I. KITSEE.

ELECTRICAL CONDUCTOR.

APPLICATION FILED APR. 10, 1908.

942,332. Patented Dec. 7, 1909.

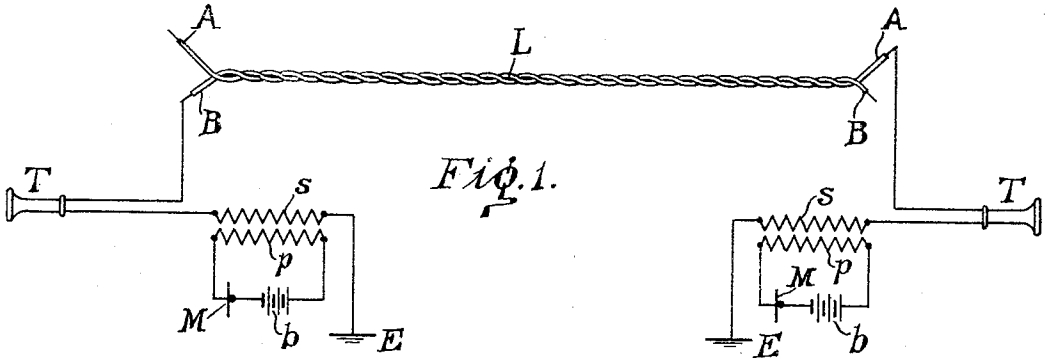
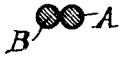


Fig. 1.

Fig. 2.

Fig. 2a.



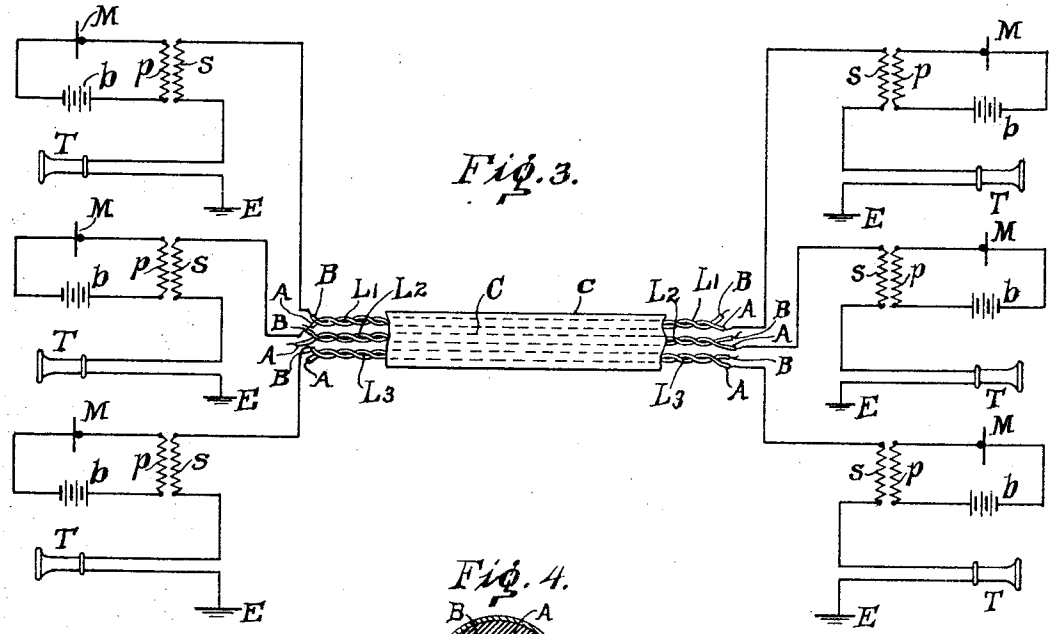
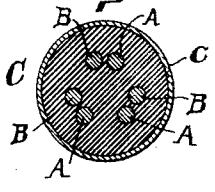


Fig. 3.

Fig. 4.



Witnesses

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ELECTRICAL CONDUCTOR.

942,332. Specification of Letters Patent. Patented Dec. 7, 1909.

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To all whom it may concern:

Be it known that I, ISIDOR KITSEE, a citizen of the United States, residing in the city of Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented a new and useful Electrical Conductor, of which the following is a specification.

My invention relates to the transmission over long distances of fluctuating or varying electric currents or current impulses, and has more especial reference to such complex currents as are characteristic of telephony, though my invention is equally applicable to telegraphy and other signaling, even to the transmission of substantial quantities of energy.

My invention herein described relates to such systems and conductors as disclosed in Letters Patent of the United States Nos. 803,107; 803,109; and 803,110 heretofore granted to me; and my invention relates to composite lines or conductors which are conductively independent of each other but associated in inductive relation whether twisted, simply parallel with each other, or any other relation.

By properly proportioning the resistance of the individual conductors with relation to the resistance of the dielectric or insulating medium between the individual conductors, and by suitably proportioning the absolute or self-capacities of the individual conductors with respect to their mutual capacity, the transmission of varying electric currents over composite conductors is materially improved, and in these improvements my invention resides.

As explanatory of my invention, reference may be had to the accompanying drawing, in which:

Figure 1 is a diagrammatic illustration of a telephone system in which a composite twisted conductor extends between the stations. Fig. 2 is a cross sectional view of one of the forms the composite conductor may take. Fig. 2^A is a cross section of another form the composite conductor may take. Fig. 3 is a diagrammatic illustration of a plurality of telephone stations connected by a plurality of composite conductors disposed as a cable. Fig. 4 is a cross sectional view of one of the forms the cable may take.

Referring to Fig. 1, L represents the composite line conductor comprising the conductively independent conductors A and B twisted together throughout their length. At the left of the line and between the conductor B and earth E are serially connected the telephone receiver T and the secondary *s* of an induction coil or transformer whose primary is *p*. In the primary circuit are connected the usual microphone or transmitter M and the battery *b*. At the other end of the composite conductor L the conductor B is free, that is, not connected to anything, while between the conductor A and the earth E is connected telephone apparatus similar to that at the other end of the line. To improve the transmission over such a composite conductor, I have found that the resistance between conductors, that is, of the dielectric or insulation, must be at least twice the resistance of one of the individual conductors; but to secure the best transmission the resistance between conductors, that is, of dielectric or insulation, should be twice or more than twice the combined resistances of the individual conductors. Furthermore, the individual conductors A and B should nevertheless, while thoroughly insulated from each other, be brought as close together as possible so that the mutual capacity between the conductors A and B shall be great, and greatly preponderate, by at least 50%, over the absolute or self-capacity of an individual conductor. But for best transmission the mutual capacity between the individual conductors should be at least 50% greater than the sum of the self-capacities of the individual conductors A and B. These proportions as to resistance and capacity become more and more important as the distance between stations increases and observation of the above described proportions will greatly improve transmission of telephonic or other varying currents over great distances.

The individual conductors A and B may be disposed as shown in Fig. 2, in cross section. Here the conductors lie close together but are none the less highly insulated from each other, the resistance between them being twice or more than twice the sums of the resistances of the individual conductors A and B. And these conductors are also surrounded by the same insulation which separated them. Or the same proportions are carried out as shown in Fig. 2^A where the individual conductors A and B are individually insulated. Nevertheless, they are disposed so close to each other that their

mutual capacity greatly preponderates over their individual capacities and the resistance between conductors, that is of the dielectric, is twice or more than twice the total resistance of the two conductors A and B. For long distance working, therefore, the conductors, while they may be smaller and of higher resistance than in ordinary telephone circuits, should not be too greatly reduced in diameter and increased in resistance, else their total resistance will become greater than one-half of the resistance of the dielectric between them. But while using conductors of very small diameter and high resistance could satisfy this rule by increasing the distance between conductors so as to have increased dielectric resistance, yet the conductors must be brought close to each other, though highly insulated from each other, so as to have their mutual capacity preponderate over their absolute or self-capacities. To minimize their self- or absolute capacities, the conductors are preferably of such size or surface that their self or individual capacities are small, especially as compared to their mutual capacity.

Fig. 3 shows three composite lines L_1, L_2, and L_3 disposed in a submarine, subterranean or other cable C. Each composite line conductor connects two telephone stations. Each of these composite line conductors is proportioned as hereinbefore described as to resistance and capacity and the three composite conductors insulated from each other and from the cable sheath.

Fig. 4 shows one of the forms a cable of composite conductors may take. The individual conductors of a pair are thoroughly insulated from each other but brought close together so that their mutual capacity shall greatly preponderate over their self or absolute capacities; and the total resistance of the individual conductors is half or less than half of the resistance between the individual conductors. And the insulation between pairs or composite conductors is made much greater than between individual conductors of a composite conductor, and the insulation between the pairs and the cable sheath *c* is made great. The cable sheath *c* may be a continuous metallic sheath or may be braided or twisted wires, or any form of cable sheath.

While in the foregoing figures of the drawing, the composite conductors are shown as composed of conductively independent individual conductors twisted together, it is to be understood that my invention applies also to a composite conductor comprising conductively independently individual conductors which are not twisted, but simply disposed parallel with each other, or in any other manner. In these cases also the mutual capacity is made to preponderate over the self or absolute capacities of the individual conductors and the total resistance of the individual conductors of a composite conductor is made half or preferably less than half the resistance as measured between conductors, that is the dielectric resistance.

While I have herein shown the earth employed as a return, it is to be understood that a conductor may be employed as a return or that a composite conductor proportioned as herein described may be employed as a return conductor. And the same is true of the cable system.

What I claim is:

1. A composite line conductor comprising conductively independent conductors disposed in proximity to each other, the resistance of said conductors being half or less than half the resistance between said conductors.

2. A composite line conductor comprising conductively independent conductors disposed in proximity to each other, the mutual capacity between said conductors being twice or more than twice the absolute capacity of said conductors.

3. A composite line conductor comprising conductively independent conductors disposed in proximity to each other, the resistance of said conductors being half or less than half the resistance between said conductors, and the mutual capacity between said conductors greatly preponderating over the self or absolute capacity of said conductors.

4. A composite line conductor comprising conductively independent conductors disposed in proximity to each other, the resistance of said conductors being half or less than half the resistance between said conductors, and the mutual capacity between said conductors being twice or more than twice the absolute capacity of said conductors.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

ISIDOR KITSEE.

Witnesses:
ANNA E. STEINBOCK,
DANIEL WEBSTER, JR.