

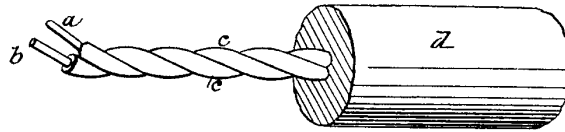
(No Model.)

A. G. BELL.  
TELEPHONE CIRCUIT.

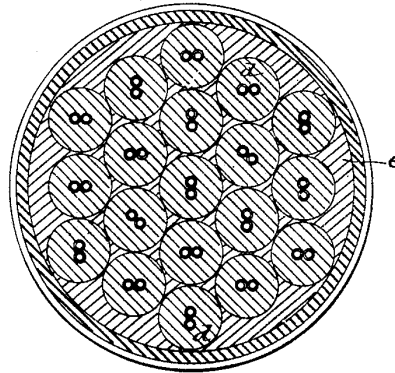
No. 244,426.

Patented July 19, 1881.

*Fig. 1.*



*Fig. 2.*



*Witnesses*

*E. S. Masson.*  
*Philipellaurer*

*Inventor:*

*Alexander Graham Bell*  
*by A. Pollok*  
*his attorney.*

N. PETERS, Photo-Lithographer, Washington, D. C.

# UNITED STATES PATENT OFFICE.

ALEXANDER GRAHAM BELL, OF WASHINGTON, DISTRICT OF COLUMBIA.

## TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 244,426, dated July 19, 1881.

Application filed June 4, 1881. (No model.)

*To all whom it may concern:*

Be it known that I, ALEXANDER GRAHAM BELL, of Washington, in the District of Columbia, have invented a new and useful Improvement in Telephonic Circuits, which improvement is fully set forth in the following specification.

This invention relates to cables for telephone transmission, and has for its object the production of a cable in which the circuits are so arranged that no disturbance will, in use, arise from their inductive action upon one another. The several circuits are composed each of two wires—a direct and a return wire—forming a metallic circuit.

Inductive disturbance in the telephone and in other electrical instruments connected with a metallic circuit when the latter is placed in the neighborhood of other electrical circuits arises from the unequal inductive effect of the latter upon the two wires, for it is obvious that if the direct and the return wire were affected equally the current generated in one would neutralize and destroy that created in the other. The disturbance can be avoided by placing the two wires in the same inductive relation to the disturbing currents, or, other conditions being the same, by placing them at equal distances from the said circuits. This desired result is accomplished in the present invention. The two wires of each circuit are equidistant, or substantially equidistant, from every other wire in the cable.

The wires which are to form the metallic circuit are covered, one or both, with insulating material, and after being placed together are embedded in or surrounded by insulating material. The outer layer of insulating material may in some cases be dispensed with, but in all cases the wires of each pair are insulated from each other and from all the other wires, and are bound together so as to form one strand of the cable. Any desired number of strands are united or held together in any ordinary or suitable way. The two wires of each strand may be laid side by side or they may be twisted. The twisted wires are preferred, as giving the most perfect freedom from inductive disturbance, although they are more liable to become injured by handling than the other form on account of the pressure and rubbing action of

the wires against each other when the conductor or cable is stretched.

With parallel wires, side by side, it is obvious that in a cable composed of numerous circuits the two wires of each strand will not be absolutely equidistant from every one of the other wires; but the difference in the present invention is made of no practical importance by placing wires of each strand very much nearer to each other than to those of any other strand, so much nearer, in fact, that the difference is only a small fraction of the distance of either wire of a strand to the nearest wires of adjacent strands, and the unneutralized current is inappreciable, or does not create serious disturbance.

The desired relation of circuits is secured by providing a very thin coating of insulating material (such as silk or cotton soaked in paraffine) between the wires of each strand and surrounding the pair with a much thicker coating, (such as tarred rope, gutta-percha, perite, or india-rubber.) With twisted wires the relative distances of the wires is of little or no consequence, so far as obviating inductive disturbance is concerned, since by the twist the wires of each pair are brought alternately to the same position relative to the other wires. Where both wires of each strand are well insulated the external envelope of the strand may be omitted, but it is preferred to surround the twisted wires as well as the parallel wires with insulating material.

The accompanying drawings, which form a part of this specification, illustrate what is deemed the best method of carrying the invention into effect.

Figure 1 represents one of the strands of the cable, the view being in elevation, with the insulating-layers partly cut away to show more clearly the construction. Fig. 2 is a view, in cross-section, of the improved cable.

The two wires *a b* of each strand are small copper wires, equal in size. They each have a coating, *c*, of cotton or silk soaked in paraffine, applied in the usual way. After being twisted together they are surrounded with a layer, *d*, of tarred rope, gutta-percha, or other suitable insulating material. A number of these strands are formed into a cable. As shown, they are bound together by an outer

covering, *e*, which is or may be of rope, wire, or a combination of materials.

Cables constructed in accordance with this invention may be used above ground, under  
5 ground, or under water, and the details of construction can be modified to adapt them to the particular circumstances in which they are to be placed.

Having now fully described the said invention and the manner of carrying the same into  
10 effect, I would observe, in conclusion, that I do not claim herein, broadly, as a means for obviating the inductive disturbance of electrical circuits upon each other, the arrangement  
15 of two wires constituting a metallic circuit in the neighborhood of disturbing-wires so much nearer to each other than to any of the disturbing-wires that they are practically equidistant from every one of said disturbing-wires;  
20 nor do I claim herein the twisting of the insulated wires of the metallic circuit for the pur-

pose indicated, for these matters I have claimed in my application for Letters Patent for improvements in telephonic circuits filed June 10, 1878, of which the present application is a  
25 division, and I reserve them for that application; but

What I do claim herein, and desire to secure by Letters Patent, is—

A cable composed of a number of strands each  
30 consisting of two insulated wires arranged as set forth, the wires of each strand being equidistant, or practically equidistant, from the wires of other strands, substantially as described.

In testimony whereof I have signed this  
35 specification in the presence of two subscribing witnesses.

ALEXANDER GRAHAM BELL.

Witnesses:

PHILIP MAURO,  
D. P. COWL.