No. 717,776. PATENTED JAN. 6, 1903.

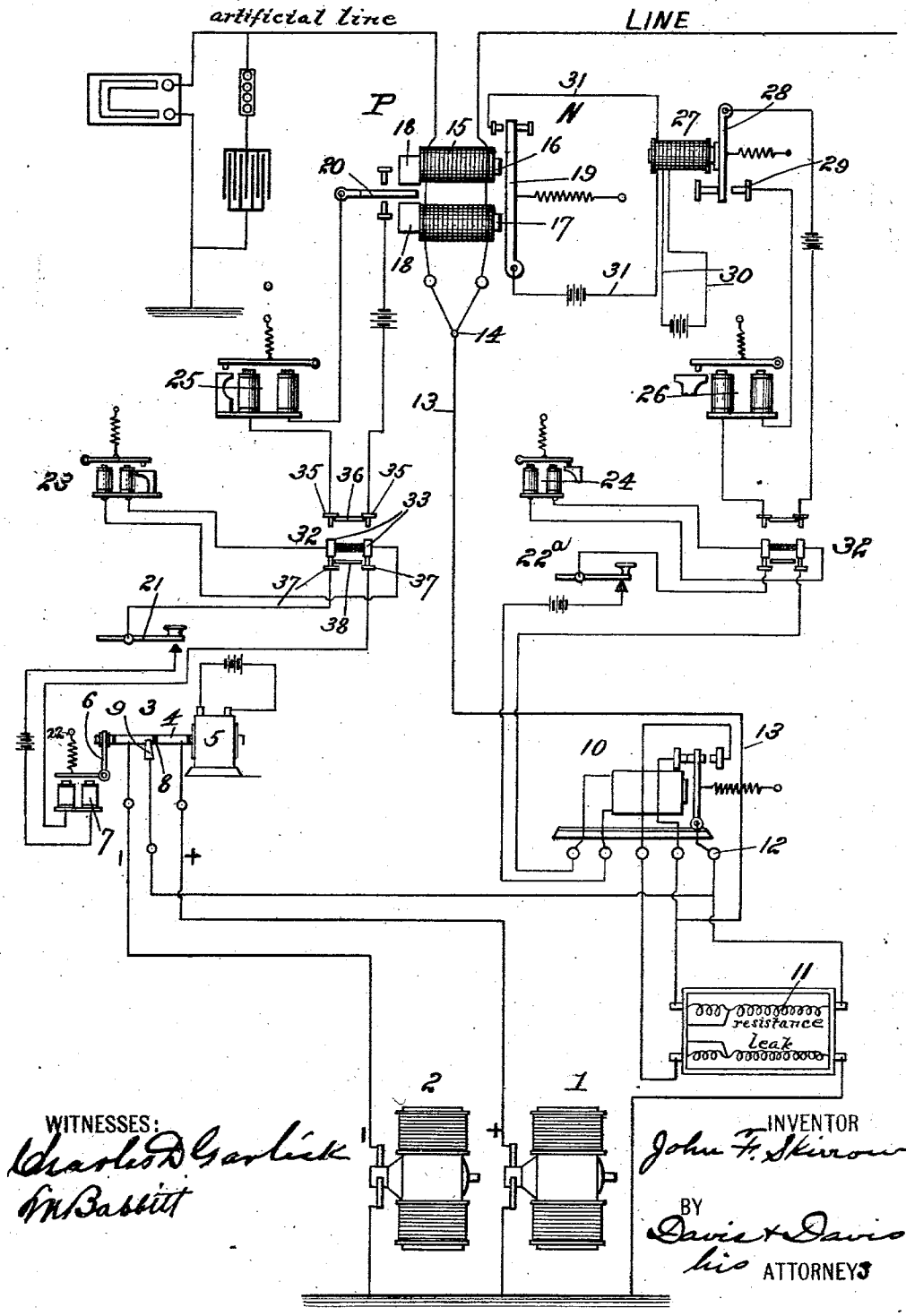
J. F. SKIRROW.

QUADRUPLEX TELEGRAPH SYSTEM.

APPLICATION FILED NOV. 8, 1901. RENEWED DEC. 5, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

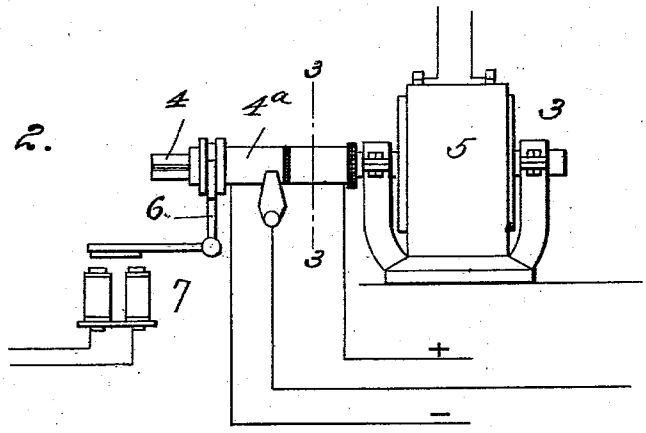


Fig. 3.

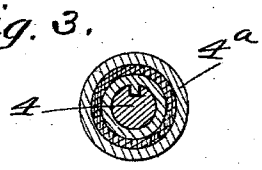
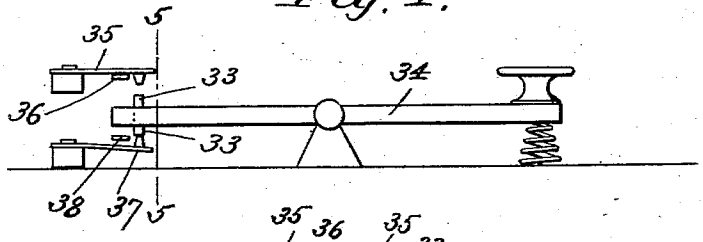


Fig. 4.



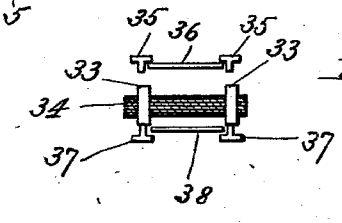


Fig. 5.

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JOHN F. SKIRROW, OF EAST ORANGE, NEW JERSEY.

QUADRUPLEX TELEGRAPH SYSTEM.

SPECIFICATION forming part of Letters Patent No. 717,776, dated January 6, 1903.

Application filed November 8, 1901. Renewed December 5, 1902. Serial No. 134,046. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. SKIRROW, a citizen of the United States, residing at East Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Quadruplex Telegraph Systems, of which the following is a specification, reference being had therein to the accompanying drawings, in which—

Figure 1 is a theoretical diagram of one end of a dynamo quadruplex system; Fig. 2, a detail side elevation of the pole-changer or polarity-transmitter; Fig. 3, a detail sectional view taken on the line 3 3 of Fig. 2; Fig. 4, a detail side elevation of the break-key; Fig. 5, a detail sectional view taken on the line 5 5 of Fig. 4.

One object of this invention is to provide a differentially-wound double-acting relay-magnet having two separated cores, one pair of adjoining ends of which form the neutral relay and the other pair of ends the polarized relay, whereby one instrument will serve the same purpose as the neutral relay and the independent polarized relay of the old form.

Another object of the invention is to provide an improved pole-changer or polarity-transmitter in which the connections will be made through normally engaged contacts, one of which will be moved by the magnet in the local sending-circuit to shift the contacts one on the other to change the polarity, thereby doing away with the objectionable features of the present style of walking-beam pole-changer in which platinum points are employed.

Another object of the invention is to provide a "break-key" or cutting-in key in each side of a quadruplex system or one at each end of a duplex system, whereby either one of the operators may cut the sending-sounder in circuit with the receiving-sounder in order that the sending-operator may receive on his own sounder whenever it is desirable and in that way be quickly and accurately informed by the operator on the other end of the line of his desire for repetitions of the message or parts thereof for the purpose of correcting errors or omissions. This cutting-in key, as shown in the drawings, places the sending-sounder in circuit with the receiving-sounder without interfering with the sending-circuit; but it is obvious that it may be arranged in such a manner that when the sending-sounder is cut into the circuit of the receiving-sounder the sending-circuit will be broken.

A further object of the invention is to provide means for securing positive and clear signals on the neutral side of a quadruplex system. It is well known that the signals on the neutral side are not clear, because the armature of the neutral relay will vibrate and make false contacts during the reversal of the polarity of the line-current. By means of the devices shown in the drawings this difficulty is avoided and clear and positive signals are secured.

In Fig. 1 of the drawings is shown a theoretical diagram of one end of a dynamo quadruplex system, in which numeral 1 designates the positive dynamo, and 2 the negative dynamo, the terminals of which are connected to the shaft 4 of the pole-changer or polarity-transmitter 3. This shaft is rotated by means of the motor 5, which is suitably driven, said shaft being mounted in such a manner that it may be moved endwise by means of a lever 6, operated by magnet 7 of the sending-key 21 of the polarized side. The shaft of the pole-changer is divided about midway its ends into two parts, which parts are insulated from each other, as at 8, the positive dynamo being connected to one part of the shaft and the negative dynamo being connected to the other part. Bearing on this shaft about midway the ends thereof is a brush or contact-point 9, which is connected to the line 13 through the transmitter 10. Connected also to this contact-point or brush is the added resistance 11, said added resistance being also connected to the line 13 in the usual manner.

Instead of moving the shaft of the motor a sliding sleeve 4^a, Fig. 2, may be mounted thereon and the lever 6 be arranged to shift said sleeve. This sleeve is divided and the sections are insulated from each other and from the shaft of the motor and are connected to the terminals of the dynamos.

It will be readily understood that instead of moving the shaft or the sleeve thereon the contact-point or brush may be moved by the magnet 7.

The double-acting differentially-wound re-

lay 15 is formed with a polar side (marked P) and with a neutral side (marked N) and consists of two straight disconnected cores 16 and 17, which are differentially wound, said cores at one of their ends being enlarged, as at 18. Between these enlarged ends of the cores is mounted to vibrate the magnetized armature 20 of the polarized relay. This armature may be magnetized by a permanent magnet or by a coil, as desired. The other ends of these cores are the neutral ends and attract the spring-controlled armature 19, which, together with the adjacent ends of the cores, forms the neutral relay. It will be readily understood that the armature forming the neutral relay will be attracted toward the magnet when the current passing through the magnet is of sufficient strength to cause it to overcome the spring controlling the neutral armature without regard to the direction of flow of the current. It will also be noted that the armature of the polarized relay will vibrate between the enlarged ends of the magnet-cores whenever the direction of flow of the current is reversed and will be effected without regard to the strength of the current flowing through the magnets. It will thus be seen that this one instrument will serve the purpose of separate neutral relay and the independent polarized relay heretofore used, thereby saving in the cost of the apparatus and reducing resistance and inductance in the circuit.

From the double-acting relay main and artificial lines extend.

When the key 21 in the local pole-changer circuit is closed, the magnet 7 draws down its armature and through the lever 6 shifts the shaft 4 to such an extent as to change the brush 9 from the one side of the insulation 8 to the other, thereby changing current to the line from — to + or the reverse, depending on the character of the current normally to the line. When the key 21 is opened, the spring 22 withdraws the armature of magnet 7 and returns the shaft to its normal position, thereby again reversing the current to the line. The advantages of this form of pole-changer over the old form are obvious. The brush or point 9 is always in contact with the rotating shaft 4, and therefore there will be no deposit of dust or dirt between the contacts. It will also be noted that as there will be a grinding action between the shaft and the brush the contact will always be bright and clean.

Whenever the key 22^a in the transmitter local circuit is closed, the current to the line is increased, whether the current be — or +, and whenever said key is open the current is decreased, and this is accomplished by means of the circuits through the "added resistance" and "leak-coils" in the usual manner.

In Fig. 1 of the drawings the key 22^a is shown as closed and the armature of the neutral transmitter is against the left-hand stop, the path to earth being through the line 13 from the binding-post 14 up through the left-hand stop of the transmitter, through the armature of the transmitter, and thence through the pole-changer device to the ground through the dynamo 2. When the key 22^a is open, the armature of the neutral transmitter will be held against its right-hand stop, and the path of the current with the pole-changer in position to put — current to the line, as shown in Fig. 1, will be as follows: Current flowing in from the line 13 will pass through the resistance-coil 11, thence to contact 9 of the pole-changer, and thence to dynamo 2 and to the earth.

In circuit with each of the keys 21 and 22 are the usual sending-sounders 23 and 24, respectively. These sounders are inserted in local circuits with the keys in order that the operator may hear himself transmit.

In circuit with the polarized side of the double-acting relay is the receiving-sounder 25. The receiving-sounder 26, which is operated through the armature of the neutral side of the double-acting relay, is controlled through a differentially-wound magnet 27, which is provided with an armature 28. This armature and its back-stop 29 are in the local circuit with the receiving-sounder 26. One winding of the differentially-wound magnet 27 is in a permanently-closed local circuit 30, so that the armature 28 is normally held away from the back-stop 29, the circuit in which the sounder 26 is located being therefore normally open. The other winding of this differentially-wound magnet is in an independent local circuit 31, which includes the armature 19 of the double-acting relay 15 and the forward stop thereof. As the armature 19 is normally held against its back-stop by its spring, the local circuit 31 is maintained normally open. When the armature 19 is drawn against its forward stop by the neutral side of the double-acting relay, the circuit 31 is completed, and as the second winding of the differentially-wound magnet is in said circuit it will be seen that the effect of the current flowing through the normally closed circuit 30 and the first winding of the magnet 27 will be neutralized. As soon as the full current is flowing through the circuit 31 the armature 28 will be released by the magnet 27 and it will be drawn against its back-stop, thereby completing the circuit through the receiving-sounder and causing the signal to be given by it. When the armature 19 is released by the relay 15, its spring pulls it away from the forward stop, thereby opening the circuit 31, returning magnet 27 to its normal condition and opening the circuit of the receiving-sounder. The object of thus controlling the receiving-sounder on the neutral or common side is to secure a clear and perfect signal. It is well known that in quadruplex systems the signals on the common side are poor—that is, they are not clear and sharp, but are ragged or fluttering. This is due to the vibration of the neutral armature, caused by the re-

versal of polarity of the line-current in operating the polar side. This vibration of the neutral armature is sometimes sufficient to cause the repeating-sounder to give a false signal and is at all other times when in action sufficient to keep the armature of the repeating-sounder quivering to such an extent that when the increased current is sent over the line and the signal-contact is made by armature 19 the signal is ragged. By the use of the differentially-wound magnet 27 this defect is overcome. It is well settled that it requires time for current to reach its full flow through a coil. It will therefore require that a solid contact be maintained between armature 19 and its back-stop for a sufficient length of time to permit the current through circuit 31 and its coil of magnet 27 to reach its full capacity before the effect of the current in circuit 30 will be neutralized and the armature 28 released. A signaling-contact between armature 19 and its forward stop will be sufficient for this purpose; but the slight and imperfect contacts made at the instant of reversal will not be sufficiently maintained for this purpose.

In duplex and quadruplex systems of telegraphy it is the usual practice to place a sending-sounder in circuit with the key in order that the operator may hear himself transmit. These sending-sounders are not in circuit with the receiving-sounders and the receiving-sounders are not in a position near the sending operator, so that it is very inconvenient for the sending operator to hear messages received on the receiving-sounder. Whenever the operator on the opposite end of the line desires to communicate with the sending operator at the home key, it is necessary for the receiving operator at the home station to notify the sending operator and to call his attention to the message being sent to him by the operator at the other end of the line. This is very awkward and requires time and interferes with the operation of the system. To avoid this difficulty, a break-key is inserted between the receiving-sounder and the sending-sounder of a duplex system or between the sending-sounder and the receiving-sounder of both the polarized side and the neutral or common side in a quadruplex system. This break-key is so located that it may be depressed or operated by either the sending operator or the receiving operator, and the purpose of it is that when it is depressed it cuts the sending-sounder out of the sending-circuit and places it in circuit with the receiving-sounder, so that the sending-sounder will then be operated through the receiving-circuit and the incoming signals will be diverted to the sending-sounder. By this means the receiving operator whenever he receives a signal requesting the sending operator to "break"—that is, to stop sending—he will depress the break-key, thereby cutting the sender-sounder in circuit with the receiving-sounder, so that the sending operator will receive the break-signal on his own sounder, thus permitting either operator at the other end of the line to communicate directly with the sending operator at the home station or key. By releasing the break-key the circuits will be automatically returned to their normal condition. This break-key 32 consists of two contact-points 33, which are insulated from each other and are carried by a lever 34, suitably mounted on a base. Above the contact-points are located two spring-contacts 35, which are in circuit with the receiving-sounder. These contacts are insulated from each other, but are normally connected by means of a bridge-piece 36, so that the circuit of the receiving-sounder is normally completed through the key. Below the contact-points 33 are located two spring-contacts 37, similar to contacts 35, said contacts 37 being in circuit with the sending-key. These contact-points are normally engaged by the points 33 of the lever 34 and are depressed sufficiently to disengage them from their bridge 38. The terminals of the sending-sounder are connected to the contact-points 33, so that normally—that is, when the points 33 engage the points 37 and disengage them from the bridge 38—the local key-circuit is completed through the contact-points 37 and 33 and the sending-sounder. When it is desired to cut the sending-sounder out of the local key-circuit, the contact-points 33 are raised and brought into contact with the points 35, and the points 37 are permitted to spring into contact with the bridge 38, so that the local sending-key circuit will be completed through the bridge 38 and the points 37, and the points 35 will be raised sufficiently to disengage them from the bridge 36 and the local circuit of the receiving-sounder will then be completed through the points 33 and the sending-sounder, thus enabling the sending operator to receive on his own sounder any message that the operator from the other end of the line may desire to send him. It will be noted that the sending-sounder is cut in the local circuit of the receiving-sounder without interfering with the sending-circuit, so that while the break-key is maintained depressed the sending operator may receive and send messages simultaneously. It is evident, however, that this break-key may be arranged in various ways, and I do not desire to thus limit myself to the exact form of device shown.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a multiplex system comprised of a neutral side and a polarized side, the combination of a differentially-wound core, a closed local circuit connected to one winding of said core whereby said core is normally magnetized, an open local circuit connected to the other winding of said core, means operated by the neutral relay for closing this latter circuit through the second winding of the core,

an armature normally held by the magnetized differentially-wound core and adapted to be released when the circuit is completed through the second winding of said core, a signal-receiving instrument, and a circuit connected thereto and adapted to be closed by the release of the armature from the differentially-wound core.

2. In a multiplex system comprised of a neutral side and a polarized side, means for preventing the mutilation of signals received on the neutral side, said means consisting of a differentially-wound core, a local circuit for each of the windings of said core, one local circuit of the core being permanently closed to normally magnetize the core, and means controlled by the armature of the neutral relay whereby the signal-receiving instrument will be operated through the differentially-wound core.

3. In a multiplex system comprised of a neutral side and a polarized side, the combination with the neutral relay, of a differentially-wound core one local circuit of the core being permanently closed to normally magnetize the core, an armature controlled thereby, a signal-receiving instrument controlled by said armature, and means operated by the armature of the neutral relay whereby the receiving instrument will be operated through the differentially-wound core.

4. In a multiplex system comprised of a neutral side and a polarized side, the combination of a differentially-wound core, independent circuits connected to the windings of said core, one local circuit of the core being permanently closed to normally magnetize said core, an armature for said core, a receiving instrument controlled by said armature, means controlled by the armature of the neutral relay whereby the receiving instrument will be operated through the differentially-wound core.

5. In a multiplex system comprised of a polarized side and a neutral side, the combination of a device to prevent the mutilation of signals received on the neutral side, two independent local circuits connected to the said device one of said circuits being permanently closed and one being normally open and controlled by the neutral armature, an armature and a receiving instrument in circuit therewith, said armature being controlled by the neutral armature through the device to prevent the mutilation of the signals.

6. In a multiplex system, the combination of a signal-receiving instrument, a local circuit therefor, a sending-sounder a local circuit therefor, a key in said local sending-circuit, and a break-key in circuit with the sending-sounder and the signal-receiving instrument and adapted to shift or cut the sending-sounder in circuit with the receiving instrument.

7. In a multiplex system, the combination of a receiving-sounder, a local circuit therefor, means for completing said circuit to operate the receiving-sounder, a sending-sounder, a local circuit therefor, a key in said circuit, a break-key, the two sounder-circuits being normally completed through the break-key, each circuit being independent, said key being adapted to cut the sending-sounder out of the sending-circuit and into the circuit with the receiving-sender.

8. In a multiplex system, the combination of a sending-sounder, a local circuit therefor, a key in said circuit, a receiving-sounder, a local circuit therefor, and a break-key, the sounder-circuits being connected to and completed through said key, and means operated by said key whereby the sending-sounder may be cut out of the sending-circuit and into the receiving-circuit without interrupting the sending-circuit.

9. In a multiplex system, the combination of a sending-sounder, a local circuit therefor, a key in said circuit, a signal-receiving instrument, a local circuit therefor, and a break-key through which the local circuits are normally completed independent of each other, and means operated by said key whereby the incoming signals may be diverted to the sending-sounder.

10. A multiplex system, comprised of two sources of current one being + and one −, a pole-changer connected to said sources of current, a neutral transmitter connected to said pole-changer, the pole-changer and the neutral transmitter being connected to the line, and a signal-receiving means connected to the line, said receiving means consisting of a pair of cores differentially wound both of said windings being connected to the line on the home side and to the main and artificial lines on the other side, and a neutral receiving means operated by one pair of ends of the cores, and a polarized receiving means operated by the other ends of said cores.

11. A quadruplex system, comprised of a source of + current, and a source of − current, a polarized transmitter device connected to said source of current and to the line, a neutral transmitter connected to the polarized transmitter and to the line, and a receiving means interposed in the line and consisting of a pair of differentially-wound cores, a magnetized armature mounted to vibrate between one pair of adjoining ends of said cores, a signal-receiving means operated by said armature, and a neutral armature adapted to be moved by the other ends of said cores, and a signal-receiving means adapted to be operated by said neutral armature.

12. A quadruplex system, comprised of a source of + current, a source of − current, a polarized transmitter connected to said sources of current and to the line, a neutral transmitter connected to the line and to the polarized transmitter, a signal-receiving means interposed in the line and consisting of a pair of separated differentially-wound cores, the ends of said windings on the home side being connected to the line, the other end

of one of said windings being connected to the main line, the other end of the other winding being connected to the artificial line, a polarized signal-receiving means operated by one pair of adjoining ends of said cores, and a neutral signal-receiving means being operated by the other end of said cores.

13. A quadruplex system, comprised of a source of + current, and a source of — current, a polarized transmitter connected to said sources of current and to the line, a neutral transmitter connected to the polarized transmitter and to the line, and a signal-receiving device interposed in the line and consisting of a differentially-wound electromagnetic device, a polarity-armature adapted to be operated by one end of said device, and a neutral armature adapted to be moved by the other end of said device.

14. A quadruplex system, comprised of a source of + current and a source of — current, a polarized transmitter connected to the said source of current and to the line, a neutral transmitter connected to the polarized transmitter and to the line, and a signal-receiving means in the line beyond the neutral transmitter and consisting of a differentially-wound electromagnetic device having a neutral side and a polarized side, a polarized armature and a neutral armature adapted to be operated by opposite sides of said device, said device being so connected to the line that its armatures will be affected only by an inflowing impulse of current.

15. A multiplex system, comprised of a source of + current, and a source of — current, a polarized transmitter connected to said source of current, and to the line, said transmitter consisting of a plurality of insulated sections each section being connected to a source of current, a single contact bearing on the sectional contact and connected to the line, a polarized transmitter-key, and means connected thereto for shifting one of the contacts of the polarized transmitter on the other whereby the polarity of the current to the line is changed, and a receiving means in the line and consisting of a differentially-wound electromagnetic device, a signal-receiving means operated thereby, the said device being so connected to the line that the signal-receiving means will only be operated by an inflowing impulse of current.

16. A multiplex system, comprised of a source of + current, a source of — current, a polarity-transmitter consisting of a rotatable contact device divided into a plurality of insulated sections each of said sections being connected to one of the sources of current, a single contact device bearing on the rotatable contact device and connected to the line, a key, means operated by said key for shifting one of the contact devices on the other whereby the polarity of the current to the line may be changed, a signal-receiving means on the line and consisting of a suitably-wound electromagnetic device, a signal mechanism operated by said device, said electromagnetic device being connected to the line in such a manner that the signal-receiving means will be operated only by an inflowing impulse of current.

17. In a multiplex system, the combination of a sounder, a local circuit therefor, a signal-receiving instrument, a local circuit therefor, and a break-key through which the local circuits are normally completed independent of each other, and means operated by said key whereby the incoming signals may be diverted to the sounder.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 7th day of November, 1901.

JOHN F. SKIRROW.

Witnesses:
THEODORE L. CUYLER, Jr.,
JOSEPH J. CARDONA.