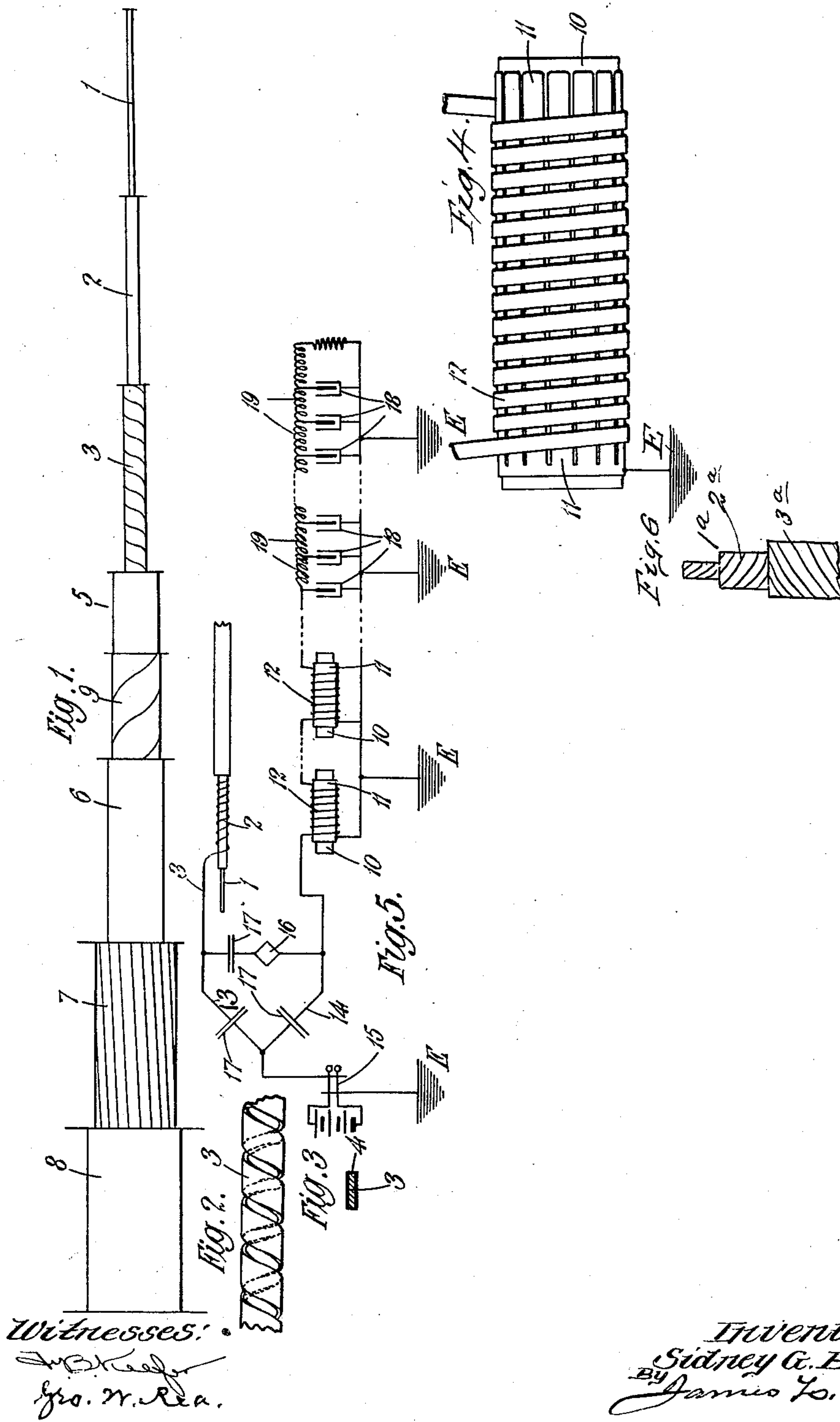


No. 845,609.

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S. G. BROWN.
ELECTRIC CONDUCTOR.
APPLICATION FILED JUNE 16, 1902.



Witnesses:
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UNITED STATES PATENT OFFICE.

SIDNEY GEORGE BROWN, OF LONDON, ENGLAND.

ELECTRIC CONDUCTOR.

No. 845,609.

Specification of Letters Patent.

Patented Feb. 26, 1907.

Application filed June 16, 1902. Serial No. 111,964.

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 county of London, England, electrical engineer, have invented certain new and useful Improvements in and Relating to the Manufacture of Electric Conductors, of which the following is a specification.

This invention relates to improvements in duplex line conductors for the telegraph and telephone purposes in which the self-inductance will balance the capacity, thus leaving only the resistance effect to be dealt with, and thereby increasing the speed and efficiency of the signaling by electric-wave propagation.

According to this invention I overcome the effect of capacity of the line or cable by placing self-inductance in a continuous manner along the core of said line or cable. For this purpose I surround a central insulated core with a preferably spiral-wound conductor having its turns insulated from one another, and I coat said conductor with gutta-percha or other suitable insulator.

According to the form of construction which I prefer—say for a submarine cable—I employ a central core which may be of iron or steel wire broken into lengths, if found necessary, to prevent electrostatic charges running along the core, or said central core may be a jute, hemp, or similar cord constituting an air-core. This central core is surrounded by paper or other insulation material saturated, if necessary, in oil or wax. Outside the paper or other insulation material I place the preferably spirally-twisted copper conductor, the turns of which are insulated from one another by cotton, silk, paper, or other suitable material and which may consist of two or more strands. This conductor may advantageously be of square or rectangular cross-section. The twisted conductor is covered with gutta-percha, which is in turn covered by jute-yarn steeped in "cutch" or other preservative, and the cable may be provided with a steel-wire sheathing or armor.

In constructing a land-wire for telephone or telegraph purposes the jute or similar material and the sheathing or armor may be

omitted, the central core taking the stress and acting as a return-conductor.

When the central core is of iron, it serves to strengthen the cable or line and also acts as a magnetic material to increase the self-inductance of the twisted conductor. The twisted conductor constitutes the winding of an inductance-coil, and thus provides self-inductance in a continuous manner along the cable or line.

To duplex the line or cable, I may employ any suitable form of Wheatstone bridge; but the artificial line must possess capacity, induction, and resistance and must be made to imitate as far as possible the properties of said cable or line. To effect this, I may arrange the artificial line-boxes according to Stearn's well-known method; but the resistance between the capacities employed should be made self-inductive in such value in proportion to the capacity and resistance of the artificial line as to imitate its equivalent length of cable. The induction in the first portion of the artificial line must be especially carefully distributed. I may make this artificial line by winding a tin-foil strip round a cardboard roller of suitable dimensions, an insulated tin-foil sheet to act as earth-plate being placed under the strip and over the cardboard and insulated from said strip. This earth-plate is cut up into lengths, so as not to form a continuous conductor round the cardboard, for which purpose it is preferably split in the direction of the length of the cardboard roller or tube, so as not to interfere with the inductive effect of the strip. In other words, the purpose of the longitudinal slitting is to prevent induced currents being set up in and circulating around the earth-plate. An artificial line thus constructed would possess, first, capacity due to the effect between the strip and the earth-plate; second, resistance due to the length of the strip, and, third, induction, because the strip is spirally wound. All these three effects should be proportioned in accordance with the cable or line which it is intended to copy.

During the manufacture of the cable or line it is essential to practical success to test short lengths in order to insure that the self-induction balances the electrostatic effect or capacity.

Referring to the drawings, Figure 1 shows the cable, parts of which are removed to expose the core, the conductor, and the insulation material. Fig. 2 shows the conductor on an enlarged scale. Fig. 3 is a cross-section through one of the turns of the conductor. Fig. 4 illustrates the construction of the artificial line. Fig. 5 is a diagram illustrating the duplexing of the cable. Fig. 6 is a view of a modified form of conductor.

1 is the central iron or steel core surrounded by paper 2.

3 is a spirally-wound copper conductor having its turns insulated from one another by cotton, silk, or other suitable material 4 and covered by gutta-percha or other suitable insulator 5. This insulator 5 is protected by jute-yarn 6, steeped in cutch, and the cable thus constructed is armored in the well-known manner by iron or steel wire 7 and an outer covering 8, or the core may be protected in any other suitable manner. In some cases a brass tape 9 is wound round the insulator 5.

It is obvious that instead of consisting of a single strand, as shown, the conductor 3 might consist of several strands, either placed side by side or superposed one upon the other, and that these strands might be either all inclosed in one insulating-cover or each strand might be separately insulated.

In using the cable for a land-line the covering 5, 6, 7, 8, and 9 may be omitted, the central core acting as a support and, if necessary, as the return-conductor, or the return-conductor may be another conductor similar to, but placed over, the conductor 3 and wound in the opposite direction thereto. The outgoing and return currents will then both produce inductive effects. Such a double-wound conductor may be suitably covered and protected to act as a submarine or subterranean cable.

The signaling-currents pass through the conductor 3, producing electric waves along the core, which waves operate the receiving apparatus at the far end of the cable.

By spirally twisting the conductor 3, as above described, it is made self-inductive and the effect of capacity of the line is overcome.

Referring to Fig. 4, 10 is the cardboard roller, upon which is placed a longitudinally-slotted insulated tin-foil plate 11, connected to earth E. 12 is the spirally-wound tin-foil strip included in the line or cable circuit. This spirally-wound strip is suitably insulated from the tin-foil 11. In manufacturing this artificial line it is convenient to then cover the strip 12 with insulating material, to place a second earth-plate similar to the earth-plate 11 over said insulating material, and a second tin-foil strip, such as 12, over the earth-plate. In this manner the size of

the artificial line may be conveniently increased as required, all the tin-foil strips 12 being connected in series.

Referring to Fig. 5, the conductor 3 is connected to one arm 13 of a Wheatstone bridge, the other arm 14 of which is connected to the artificial line. The apex of the bridge is connected to the transmitter 15. The receiver 16 is placed across the arms of the bridge, and 17 17 are the usual condensers. The first two sections of the artificial line are constructed as shown in Fig. 4, and the sections of the latter end of the artificial line may conveniently comprise condensers 18, connected to earth E, and self-inductively-wound resistances 19.

In the form of embodiment of the invention shown in Fig. 6, which illustrates a slightly-modified form of conductor, 1^a designates the iron core, 2^a a spiral conductor, and 3^a a return-conductor, with its twists disposed opposite to the conductor 2^a.

It is essential to practical success to test the cable and artificial line in short lengths—say of one mile—during manufacture to insure that the capacity is balanced by the self-induction.

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

1. In an electric cable or line, the combination of a magnetic core, a spirally-wound conductor surrounding said core, material for insulating the turns of said conductor from one another, a covering of insulating substance surrounding said insulated conductor, and an artificial line included in the circuit of said cable or line and comprising a cardboard core, an insulated earth-plate surrounding said core, and a spirally-wound insulated conductor surrounding said earth-plate, substantially as and for the purpose specified.

2. In an electric cable or line, the combination of a magnetic core, a spirally-wound conductor surrounding said core, material for insulating the turns of said conductor from one another, a covering of insulating substance surrounding said insulated conductor, and an artificial line included in the circuit of said cable or line and comprising a cardboard core, an insulated longitudinally-split tin plate connected to earth and surrounding said core, and a spirally-wound insulated tin-foil conductor surrounding said earth-plate, substantially as and for the purpose specified.

3. The combination of a cable having balanced capacity and self-induction, and an artificial cable comprising a core, an earth-plate, and a self-inductively-wound resistance surrounding but insulated from said earth-plate, substantially as described.

4. The combination of a cable having bal-

anced capacity and self-inductance and an artificial line having an earth-plate and a spirally-wound insulated conductor surrounding the same, substantially as described.

5 5. The combination of a cable having capacity and self-inductance, and an artificial line having an earth-plate and a spirally-wound conductor surrounding the same.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 3d day of June, 1902.

SIDNEY GEORGE BROWN.

Witnesses:

T. SELLY WARD,
WALTER J. SKERTEN,