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PATENTED SEPT. 18, 1906.

W. C. YEATMAN.
MULTICONDUCTOR CABLE.
APPLICATION FILED JUNE 13, 1903.

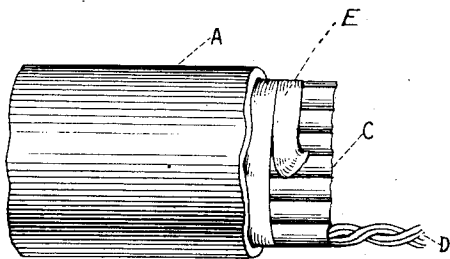


FIG. 1



FIG. 2



FIG. 3

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MULTICONDUCTOR-CABLE.

No. 831,131.

Specification of Letters Patent.

Patented Sept. 18, 1906.

Application filed June 13, 1903. Serial No. 161,334.

To all whom it may concern:

Be it known that I, WALTER C. YEATMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Multiconductor-Cables, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to an improved method of constructing cables or groups of conductors intended for telephone use; and its object is to enable the efficient transmission, without interference, of the electrical impulses over the conductors of the cable, and, more particularly, to enable the efficient transmission of more separate and distinct electrical impulses than there are pairs of wires in the cable.

Arrangements of electrical apparatus to enable additional circuits to be worked over one or more "metallic" telephone-circuits have been known for some time. It has been of common practice to work, with quite satisfactory results, a telephone and telegraph line over a single pair of wires, still leaving the telephone-circuit, a metallic or two-conductor circuit, free from deleterious ground connections. It has also been frequently attempted, with more or less success, to operate a third or "phantom" telephone-line over two such metallic lines. Three distinct types of apparatus are in use for this purpose, so that we have repeating-coil, retardation-coil, and condenser phantom circuits. In each of these systems a neutral point is obtained, so that the electrical impedance between this neutral point and one side of the line is exactly equal to that to the other side of the metallic line. By means of two such neutral points in connection with two metallic telephone-lines a third (phantom) line may be arranged, each side of which will consist of one of the actual metallic lines.

In a telephone-cable the pairs of wires will be twisted pairs of wires, in order to prevent electrostatic and electromagnetic induction between neighboring circuits. In the ordinary manufacture of such cables it is common practice to arrange the pairs in concentric layers, each layer being wound in an opposite direction to that outside and inside of it for mechanical stability. This gives per-

fect working conditions for all actual working pairs in the cable. It may readily be seen, however, that if a large number of phantom lines were connected up in such a cable there would be considerable electrostatic induction between any two such phantom lines, the cable being virtually a straight wire cable for these phantom lines. This has heretofore proved one of the serious difficulties to the introduction of phantom lines. To obviate this difficulty, I arrange my cable in groups of four conductors, each group consisting of two pairs of wires so arranged relatively to each other as not to produce electrostatic induction between the two pairs of a group nor between the phantom of the two pairs of a group and the phantom of the two pairs of another such group. It has been the practice heretofore to accomplish this result by twisting the conductors of two pairs of wires about each other in the same direction and then twisting the two pairs about each other in the opposite direction—for instance, twisting the two conductors of each pair about each other in the direction of a right-handed screw, and then twisting the two pairs about each other in the direction of a left-handed screw. In the method which I prefer to employ, however, the two pairs of wires are twisted in opposite senses—that is, one pair is twisted in a right-handed helix and the other in a left-handed helix, and the two pairs are then twisted together, either in a right or left handed helix, to form the composite conductor of the phantom circuit. It has been found that when two pairs lying adjacent to each other have their conductors twisted with a uniform pitch inductive interference results, the cause being that a conductor in one pair is more nearly parallel to the conductor in the neighboring pair having the same relative position of twist than it is to the conductor of the other pair whose twist is at all points in the opposite half of the cycle. To obviate this cause of interference it has been in some instances the practice to form cables with their adjacent pairs having their conductors twisted together in different pitches, the pitch of twist of the different pairs being varied before the pairs are brought together to form the cable. My arrangement is particularly advantageous in the production of cables or groups of conductors of this character, in that by its use it is possible in the proc-

ess of twisting pairs of conductors together to increase the pitch of one of the pairs and decrease the pitch of the other, so that without initially varying the pitch of the different pairs it is altered in forming the cable or group of conductors and inductive interference between the pairs prevented. While this arrangement is of particular value in connection with the production of cables of grouped pairs adapted for the operation of phantom circuits, it is also of value in the formation of ordinary telephone-cables where the twisted pairs are twisted in concentric layers about a central core.

Referring to the drawings, Figure 1 illustrates a cable constructed in accordance with my invention. Fig. 2 is a view of two groups of conductors twisted about each other, and Fig. 3 represents a single group of conductors.

Fig. 3 shows my preferred method of twisting two pairs of wires about each other to eliminate induction between the two pairs of the group, and between the phantom circuit employing the two pairs as its two conductors and other like phantom circuits or other sources of disturbance. In this figure, A A' represent a pair of wires twisted in one direction, and B B' a pair twisted in the opposite direction, the pairs being then twisted about each other in either direction, as desired—in the present instance in the direction of a right-handed screw. It is obvious that this system might be extended still farther to enable the connection and use of the phantom of a phantom, if desired, by twisting two groups of four conductors, such as those described, about each other. Fig. 2 illustrates two groups of four conductors each twisted about the other for this purpose.

Fig. 1 illustrates a cable made up with groups of conductors, as described. The conductors are shown at C, and may be insulated in any desired manner, such as by a paper

wrapping. A group of four conductors, as described, is shown at D. The insulated conductors may then be covered by a flexible wrapping E, such as cloth, and the whole surrounded by the metallic sheath of lead or lead alloy, which is now common practice.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a cable, a group of four insulated conductors, comprising two pairs of helically-twisted conductors, the conductors of one of said pairs being twisted in a right-handed helix, those of the other pair in a left-handed helix, and the two pairs twisted together, and held together by a wrapping of flexible material, substantially as set forth.

2. A group of four insulated conductors comprising two pairs, the conductors of each pair being helically twisted about each other with a pitch of twist the same for both pairs, the conductors of one of said pairs being twisted in a right-handed helix, those of the other pair in a left-handed helix, and the two pairs twisted together.

3. A group of four insulated conductors, consisting of two pairs of helically-twisted conductors, one of which is twisted in the opposite sense from the other, twisted about each other.

4. A multiconductor-cable, the electric conductors of which are arranged in twisted groups of four insulated conductors, each consisting of two pairs of helically-twisted conductors, one of which is twisted in the opposite sense from the other, twisted about each other.

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

WALTER C. YEATMAN.

Witnesses:

J. S. FORD,

J. M. HUMISTON.