

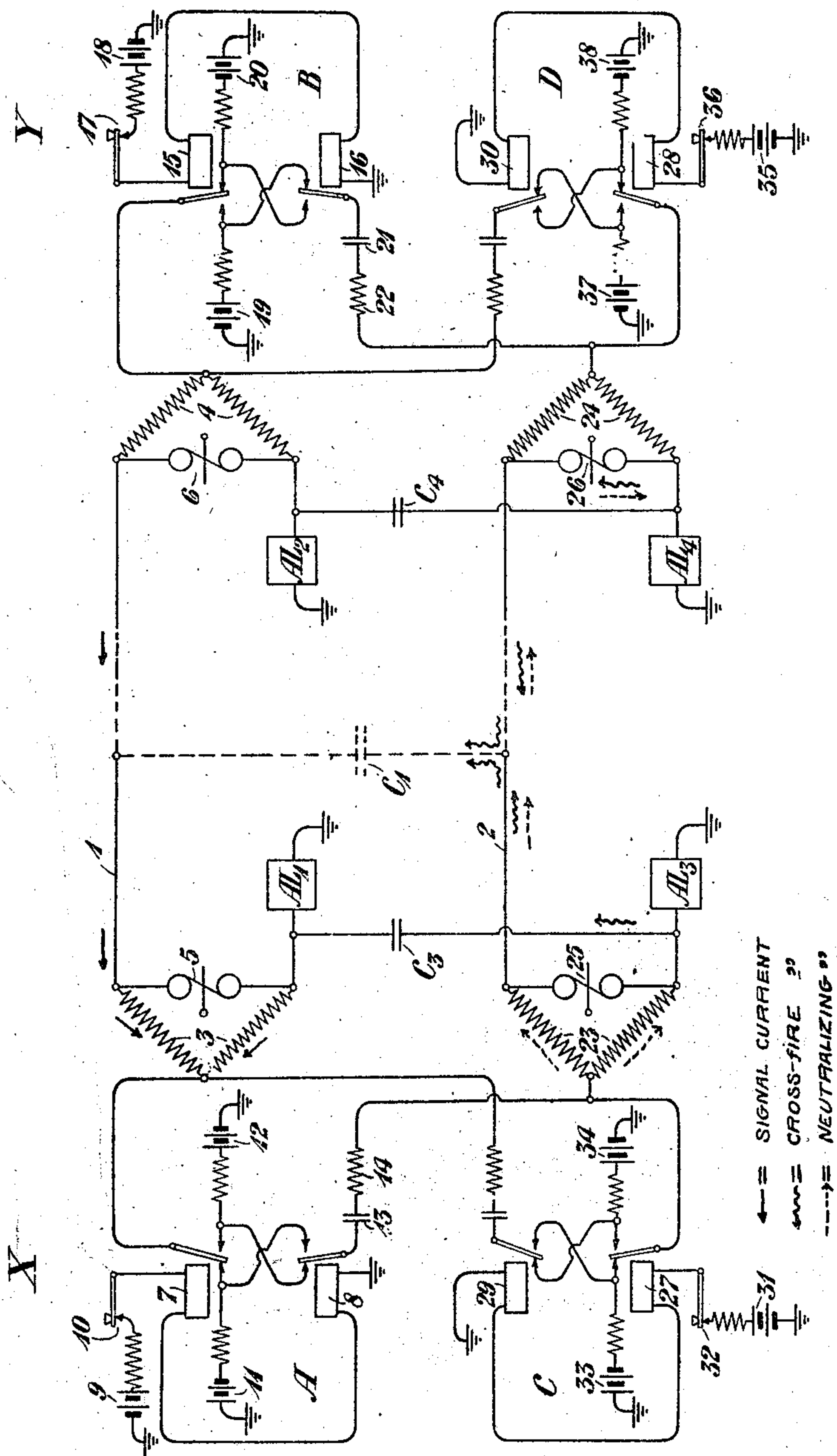
May 20, 1924.

1,494,382

R. B. SHANCK

MEANS FOR PREVENTING ELECTRICAL INTERFERENCE

Filed May 27, 1921



Inventor
R. B. Shanck

By his Attorney

J. E. Forre

UNITED STATES PATENT OFFICE.

ROY B. SHANCK, OF FLUSHING, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

MEANS FOR PREVENTING ELECTRICAL INTERFERENCE.

Application filed May 27, 1921. Serial No. 473,118.

To all whom it may concern:

Be it known that I, ROY B. SHANCK, residing at Flushing, in the county of Queens and State of New York, have invented certain Improvements in Means for Preventing Electrical Interference, of which the following is a specification.

This invention relates to means for preventing electrical interference between signaling circuits and specially to an arrangement for preventing that form of interference between telegraph circuits which may be termed "receiving-end cross-fire".

In the operation of telegraph signaling circuits it is well known that when impulses are transmitted over one telegraph circuit an interfering current will be set up in other circuits paralleling the first circuit due to the mutual admittance between the circuit over which the impulses are being transmitted, and the circuits paralleling the same. This interfering current will cause a disturbance in the terminal apparatus at both ends of the circuit in which the current is produced. The disturbance which is set up in the terminal apparatus of said other circuit which is located in the same station in which is also located the terminal apparatus from which the impulses are being sent over the first mentioned circuit, may be termed sending-end cross-fire. The disturbance which is set up in the terminal apparatus of said other circuit which is located in the same station in which is also located the receiving apparatus of the said first mentioned circuit, may be termed receiving-end cross-fire. Sending-end cross-fire has been successfully neutralized in circuits by connecting a condenser between the artificial lines of the duplex circuits.

It is the object of this invention to provide a circuit arrangement for substantially neutralizing the receiving-end cross-fire without increasing the sending-end cross-fire such as has resulted from the use of arrangements heretofore designed for this purpose.

Other and further objects of this invention will be apparent from the following description when read in connection with the attached drawing showing one form of embodiment of the invention.

In the drawing, 1 and 2 represent two telegraph signaling circuits which have associated therewith the terminal circuits A and C respectively at station X and B and D respectively at station Y. The opposite ends of the line 1 are connected with one of the windings of the bridge coils 3 and 4 respectively to the apexes of which are connected the terminal circuits A and B respectively. Across the outer terminals of the bridge coils 3 and 4 are connected the polar relays 5 and 6 respectively. The balancing networks AL_1 and AL_2 are connected with one winding of the bridge coils 3 and 4 respectively to balance the line 1 connected with the said other winding of the said coils.

The terminal circuit at A comprises a pole changer 7 and an auxiliary relay 8 which are controlled by current from the battery 9 by the operation of the key 10. Batteries 11 and 12 are connected with the contacts of the armatures of the pole changer 7 and the auxiliary relay 8. Since opposite poles of these batteries are grounded, current of opposite polarity will be applied to the two contacts of the pole changer and of the auxiliary relay. The armature of the pole changer 7 is connected with the apex of the bridge coil 3 and the armature of the auxiliary relay 8 is connected through the condenser 13 and resistance 14 with the apex of the bridge coil 23, associated with the line 2.

The terminal circuit B, located at station Y at the opposite end of line 1, comprises a pole changer 15 and an auxiliary relay 16, a key 17 and a source of current 18 for energizing the said pole changer and auxiliary relay. Batteries 19 and 20 are arranged to apply current of opposite polarities to the armature of the pole changer and also to the armature of the auxiliary relay. The armature of the pole changer is connected with the apex of the bridge coil 4, and the armature of the auxiliary relay 16 is connected through condenser 21 and resistance 22 to the apex of the bridge coil 24, connected with the line 2.

Bridged across the ends of the windings of the bridge coils 23 and 24 are the polar relays 25 and 26 respectively. These coils

also have associated with them the artificial lines AL_3 and AL_4 which are adapted to balance the line 2. The terminal circuit C, which is similar to circuits A and B, comprises pole changer 27 and an auxiliary relay 29 controlled by current from the battery 31 by means of the key 32. Batteries 33 and 34 are adapted for connection with the armatures of the pole changer and the auxiliary relay. Similarly circuit D comprises the pole changer 28 and the auxiliary relay 30, which are controlled by current from the battery 35 by means of the key 36. Batteries 37 and 38 are adapted for connection with the armatures of the pole changer and the auxiliary relay respectively. The armatures of pole changers 27 and 28 are connected with the apexes of bridge coils 23 and 24 respectively, and the armatures of the auxiliary relays 29 and 30 are connected through condensers and resistances with the apexes of the bridge coils 3 and 4 respectively.

It will be seen that all of the terminal circuits are structurally identical and that the terminal circuits at the same end of each line are so arranged that the armature of the auxiliary relay of each terminal circuit is connected with the apex of the coil of the other line circuit. The admittance between the two parallel lines 1 and 2 is represented by the condenser C_1 shown in the drawing as bridged across the said lines at their mid-points. It is to be understood, of course, that such representation is purely symbolic since such capacity is normally uniformly distributed throughout the length of the parallel conductors.

Having in mind the foregoing description of the signaling system in which this invention is embodied, the invention can be more clearly understood from the following description of the mode of operation of the system: Let it be assumed that telegraphic impulses are being transmitted from station X to station Y over line 1 and that at the same time no impulses are being transmitted over line 2 in either direction between said station. If the signaling key 10 of circuit A, which is connected with line 1, is closed, the pole changer 7 and the auxiliary relay 8 will be energized, thereby causing their respective armatures to move to their left-hand contacts thus applying a negative impulse through the armature of the pole changer to the apex of the coil 3 associated with line 1 and a positive impulse from battery 12 through the armature of relay 8 to the apex of coil 23 associated with line 2. The negative signaling impulse applied to line 1 will tend to cause interfering current to flow in line 2 in the directions represented by the wavy arrows. The effect of this interfering impulse upon the receiving apparatus 26 at station Y will be neutralized

by the impulse of opposite polarity represented by the dotted arrows which was impressed upon line 2 by the operation of the auxiliary relay 8 simultaneously with the impression of the signaling impulse upon line 1. This neutralizing impulse will be transmitted over line 2 towards the distant end, and, although it may be reduced in magnitude by such transmission, it will be capable of neutralizing the resultant interfering impulse which is also attenuated by transmission. It is, of course, to be understood that the interfering impulse produced in line 2 by the signaling impulse impressed upon line 1 is not as great as the original signaling impulse and, consequently, the neutralizing impulse impressed upon line 2 by the operation of the auxiliary relay associated with circuit A need be only of sufficient magnitude to neutralize the interfering impulse. The directions of flow of the signaling, interfering and neutralizing currents for the circuit conditions just described are as shown by the various arrows upon the drawing.

If the signaling key 10 is opened for the transmission of a signal of opposite character between station X and station Y, the armatures of the pole changer 7 and the relay 8 will move to their right-hand contacts, thereby applying a positive impulse from battery 12 through the armature of the pole changer 7 to the apex of the coil connected with the line 1 and a negative impulse from battery 11 through the armature of the auxiliary relay 8 to the apex of the coil connected with line 2. The positive impulse which is produced in line 2 by the impression of the positive impulse to line 1 will be neutralized by the negative impulse of corresponding magnitude applied to line 2 by the operation of the auxiliary relay 8. The directions of flow of the signaling, interfering and neutralizing currents for the circuit conditions just described will be opposite to that represented by the arrows upon the drawing. By careful adjustment the interfering impulses may be substantially neutralized, and the receiving apparatus 26 associated with the end of line 2 at station Y, where signals are being received over line 1, will not be affected by the cross-fire between line 1 and line 2. It will also be seen that since the neutralizing impulses applied to the line under cross-fire are directed to the apex of the coil connected with the said line, no detrimental effect will be produced in the receiving apparatus, such as 25, connected with the said line.

In like manner it will be seen that if signals are transmitted from station Y to station X over line 1 and line 2 is idle as heretofore, the polar relay 25 connected with line 2 and located at station X will not be affect-

ed by interfering impulses produced in line 2 by the transmission of signaling impulses over line 1.

Let it now be assumed that signals are being transmitted simultaneously over lines 1 and 2 from station X to station Y. When key 10 associated with the terminal circuit A is closed, the pole changer 7 and the auxiliary relay 8 will be energized, and in consequence there will be impressed upon line 1 a negative impulse and upon line 2 a positive impulse which will serve to neutralize the interfering impulse produced in line 2 by the transmission of the signal over line 1. When key 32 is closed, pole changer 27 and the auxiliary relay 29 will be energized, and in consequence a negative signaling impulse will be impressed upon line 2 and the positive neutralizing impulse upon line 1, which will serve to neutralize the interfering impulse produced in line 1 by the impression of the signaling impulse upon line 2. Accordingly, the receiving apparatus 6 and 26 connected with lines 1 and 2 respectively are rendered substantially free from the effect of cross-fire, although they will respond in the usual way to the transmission of the signaling impulse over their respective lines.

Although this invention has been shown as applied to two line circuits only, it is not thus limited, but is equally applicable to a system employing a greater number of line circuits. Furthermore, the invention is not limited to the particular form of circuit arrangement herein disclosed, since it might be embodied in other and different arrangements which will suggest themselves to those familiar with the art. The essence of this invention consists in the method and means for neutralizing receiving-end cross-fire by applying to the circuits exposed to cross-fire a neutralizing impulse simultaneous with the application of a signaling impulse over another circuit, the polarity of the neutralizing impulse being opposite that of the signaling impulse and of such magnitude as to substantially equal the impulse produced in the exposed circuits by the signaling impulse transmitted over the said other circuit.

It will be seen from the foregoing description that my invention discloses simple and effective means for protecting parallel telegraph circuits against receiving-end interference. Furthermore since the condensers C_3 and C_4 , which are connected between the artificial line sides of each end of the circuits, are adapted to substantially neutralize sending-end interference, the effect of both the sending-end and the receiving-end interfering currents may be substantially reduced and the circuits rendered substantially free from interference by means of the arrangement herein disclosed.

Although this invention has been described as embodied in a particular form and ar-

range ment of parts, it is to be understood that it is capable of embodiment in other forms and arrangements without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a telegraph signaling system comprising a plurality of adjacent circuits, the method of reducing receiving-end cross-fire between said adjacent circuits when signaling impulses are impressed upon one of said adjacent circuits which consists in impressing upon the other of said adjacent circuits impulses of a character adapted to neutralize the interfering impulses produced at the distant receiving station thereof by the transmission of signaling impulses over one of the said circuits.

2. In a telegraph signaling system comprising a plurality of adjacent circuits, the method of reducing receiving-end cross-fire between said adjacent circuits, which consists in impressing upon one of said adjacent circuits an impulse of opposite polarity to the signaling impulse impressed upon the other of said adjacent circuits.

3. In a telegraph signaling system comprising a plurality of adjacent circuits, the method for reducing receiving-end cross-fire between said adjacent circuits which consists in impressing a signaling impulse upon one of said circuits, and in simultaneously impressing an impulse of opposite polarity upon each of the other of said adjacent circuits.

4. In a telegraph signaling system comprising a plurality of adjacent circuits, the method for reducing receiving-end cross-fire between said adjacent circuits which consists in impressing a signaling impulse upon one of said circuits, impressing an impulse of opposite polarity upon other of said circuits, and in reversing the polarity of the source of current connected with the latter of said circuits whenever the polarity of the source connected with the former circuit is reversed.

5. In a telegraph signaling system, the combination with two adjacent line circuits, of sending circuits and receiving circuits individual to each line circuit, each sending circuit being characterized by means for applying a signaling impulse to its respective line circuit, and also to apply simultaneously an impulse of opposite polarity to the other of said adjacent circuits whereby receiving-end cross-fire in the said other circuits may be reduced.

6. In a telegraph signaling system, the combination with two line circuits of polar duplex terminal circuits individual to each of said line circuits, each of said terminal circuits being adapted to apply a signaling impulse to the apex of the bridge coil of its respective line circuit, and also to apply

simultaneously to the apex of the coil of the other line circuit an impulse having a polarity opposite to that of the signaling impulse.

- 5 7. In a telegraph signaling system, the combination with a line circuit of a second line circuit, a sending circuit and a receiving circuit individual to each of said line circuits, means associated with each of said
10 sending circuits to apply a signaling impulse to its respective line circuit and to control the simultaneous application to the other of said line circuits of an impulse of opposite polarity to the signaling impulse.
- 15 8. In a telegraph signaling system, the combination with a plurality of line circuits, each having a bridge coil, a balancing network and a polar relay connected at each end, a terminal circuit individual to each
20 line circuit comprising a pole changer controlled by a key adapted to apply signaling impulses of predetermined polarity to the said line circuit, and an auxiliary relay also controlled by the said key adapted to apply
25 to each of said other line circuits impulses of polarities opposite to the signaling impulses applied to the line circuit with which a particular terminal circuit may be connected.
- 30 9. In a telegraph signaling system, the combination with a line circuit of a second line circuit, a terminal circuit individual to

each line circuit comprising sources of current of opposite polarity and means for applying simultaneously impulses of opposite polarity to each of said line circuits.

33

10. In a telegraph signaling system, the combination with a line circuit of a second line circuit, a terminal circuit individual to each line circuit comprising sources of current of opposite polarity, means for applying a signaling impulse of predetermined polarity to the respective line circuits and means for simultaneously applying an impulse of opposite polarity to the line circuits other than that to which the signaling
45 impulse is applied.

11. In a telegraph signaling system, the combination with a line circuit of a bridged duplex terminal circuit connected with each end thereof, each of said terminal circuits
50 comprising a key, a pole changer, sources of current of opposite polarity, and an auxiliary relay, the circuit being so arranged that the armature of the pole changer is connected with the line circuit to which the said
55 terminal circuit is individual and the armature of the auxiliary relay is connected with the other adjacent line circuits.

In testimony whereof, I have signed my name to this specification this 24th day of
60 May, 1921.

ROY B. SHANCK.