May 22, 1951 J. A. CARR 2,553,747

METHOD AND MEANS FOR TRANSPOSING OPEN-WIRE LINES

Filed Dec. 27, 1946 2 Sheets-Sheet 1

FIG. 2

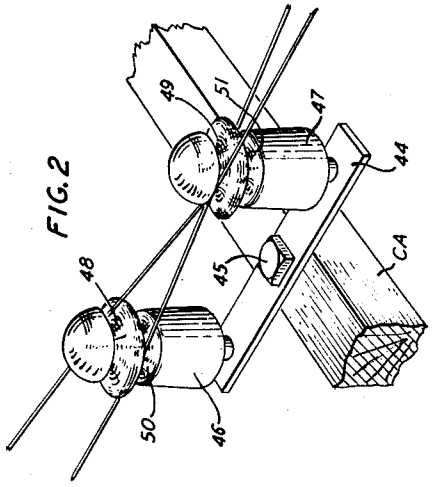

FIG. 1

INVENTOR
J. A. CARR
BY J. MacDonald
ATTORNEY

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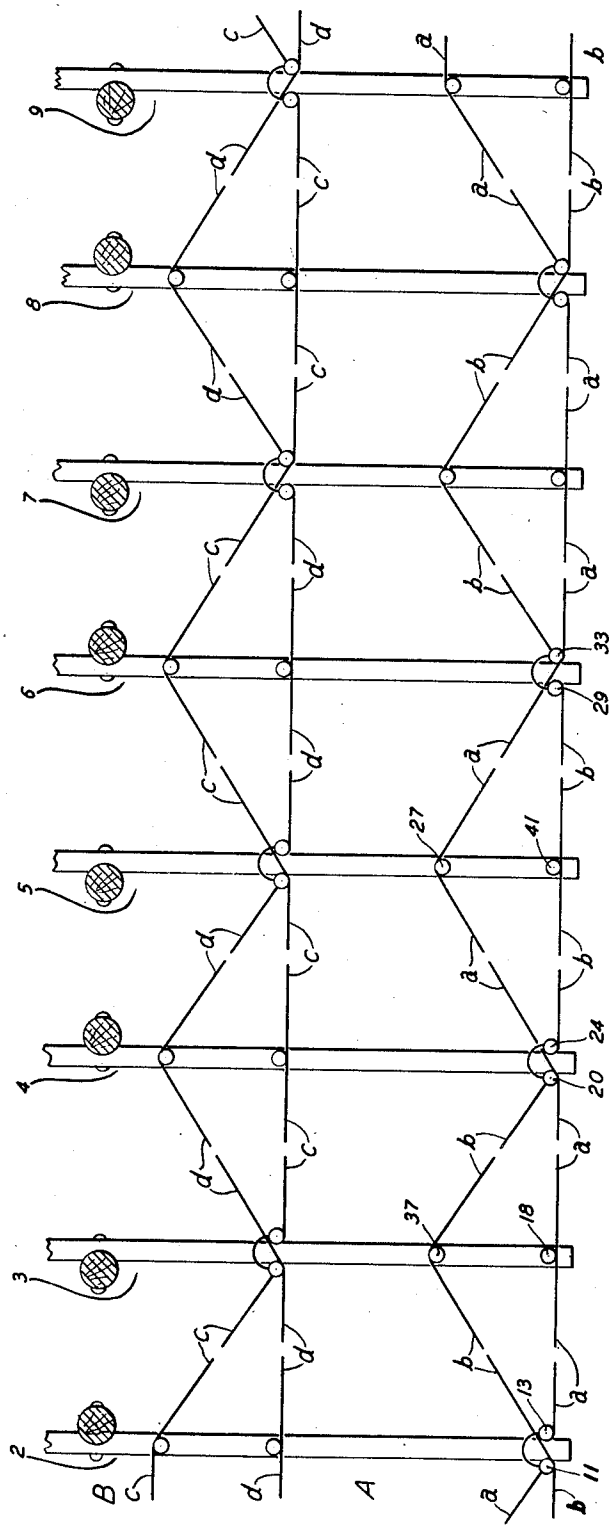

FIG. 3

INVENTOR
J. A. CARR
BY J. MacDonald
ATTORNEY

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METHOD AND MEANS FOR TRANSPOSING OPEN-WIRE LINES

James A. Carr, Maplewood, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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6 Claims. (Cl. 174—33)

1

This invention relates to a method and means for transposing telephone line wires and its object is to provide a method which will overcome some of the difficulties which are encountered in present installations.

In accordance with well-known practice, in the installation of telephone transmission lines, the conductors of the line and in particular those of an open-wire telephone line, are transposed at suitable intervals for the purpose of equalizing the inductive effect between the conductors. These are known as point transpositions and provide means whereby the conductors of a pair exchange pin positions by means of a bracket carrying four insulators which are closely grouped.

It is the general practice to support the conductors, of an open-wire transmission line, by means of suitable insulators mounted on pins which are secured into holes bored at definite intervals in cross-arms which in turn are supported on the telephone poles. The conductors of the transmission lines are each secured to its proper insulator by means of a tie-wire or other suitable means. In order to provide for the transposition of the conductors as above outlined, it has been customary to employ transposition brackets of the type disclosed in United States Patents 1,840,362 and 1,912,456 to Hunter et al. and Klein, respectively. These brackets facilitate the mounting of four or more insulators, at a point of transposition, to which the conductors of the line are secured and between which the transposition is effected. These brackets are relatively costly since at each point of transposition there are required four insulators, four pins for mounting the insulators and the bracket itself.

It is the object of this invention to simplify and reduce the construction cost of open-wire lines in which numerous transpositions must be made. This can be done by eliminating the use of the cumbersome four insulator brackets and provide a bracket and means of installation which will overcome the difficulties heretofore encountered in the establishment of sag equalization between the wires of a given pair, and between adjacent pairs.

This object is obtained, in accordance with a feature of this invention, by the provision of a pivotally mounted bracket having mounted on each end thereof, a suitable insulator pin having a double groove insulator mounted thereon. The conductors of the transmission line are positioned in the grooves of the insulators, cross over each other between the insulators and are free to slide in the grooves, with the accompanying equalization of the sag in the conductors. The equalizing of the sag is further expedited by permitting some movement of bracket which is pivotally supported on the cross-arm. In this way the conductors are transposed and sagged with a minimum amount of time and labor and by eliminating the use of a large bracket and reducing the number of associated insulators and pins, a considerable reduction in the over-all cost of each transposition is effected, which reduces considerably the installation cost of the line itself.

2

In utilizing the improved method and means for effecting point transpositions in open-wire lines, in accordance with the provisions of this invention, many variations and combinations of transpositions may be employed in a given circuit. However, I have determined that highly satisfactory results are obtainable by transposing each pair of wires at every other pole with the transposition thrown in in groups of two so that the direction of conductor cross-over is in the same direction for two succeeding transpositions and the reverse direction on the next succeeding transpositions and so on to the end of the line. For example, the cross-over at the transposition bracket on the first pole would be left over right, at the next pole there would be no transposition and the conductors would be mounted on the regularly spaced insulators mounted on the pins on the cross-arm. At the next pole the conductors would again cross, left over right at the transposition bracket and at the next pole there would be no transposition as above heretofore mentioned. At the next pole the conductor at the transposition bracket would cross, right over left, the next pole would have no transposition bracket mounted on the cross-arm thereof, but the next succeeding pole would also have a conductor cross right over left on its transposition bracket; this sequence of transposing conductor, that is, left over right in pairs and then right over left in pairs with a non-cross-over position therebetween would be continued on the poles for the continuance of the line.

In order to limit cross-talk between adjacent circuits, the transposition on any two adjacent pairs is staggered so as to fall on different cross-arms. For example, if the cross-arms are numbered consecutively, this will result in transposing one half of the circuit on the even numbered cross-arms and the other half on the circuits of the odd numbered cross-arms.

Due to the simplicity and uniformity of the design, the method of transposing telephone transmission lines in accordance with this invention may be easily laid out and installed by the construction forces without requiring any specific en-

gineering. In addition it will not be necessary to keep detailed records of the location of transposition points, and circuit extensions may be made by merely continuing the transposition schemes without regard to basic sections.

The improved bracket employed in the transposition method as set forth in this invention is relatively inexpensive and since the length of conductor required to transpose with this type of bracket is relatively small, for span length in the range of 450 feet, the transposition can be thrown after the conductors have been tensioned in long sections without readjusting the sag.

Other features of this invention will be readily understood from the following detailed description, made with reference to the accompanying drawings in which:

Fig. 1 is a fragmentary view in perspective of a telephone transmission line employing the method of effecting the necessary transpositions and the relation of the transpositions to each other in adjacent circuits.

Fig. 2 is an enlarged fragmentary view of the transposition bracket employed in effecting the transpositions as shown in Figs. 1 and 3.

Fig. 3 is a diagrammatic showing of a telephone transmission line constructed in accordance with the present invention and illustrates schematically the arrangement of the circuit as shown in Fig. 1.

In Fig. 1 of the drawing, there is shown a portion of a completed telephone transmission line comprising two circuits constructed in accordance with one of the preferred embodiments of this invention. However, for the sake of clarity, the poles supporting the cross-arms 2, 3, 4, 5 and 6 have been omitted, since it is well-known how the usual cross-arms are supported on telephone poles.

With reference to Fig. 1, the cross-arms 2, 3, 4, 5 and 6 are supported on the usual poles (not shown) and are spaced apart the required distance for the particular type of wire employed and for the particular type of circuit. Located on each cross-arm are insulating means for supporting the conductors. As shown in Fig. 1, and in the schematic showing in Fig. 2, there are two separate circuits A and B. Circuit A comprises a pair of conductors *a* and *b* and circuit B comprises a pair of conductors *c* and *d*. While each of these circuits are separate and are independent of each other and may be constructed and used one without the other, it is when they are located adjacent each other that means must be provided not only to prevent inductive interference between the wires of the pair, but to prevent induction and cross-talk between the conductors of the adjacent circuit.

In Fig. 1 as heretofore mentioned, there is shown two circuits A and B, circuit A comprising conductors *a* and *b* and circuit B comprising conductors *c* and *d*. Considering first circuit A, which as heretofore explained comprises a pair of conductors *a* and *b*, and may be run as a single circuit and installed singly on a cross-arm or it may form one of many circuits of similar nature mounted adjacent each other on a common cross-arm. As shown, the conductors *a* and *b* of circuit A are installed on the cross-arms, 2, 3, 4, 5 and 6 in such a manner that on cross-arm 2, conductor *a* which is the left-hand conductor, engages the inside of the upper groove 10 of the insulator 11 and the outside of upper groove 12 of the insulator 13. Insulators 11 and 13 are mounted on suitable pins 14 and 15 which in turn

are secured on the bracket 16. The bracket 16 is pivotally supported on the cross-arm 2 by means of a suitable bolt 17. The conductor *a* is now positioned on the inside of insulator 11 and on the outside of insulator 13 in the grooves thereof and has assumed a diagonal position with respect to the bracket 16 and is now the right-hand conductor located on the outside of upper groove 12 in insulator 13. Conductor *a* which is now the right-hand conductor, passes over cross-arm 3 and is secured to insulator 18 mounted on outside pin 19, which in turn is secured to the cross-arm 3. The insulator 18 is one of a pair of normally spaced insulators mounted on the cross-arm 3. From the insulator 18, conductor *a* extends over the cross-arm 4 and is positioned on the outside of insulator 20 which is mounted on pin 21 secured to the pivotally mounted bracket 22 on the cross-arm 4, in the lower groove 23 thereof. Conductor *a* then crosses the arm 22 diagonally and is positioned on the inside of the insulator 24 mounted on pin 25 in the lower groove 26. From the inside of insulator 24, the conductor *a*, which now again assumes the position of left-hand conductor, passes over cross-arm 5 and is secured to insulator 27, mounted on the inside pin 28 which is secured to the cross-arm 5, from insulator 27, conductor *a* extends over the cross-arm 6 and is positioned on the inside of insulator 29 which is mounted on pin 30 which in turn is secured to the pivotally mounted bracket 31 on the cross-arm 6, in the lower groove 32 thereof. Conductor *a* then crosses the arm 31 diagonally and is positioned on the outside of insulator 33, mounted on pin 34. From the outside of insulator 33, conductor *a*, which now assumes the position of right-hand conductor, extends to the next succeeding cross-arm (not shown) where it is secured to a regularly spaced insulator as heretofore described with regard to the other tansposition.

This sequence of alternate transposing of the conductors in groups of left over right and left over right, separated by a pair or regularly spaced insulators and right over left and right over left also separated by a pair of regularly spaced insulators is repeated the entire length of the transmission line or until conditions warrant the conductors of the pair to bet spaced in uniform fashion.

Conductor *b* which is the other conductor of the pair which make up the circuit A, extends in a similar manner to that of conductor *a* and as shown, in the drawings, is the right-hand conductor and is located on the outside of insulator 11 in the lower groove 35, extends diagonally across the bracket 16 and is positioned on the inside of insulator 13 in the lower groove 36 and is now the left-hand conductor. Conductor *b* passes over the cross-arm 3 and is secured to insulator 37 mounted on the inside pin 38 which in turn is secured to the cross-arm 3. From insulator 37, conductor *b* extends over the cross-arm 4 and is positioned on the inside of the insulator 20 in the upper groove 39 thereof, extends diagonally across the bracket 22 and is positioned on the outside of the insulator 24 in the upper groove 40 thereof. From the outside of insulator 24, conductor *b* which has now assumed the position of right-hand conductor, passes over cross-arm 5 and is secured to the insulator 41 mounted on pin 42 which is secured to the cross-arm 5. The conductor *b* extends from the insulator 41, over cross-arm 6 and is positioned

on the outside of the insulator **29**, in the upper groove **43** and extends diagonally across the bracket **31** and is positioned on the inside of insulator **33** in the upper groove **44** thereof, and now assumes the position of a left-hand conductor. From the inside of insulator **33**, conductor *b* extends to the next cross-arm (not shown) and continues on in a like manner as heretofore described with reference to conductor *a*.

From the above, it will be readily observed that at alternate poles we have transposed conductors *a* and *b* of circuit A and as shown, the transpositions are in pairs, that is, at the cross-arms **2** and **3** we have the conductors crossing left over right. We then have a non-transposed position at the next cross-arm and at the two following transposed positions on alternate cross-arms, we have the conductors crossing right over left, i. e., left over right at **2**, no cross-over at **3**, left over right at **4**, no cross-over at **5**, right over left at **6**, no cross-over at **7** and right over left at **8**. This sequence of transposed and non-transposed positions is continued the entire length of the line.

From the above, it will be observed that the conductors *a* and *b* converge and cross-over at the transposed positions and then diverge in the direction of the non-transposed position. As the conductors leave the non-transposed position they converge as they approach the next transposed position. This converging and diverging and crossing over of the conductors *a* and *b* with the cooperation of the pivoted transposition bracket, which mounts the double groove insulators, permits the operation of open wire circuits with a minimum amount of cross-talk between adjacent circuits and inductive interference between the conductors of a pair and foreign conductors.

As shown in Figs. 1 and 3, there is also shown, mounted on the cross-arms **2**, **3**, **4**, **5** and **6**, an additional circuit B which comprises the conductors *c* and *d*. These conductors are installed in the same manner as conductors *a* and *b* of circuit A except that the transpositions are staggered and are located on the odd number cross-arms wherein in circuit A the transpositions are located on the even number cross-arms.

In Fig. 2 there is shown, in detail, a portion of a cross-arm CA having mounted thereon an insulator supporting bracket **44**, this bracket is pivotally supported on the cross-arm CA by means of the bolt **45** and has positioned thereon a pair of insulators **46** and **47** provided with upper grooves **48** and **49** and lower grooves **50** and **51**.

As shown in Fig. 2, the conductors are positioned in these grooves and cross-over one above the other and diverge as they extend to the insulators on the next adjacent cross-arm (not shown). Due to the arrangement shown no tie wires are needed at the insulators to secure the wires of the conductors thereto and the conductors may be tensioned and sagged with a minimum amount of time and effort, and as a matter of fact the wires of the conductors may be strung along the cross-arms, tensioned and the transposition thrown in without materially disturbing the initial tension of the line.

While I have shown and described the preferred embodiment of my invention, it is obvious that various changes and modifications may be made therein and I am not limited to any specific sequence or spacing of the transposed positions and I am only limited by the appended claims.

What is claimed is:

1. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, mounted on certain other supports, and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper grooves of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom, said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator of the pair to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

2. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, mounted on alternate supports and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper grooves of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom, said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator of the pair to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

3. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, pivotally

mounted on certain other supports and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper grooves of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom, said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator of the pair to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

4. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, pivotally mounted on alternate supports and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper grooves of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom, said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

5. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, mounted on said supports in staggered relation and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper groove of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator of the pair to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

6. A telephone transmission line comprising one or more circuits, each of said circuits comprising a pair of spaced-apart conductors, insulator supports located at regular intervals along the length of said conductors, certain of said supports having wire supporting insulators mounted thereon in normal transverse space relation, conductor transposing means comprising an elongated bracket having a pair of transposition insulators mounted in tandem relation thereon, pivotally mounted in staggered relation on said supports and so positioned that the bracket extends in the direction along the transmission line, said transposition insulators having upper and lower grooves therein, one of the conductors in each pair located in the lower grooves of said transposition insulators, extending diagonally between and positioned on opposite sides of each pair of transposition insulators, the other conductor of the pair located in the upper grooves of said transposition insulators, crossing diagonally over said first conductor and substantially spaced therefrom, said conductors converging on one transposition insulator of a pair from certain of said normally spaced insulators and diverging from the other transposition insulator of the pair to certain other normally spaced insulators, the normally spaced insulators being located along the conductors at such intervals that the conductors make angles with the transposition insulators to retain the conductors in the grooves of the transposition insulators.

JAMES A. CARR.

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