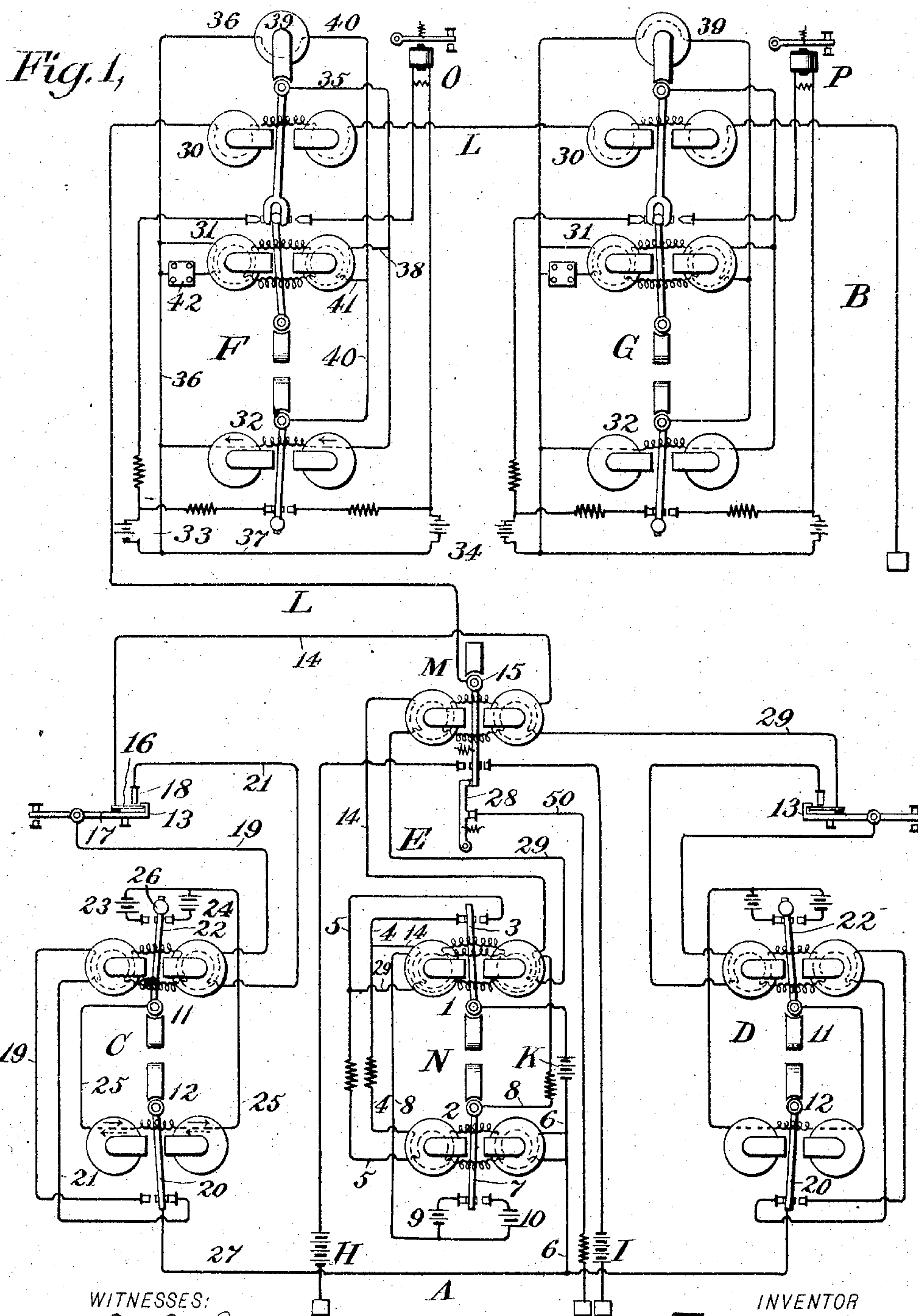


T. B. DIXON.
TELEGRAPHY.

APPLICATION FILED APR. 22, 1902.

NO MODEL.

2 SHEETS—SHEET 1.



WITNESSES:

M. M. Connor.

A. J. Feltus

INVENTOR

Thomas B. Dixon

BY

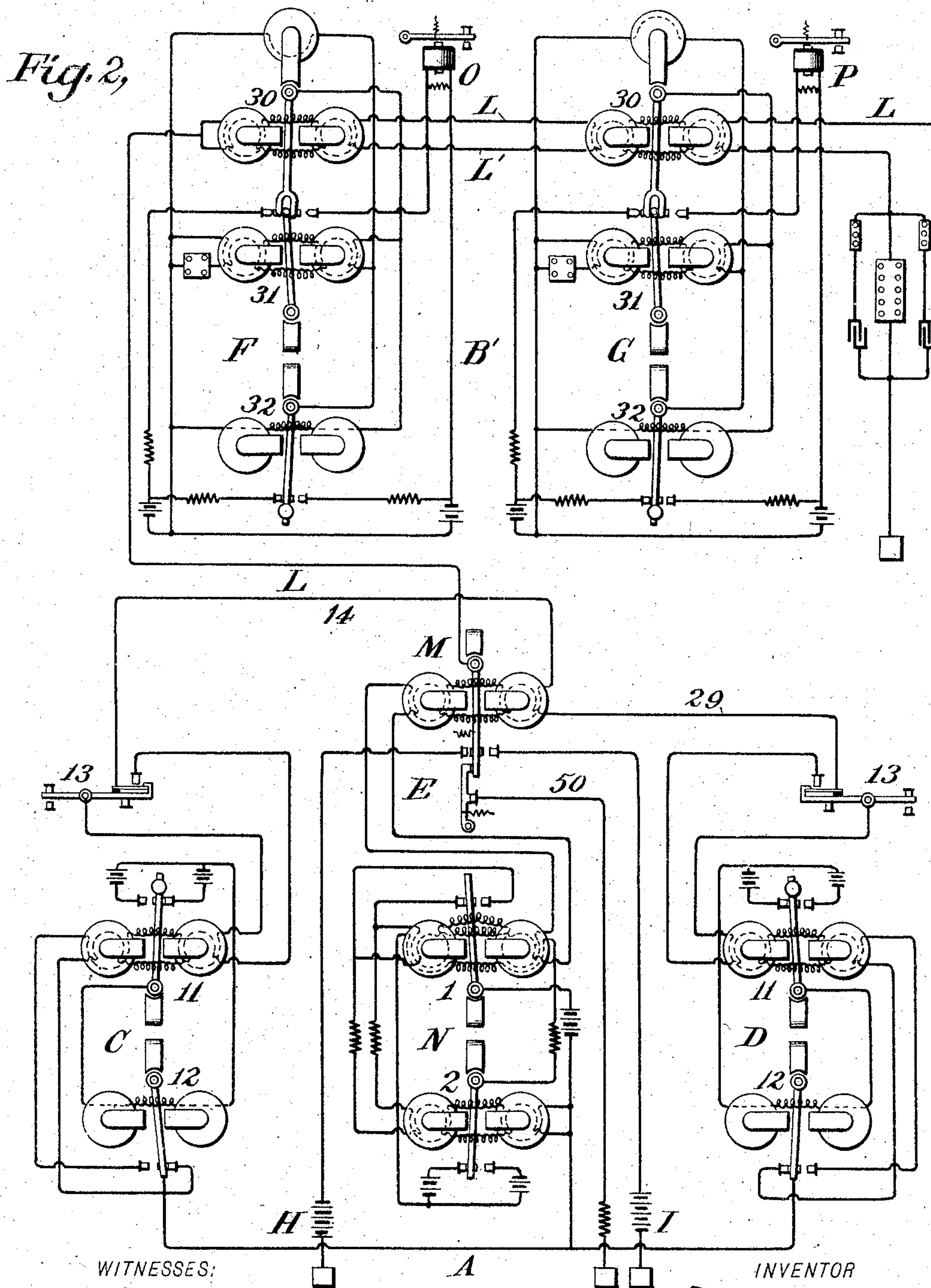
Chapin Haywood & Marble
ATTORNEYS

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2 SHEETS—SHEET 2.



WITNESSES:

M. M. Conover.
A. H. Feltus

INVENTOR

Thomas B. Dixon

BY

Chapin Haywood & Smith
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UNITED STATES PATENT OFFICE.

THOMAS B. DIXON, OF NEW YORK, N. Y.

TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 778,177, dated December 20, 1904.

Original application filed October 11, 1898, Serial No. 693,205. Divided and this application filed April 22, 1902. Serial No. 104,154.

To all whom it may concern:

Be it known that I, THOMAS BULLITT DIXON, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Telegraphy; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates generally to signaling systems, and particularly to improvements in systems of multiplex telegraphy whereby a plurality of distinct and separate messages may be transmitted simultaneously over a single wire or conductor or over a submarine cable.

My invention resides in a novel system of transmitting two telegraphic messages simultaneously in the same direction over a single line wire or conductor, which may be combined with other well-known systems of duplex telegraphy, so as to permit the simultaneous transmission of an equal number of messages in the opposite direction.

The objects of my invention are, first, to improve multiplex signaling systems, and particularly multiplex systems of telegraphy, and render it possible to operate such multiplex systems over longer lines and with greater rapidity than has been practicable with former systems, to avoid all interference between the messages transmitted, and to avoid interference with the transmission due to leakage, mutilation of signals, induction, and similar disturbing causes; second, to render it practicable to transmit two messages simultaneously in the same direction and an equal number of messages in the opposite direction over long submarine-cable lines, which cannot be done with the systems of multiplex telegraphy now in use on such lines, and, third, to make the system as simple as possible.

These objects are attained in the systems of signaling, particularly adapted for telegraphic signaling, herein described, apparatus and circuits for which are illustrated in the drawings which accompany and form a part of this specification.

In the drawings, Figure 1 is a diagram illus-

trating an arrangement of circuits and instruments for transmitting two simultaneous messages over a single line conductor in one direction. Fig. 2 is a diagram illustrating the arrangement of circuits and transmitting and receiving instruments at one end of a quadruplex line, the arrangement of circuits and transmitting and receiving instruments being similar to those shown in Fig. 1.

In the duplex and quadruplex telegraph systems herein described all of the signals are transmitted by pulsatory currents, each signal being transmitted by two pulses, one at the beginning and the other at the end of the signal. One transmitter at the end of the line produces positive pulses only in the line, the other transmitter producing only negative pulses. The two receiving-relays which respond to the said transmitters are operated one by positive pulses only and the other by negative pulses only, each relay being changed from and restored to normal condition by alternate pulses of that polarity by which said relay may be operated. Interference with the operation of the receiving instruments at one end of the line by the currents produced by the operation of the transmitting instruments at the same end of the line is prevented by any of the ordinary methods of duplex telegraphy.

Referring now to the drawings, and first of all to Fig. 1, which illustrates the arrangement of circuits and instruments for diplex telegraphy over land lines and short submarine-cable lines, A is a transmitting-station, and B a receiving-station, at opposite ends of a line-wire L. C and D are transmitting instruments, and E a selecting instrument, at the transmitting end of the line, and F and G are receiving-relays at the receiving end of the line. H and I are line batteries or generators oppositely connected to the line, so as to furnish thereto currents of opposite direction, and K a local battery or generator of the transmitting-station which supplies current for circuits connecting the selector E and the transmitting instruments C and D. Other batteries at the transmitting-station are local to the instruments to which they are connected and will be mentioned hereinafter.

The function of transmitter C is to place battery H to the line for an instant at the beginning and again at the end of each signal sent through that transmitter, and similarly the function of transmitter D is to place battery I to the line momentarily at the beginning and again at the end of each signal sent through that transmitter. Since both batteries may not be connected with the line simultaneously without each neutralizing the effect produced by the other, the selector E is employed to give precedence automatically to one battery, placing the other battery to the line as soon as the pulse from the battery having precedence is completed. The selector consists of a main or selecting relay M and a vibrator N, itself composed of two polar relays 1 and 2, which alternately reverse each other, thus producing exceedingly rapid vibration of their armatures. The circuits of or controlled by selector E are as follows: The positive pole of battery K is connected to the armature 3 of the relay 1. To the two contact-stops of this armature are connected the local-circuit conductors 4 and 5, leading to opposing magnet-coils of relay 2 and thence to a return-conductor 6, leading to the negative pole of battery K. The one circuit or the other is complete according to with which contact-stop the armature 3 makes contact at any instant.

To the armature 7 of relay 2 is connected the local-circuit conductor 8, connected to one set of coils of relay 1 and thence to batteries 9 and 10, oppositely placed, which are connected each to one of the contact-stops of armature 7. Circuit 4 when complete tends to move armature 7 to the left, so as to complete circuit 8 through battery 9, and circuit 8 when completed through battery 9 tends to move the armature 3 of relay 1 to the right, so completing circuit 5. Circuit 5 when complete tends to move armature 7 to the right, so completing circuit 8 through battery 10, and since battery 10 is placed oppositely to battery 9 the completion of circuit 8 through battery 10 tends to deflect the armature 3 to the left again. When two polar relays are connected together in this way, each reversing the other, their armatures vibrate with great rapidity, particularly if the armatures be light and their stops adjusted so as to permit only a small amplitude of movement. Such a vibrator is preferable for use in my system to vibrators consisting of spring-reeds electrically driven, because when either armature is in either of its extreme positions no tendency exists for it to move to the opposite position until the polarity of its magnets has been reversed, and if such reversal of the magnets of one of the relays be prevented at any instant—as, for instance, by energizing other coils of the relay, which exert a preponderating influence on the armature—the vibration of the armatures ceases instantly, to be resumed instantly when the circuit exerting such preponderating in-

fluence is broken; but I do not limit myself to the use of this type of vibrator.

Transmitters C and D are exactly similar in construction, and the circuits by which they are connected to selector E are similar. Only transmitter C need be described. It consists of polar relays 11 and 12, a hand-key 13, and suitable circuits now to be described.

From conductor 4 a branch conductor 14 leads through coils of relays 1 and M to a contact-tongue of hand-key 13, forming a part of transmitter C. The coils of relays 1 and M, through which this circuit 14 passes, are so wound that when energized the armature 3 of relay 1 is held to the left and the armature 15 of relay M is moved to the left. The coils of relay 1, through which circuit 14 passes, exert a stronger influence upon the armature 3 when energized than do the coils through which circuit 8 passes. This is indicated in the drawings by showing the battery K as made up of a greater number of cells than batteries 9 and 10. Key 13 has contact-points similar to the contact-points of an ordinary continuity-preserving transmitting-relay—that is to say, it has a spring contact-tongue 16, mounted upon a movable lever 17, having a contact point or hook adapted to make contact with the tongue, and a stationary contact-point 18, adapted to make contact with the contact-tongue when the key is depressed and to move the tongue away from the contact-hook. To the lever 17 of key 13 is connected a conductor 19, leading through coils of relay 11 to the left-hand contact-stop of relay 12. Normally conductors 14 and 19 are in communication, their circuit being broken at relay 12, the armature 20 of said relay being in contact with its right-hand contact-point. To the contact-point 18 of key 13 is connected a conductor 21, leading through coils of relay 11, which oppose those coils to which conductor 19 is connected to the right-hand contact-point of relay 12. To the contact-stops of the armature 22 of relay 11 are connected batteries or generators 23 and 24, the poles of which are oppositely placed, both of those batteries being connected to a conductor 25, leading through coils of relay 12 to the armature 22. When the circuit 25 is complete through battery 24, it tends to move the armature 20 to the right and hold it in that position, and when complete through battery 23 said circuit tends to move the armature 20 to the left and to hold it in that position. Relay 12 is very quick-acting, having a very light armature, while relay 11 is slower acting, its armature having upon it a weight 26, by moving which along the armature the speed of the relay may be adjusted.

When key 13 is depressed, its contacts 16 and 18 make contact, and if the armature 3 be then in contact with its left-hand contact-stop circuit 14 is completed through conductor 21,

armature 20, and a return-conductor 27, connected to the return-conductor 6, which leads to the negative pole of battery K. If armature 3 be not in contact with its left-hand contact-stop at the very instant when contact is made between contacts 16 and 18 of key 13, it will be in contact therewith an instant thereafter, since it is in rapid vibration. As soon as the circuit 14 is complete armatures 3 and 7 stop vibrating and the armature 15 of relay M moves to the left, as does the armature 22 of relay 11. As soon as armature 22 reaches its left-hand contact-stop it completes circuit 25 through battery 23, thus reversing relay 12 and breaking circuit 14. Armatures 3 and 7 of relays 1 and 2 then commence vibrating again. When the key 13 is released, contact-tongue 16 and contact-hook 17 make contact, completing circuit 14 through conductor 19, armature 20, and return-conductors 27 and 6, if as soon as armature 3 is in contact with its left-hand contact-stop and the armature 22 of relay 11 is deflected to the right, circuit 14 remaining complete, however, until armature 22 has reached its right-hand contact-stop and by completing circuit 25 through battery 24 has reversed relay 12.

The armature 15 of relay M has a spring which tends to draw it to the left; but it is held in central position normally against the tension of said spring by a continuity-preserving contact-lever 28, having a stronger spring. A contact-stop of said lever 28 prevents it from moving the armature 15 beyond the central position. When circuit 14 is completed, (as it is for an instant when key 13 is depressed and again when key 13 is released, as shown above,) armature 15 is moved to the left until it makes contact with its left-hand contact-point, to be returned to central position as soon as circuit 14 is broken. To the left-hand contact-stop of armature 15 is connected the positive pole of line-battery H, and to the armature itself is connected the line conductor L. When key 13 is depressed and again when key 13 is released, therefore, battery H is placed to the line momentarily, so producing in the line a momentary current pulsation of positive polarity.

A conductor 29, branching from conductor 5, passes through magnet-coils of relays 1 and M, these coils being wound, however, so as to hold armature 3 and deflect armature 15 to the right when energized, and said conductor is connected to the contact-tongue of the key 13 of transmitter D. When said key is depressed and again when it is released, the armature of relay M is moved to the right, and since the right-hand contact-stop of said relay is connected to the negative pole of line-battery I said battery is placed to the line momentarily when the key is depressed and again when it is released, so producing in the line a momentary current pulsation of negative polarity. Both batteries H and I may

not be placed to the line simultaneously, however, because should both keys 13 be depressed at the same instant the selector E will give precedence to the pulse from one battery, causing it to be placed to the line before the other battery is so placed and holding back the pulse from the second battery until the pulse from the first battery is completed. Which of the two batteries is thus given precedence depends upon whether the armature 3 of relay 1 of the selector makes contact with its right-hand stop or with its left-hand stop the instant after the keys are depressed. With whichever stop it first makes contact it is held in contact therewith until the pulse from the corresponding battery H or I is completed—that is to say, until the armature 22 of the relay 11 of the corresponding transmitter has reversed the relay 12 of the transmitter. As soon as one pulse has been completed, so that the armature 3 is released, it moves to the opposite contact-stop, and so permits the pulsations of current from the other battery to pass through the line.

If one transmitting-key is depressed after the other transmitting-key has been depressed and after the line-battery controlled thereby has been placed to the line, the placing to the line of that line-battery which corresponds to the transmitting-key last depressed will be delayed until the battery corresponding to the transmitting-key first depressed has been cut out of the line by the operation of its transmitter. The length of the current pulsations produced by the operation of the transmitters is so brief as compared with the length of a "dot" of the telegraphic code that the slight delay in the production of a pulsation from one of the batteries due to the selecting action of the selector E, above described, does not produce any appreciable or detrimental delay in the operation of the corresponding receiving instrument at the distant end of the line nor does it appreciably or detrimentally shorten the signal whether it be a dot or a "dash."

The function of relays 11 and 12 of the transmitters is simply to so operate the circuits connected to the corresponding transmitting-key 13 that a pulsation of the current of the proper polarity will be produced in the line at the instant when the key is depressed and again at the instant when the key is released; but I do not limit myself to the use of any particular devices for producing double pulses each time a key is depressed and then released, nor do I limit myself to the particular selecting devices employed for giving precedence to one or the other of the pulses when two keys are depressed simultaneously, although I believe the transmitting instruments and the selector to be particularly suitable for use in this system. The relays 11 may be termed "primary" relays of the transmitters and the relays 12 "secondary" relays. The circuits

of which conductors 14 and 29 form parts are controlling-circuits of the selector and may also be called the "selector-circuits" of the transmitters. The use of two batteries in the
 5 circuits controlled by relay 2 of the selector and relays 11 of the transmitters is simply a convenient means of reversing the currents in these circuits. Instead of employing two
 10 batteries one or the other of which is in circuit, according to the position of the armature, any other convenient means of reversing the action of a relay may be employed.

The receiving-relays F and G at the receiving-station B may be termed "single-direction double-current" relays, since each re-
 15 sponds to current impulses of but one direction, but is changed from and restored to normal condition by alternate current impulses of that direction. Each of the relays consists, essentially, of a polar relay provided
 20 with means for reversing the polarity of its armature when the position of said armature is reversed, so that a current impulse of the same direction as the impulse which first de-
 25 flected the armature from its normal position will send it back to normal position; but in order to obtain great delicacy of operation and also steadiness I prefer to employ in the relay the principles employed in the polar re-
 30 lay covered by my Patent No. 560,313, dated March 19, 1896—that is to say, to employ a secondary circuit which tends to hold the armature stationary, but is broken when the armature moves and is reversed when the po-
 35 sition of the armature is reversed, and a tertiary circuit which normally opposes the secondary circuit, but is weaker than the secondary circuit, and is reversed by a reversing-relay controlled by said secondary circuit
 40 when the position of the main armature is reversed.

Each receiving-relay consists of three sub-relays—viz., a main relay 30, through which the line-circuit passes, a secondary relay 31,
 45 and a reversing-relay 32. The armatures of relays 30 and 31 are mechanically connected, so as to move together, and may be connected in the manner shown diagrammatically, one having a rounded end fitting within a forked
 50 end of the other, though I do not limit myself to their connection in this manner. Relay 32 is an ordinary polar relay, having, however, a weighted armature, the weight being adjustable, as is the case with the relays 11 of
 55 the transmitters. Each receiving-relay has two local batteries 33 and 34, the poles of which are oppositely placed. The positive pole of battery 33 is connected to the left-hand contact-stop of the connected armatures of
 60 relays 30 and 31 and is also connected to the left-hand contact-stop of relay 32. The negative pole of battery 34 is similarly connected to the right-hand contact-stop of relay 32 and to the right-hand contact-stop of relays
 65 30 and 31 through a sounder or other receiv-

ing instrument, which is lettered O, for receiving relay F and P for receiving relay G. Preferably a shunt resistance-coil is connect-
 ed across the terminals of each sounder, as shown in the drawings. One of the two con-
 70 nected armatures of relays 30 and 31 is connected to a conductor 35, leading through coils of relay 32 to a return-conductor 36, connect-
 ed to a conductor 37, which connects the negative pole of battery 33 and the positive pole
 75 of battery 34. When battery 33 energizes this circuit of conductor 35, the armature of relay 32 is moved or held to the left, and when battery 34 energizes the circuit said armature is moved or held to the right. A
 80 branch conductor 38 leads from conductor 35 through coils of relay 31 to return-conductor 36, and these coils of relay 31 when energized by battery 33 tend to hold the two con-
 85 nected armatures to the left, while when the coils are energized by battery 34 they tend to hold the connected armatures to the right.

Relays 31 and 32 have their armatures magnetized by permanent magnets, or if their armatures be magnetized by electromagnets
 90 the polarity of such magnets is never changed with respect to that of the main or "field" magnets. The armature of relay 30, however, is magnetized by an electromagnet 39, the po-
 95 larity of which is reversed by the relay 32 when it operates, owing to the fact that re-
 lay 39 is energized by current from whichever of the batteries 33 or 34 is in communication with the armature of relay 32 and pass-
 100 ing from said armature through conductor 40, which is also connected to the coils of magnet 39 and through the return-conductor 36. A branch conductor 41 leads from conductor 40 through coils of relay 31, which opposes those
 105 to which conductor 38 is connected, and through an adjusting-rheostat 42 to the return-conductor 36. The resistance of the rheostat 42 is so adjusted that the effect upon
 110 the connected armatures of the coils to which conductor 36 is connected when said coils are energized is almost neutralized by the effect on said armatures of the coils to which con-
 115 ductor 41 is connected, sufficient of the magnetizing force of the coils connected to the conductor 38 being left unneutralized, how-
 ever, to hold the armatures stationary against the effects of leakage or induction-currents in the line. The line conductor L passes through
 120 the coils of the main magnet of subrelay 30 of relay F and through the corresponding coils of subrelay 30 of relay G to ground.

Conductors 35 and 38, passing through magnet-coils of subrelays 31 and 32, together with conductors connecting the batteries 33
 125 and 34 to the contact-points of the connected relays 30 and 31 and the return-conductors, may be said to constitute a secondary circuit. Conductors 40 and 41, passing through magnet-coils of relay 31 and through the arma-
 130 ture-magnet 39 of relay 30, together with the

conductors connecting the batteries 33 and 34 to the contact-points of relay 32 and the return-conductors, may be said to constitute a tertiary circuit.

5 As will be shown, each of the relays F and G responds only to the currents of one polarity, being extremely sensitive, however, to currents of that polarity, so that it may be operated by exceedingly brief pulsatory
10 currents. The polarity of the currents to which each relay will respond is determined by the polarity of its magnet 39, and these magnets of the two relays F and G are oppositely wound or oppositely connected to the
15 conductors 40 and 36, so as to be magnetized oppositely.

The operation of relays F and G may now be understood. It is not necessary to explain the operation of both, as they operate similarly. The magnet 39 of relay F is so wound or so connected in its circuit that said relay responds only to positive pulses—that is to say, to the pulses produced by the operation of the transmitter C. The armatures of the
25 relays are shown in their normal position. When a positive pulse comes over the line at the beginning of a signal, it energizes the main magnet of relay 30 of transmitter F and with the aid of the tertiary circuit in
30 relay 31, overcomes the effect of the secondary circuit in relay 31, deflecting the connected armatures to the right. The instant the armatures begin to move the secondary circuit is broken, and the effect of the tertiary
35 circuit on the armatures being then unopposed the current in said tertiary circuit will carry the armatures over, even though the current pulsation in the line which primarily caused the armatures to move should cease
40 before they have reached the right-hand contact-stop. As soon as the armatures reach such stop the secondary circuit is completed from battery 34 through sounder O, thus operating the sounder, holding the connected
45 armatures against their right-hand contact-stop and reversing the armature of relay 32, so reversing the tertiary circuit, which when reversed again opposes the secondary circuit in relay 31. The reversal of the armature
50 of relay 32 reverses the polarity of magnet 39, so that when a second positive pulse comes over the line the connected armatures of relays 30 and 31 will be moved to the left and relay 32 again reversed, thus cutting out the
55 sounder O and restoring the parts to their first positions. When the parts of relay F are in their normal positions, negative pulses in the line tend merely to hold the connected armatures of its relays 30 and 31 to the left,
60 and when said armatures are against their right-hand stop, the polarity of magnet 39 having been reversed, negative pulses in the line conductor simply tend to hold the armatures in that position.

65 To the contact-stop of contact-lever 28 of

selecting-relay M is connected a conductor 50, leading to ground. When the armature 15 of said relay occupies an intermediate position, the line conductor L is connected through the armature and lever 28 to conductor 50, and
70 so to ground. This ground connection facilitates the discharge of the line after each signal.

The operation of the instruments and circuits shown in Fig. 1 is as follows: Normally
75 the armatures of relays 1 and 2 of vibrator N are in rapid vibration. If one of the transmitter-keys—as, for instance, that of transmitter C—be depressed, a selector-circuit is completed through conductor 14 in this case and
80 through conductor 21 of the transmitter, thus deflecting the armature of selecting-relay M to the left and placing battery H to the line and arresting the vibration of armatures 3 and 7 of the vibrator. Energizing the magnet-
85 coils of relay 11, through which conductor 21 passes, causes the armature of said relay to move to the left, and when it has reached its left-hand contact-point it completes the local circuit of conductor 25 through battery 23,
90 thus reversing the relay 12, breaking the selector-circuit of conductor 14, and ending the current impulse from battery H, the vibrator beginning to operate again immediately. When the transmitter-key is released, selector-
95 circuit 14 is again completed, this time through conductor 19, the battery H is again placed to the line by relay M, and the relay 11 is again reversed, thus reversing relay 12 and breaking
100 the selector-circuit again, thus ending the current impulse from battery H. In this way a brief current impulse is produced in the line at the beginning and again at the end of each signal of transmitter C, the length of the im-
105 pulse being determined by the adjustment of the weight on the armature of relay 11 and the distance between the stops of said armatures. If transmitter D be operated, an im-
110 pulse of current from battery I passes through the line at the beginning and again at the end of each signal of the transmitter. Both selector-circuits—viz., the circuits of conductors 14 and 29—cannot be complete at the same in-
115 stant, for said circuits pass through opposing contacts of relay 1. Hence if the transmitter-keys of the two transmitters be operated simultaneously that selector-circuit will be completed first with the contact-point of which
120 the armature 3 first makes contact, and as each impulse in each selector-circuit checks the vibration of the armature 3 the impulse in the other selector-circuit will be delayed until the impulse in the selector-circuit first completed is finished. In this way conflict between the
125 two transmitters is avoided. The impulses are of such short duration, however, that the slight delay in the sending of an impulse by one transmitter under such circumstances is imperceptible, and the delay is never sufficient to convert a dot into a dash. When an impulse
130

of positive current passes through the line at the beginning of a signal of transmitter C, it deflects the connected armatures of relays 30 and 31 of receiving instrument F to the right. The secondary circuit through conductor 31 is broken the instant said armatures begin to move, so that the tertiary circuit will carry the armatures over even should the impulse cease before the armatures have reached their right-hand contact-point. When they do reach said right-hand contact-point, the secondary circuit is again completed, but with the current reversed, and the reversing-relay 32 is reversed, thus reversing the direction of current in the tertiary circuit and reversing the magnet 39, by which the armature of relay 30 is magnetized. Negative impulses in the line can have no influence on relay F when the parts are in this position therefore; but when a succeeding positive pulse passes through the line the armatures are deflected back to their first positions by a similar action of the circuits, magnet 39 recovering its former polarity. The completion of the secondary circuit through the right-hand contact-point of relays 30 and 31 operates the sounder O. Receiving-relay G is operated in a similar manner by negative current impulses, but does not respond to positive current impulses.

The receiving-relays are not affected by leakage and induction-currents in the line, since a line-current in order to operate either relay must overcome, though but for an instant, that portion of the influence of the secondary circuit on the armatures of relays 30 and 31 which is not balanced by the tertiary circuit.

In Fig. 2 the transmitting and receiving instruments at one end of a quadruplex line are shown. The transmitting instruments and circuits are the same as those shown in Fig. 1. Since the receiving-station corresponds to a transmitting-station at the distant end of the line, it is lettered B'. The receiving instruments are the same as those shown in Fig. 1, except that each main relay is provided with two separate sets of coils, one connected to the line conductor L and the other to an artificial line conductor L'. The effect of the artificial line is to balance the influence of outgoing messages in the line upon the home receiving instruments.

A great advantage of the system of duplex and quadruplex telegraphy herein described is that it employs nothing but pulsatory currents. I have found that much better results may be obtained by the use of such currents than by the use of currents of longer duration. Arcing at the contact-points is avoided, and it is possible to use a higher line potential without excessive leakage than would be possible otherwise, thus insuring clearer signals. Another great advantage of this system is that it employs nothing but polar

instruments, which are far more sensitive, quick-acting, and reliable than instruments of the neutral type.

For convenience in following the action of opposing magnet-coils of certain of the instruments herein illustrated I have sought in certain instances—as, for example, in the illustration of relay 1—to indicate the opposing action of the several coils in each magnet-spool of the relay by showing the same wound in opposite directions about the core. It will be understood that such illustration is purely diagrammatic and illustrative and does not indicate any specific direction of winding. Furthermore, it has been necessary to avoid confusion of the drawings to show corresponding coils on opposite sides of the armatures of the said relays as wound in the same direction. It will be understood that in so doing I illustrate merely the relative winding with respect to each core considered separately of the coils surrounding the same and that the connection of the several corresponding coils to their respective circuits must, nevertheless, be such that corresponding coils on opposite sides of an armature tend in every case to produce opposite magnetic poles, as in any ordinary relay or horseshoe-electromagnet.

In another application for Letters Patent, filed October 11, 1898, Serial No. 693,205, of which this application is a division, I have illustrated, described, and claimed the apparatus herein illustrated and described and which carries out the method of transmission herein described and claimed.

What I claim is—

1. The herein-described method of transmitting simultaneous telegraphic messages in the same direction, through a single circuit, which consists in transmitting the signals of each message by current impulses occurring in pairs, one at the beginning and the other at the end of each signal, the signals of one message being transmitted by positive impulses and the signals of the other message by negative impulses.

2. The herein-described method of transmitting simultaneous telegraphic messages in the same direction, through a single circuit, which consists in transmitting the signals of each message by current impulses occurring in pairs, one at the beginning and the other at the end of each signal, the signals of one message being transmitted by positive impulses and the signals of the other message by negative impulses, and in giving precedence to an impulse of one signal over an impulse of another signal, when required.

3. The herein-described method of transmitting simultaneous telegraphic messages, through a single circuit, which consists in transmitting two messages in each direction by current impulses occurring in pairs, one at the beginning and the other at the end of each

signal, the signals of one message being transmitted by positive impulses and the signals of the other message by negative impulses, and in counteracting, at each end of the line, the effect of the outgoing messages upon the receiving instruments located at that end of the line, by a method of duplex telegraphy, substantially as described.

4. The herein-described method of transmitting simultaneous telegraphic messages, through a single circuit, which consists in transmitting two messages in each direction by current impulses occurring in pairs, one at the beginning and the other at the end of each signal, the signals of one message being transmitted by positive impulses and the signals of the other message being transmitted by negative impulses, in giving precedence to an impulse of one signal over an impulse of another signal, when required, and in counteracting, at each end of the line, the effect of the out-

going messages upon the receiving instruments located at that end of the line, by a method of duplex telegraphy, substantially as described.

5. The herein-described method of transmitting telegraphic signals, which consists in transmitting signals by current impulses always of the same polarity, which occur in pairs, one at the beginning and the other at the end of each signal, each signal, dot or dash, as the case may be, comprising two such impulses, the duration of the interval between the impulses of each signal determining whether that signal is a dot or a dash.

In testimony whereof I affix my signature in the presence of two witnesses.

THOMAS B. DIXON.

Witnesses:

HARRY M. MARBLE,
A. H. PERLES.