I. KITSEE.

QUADRUPLEX TELEGRAPHY.

APPLICATION FILED OCT. 10, 1911. RENEWED DEC. 30, 1916.

1,219,955.

Patented Mar. 20, 1917.

2 SHEETS—SHEET 1.

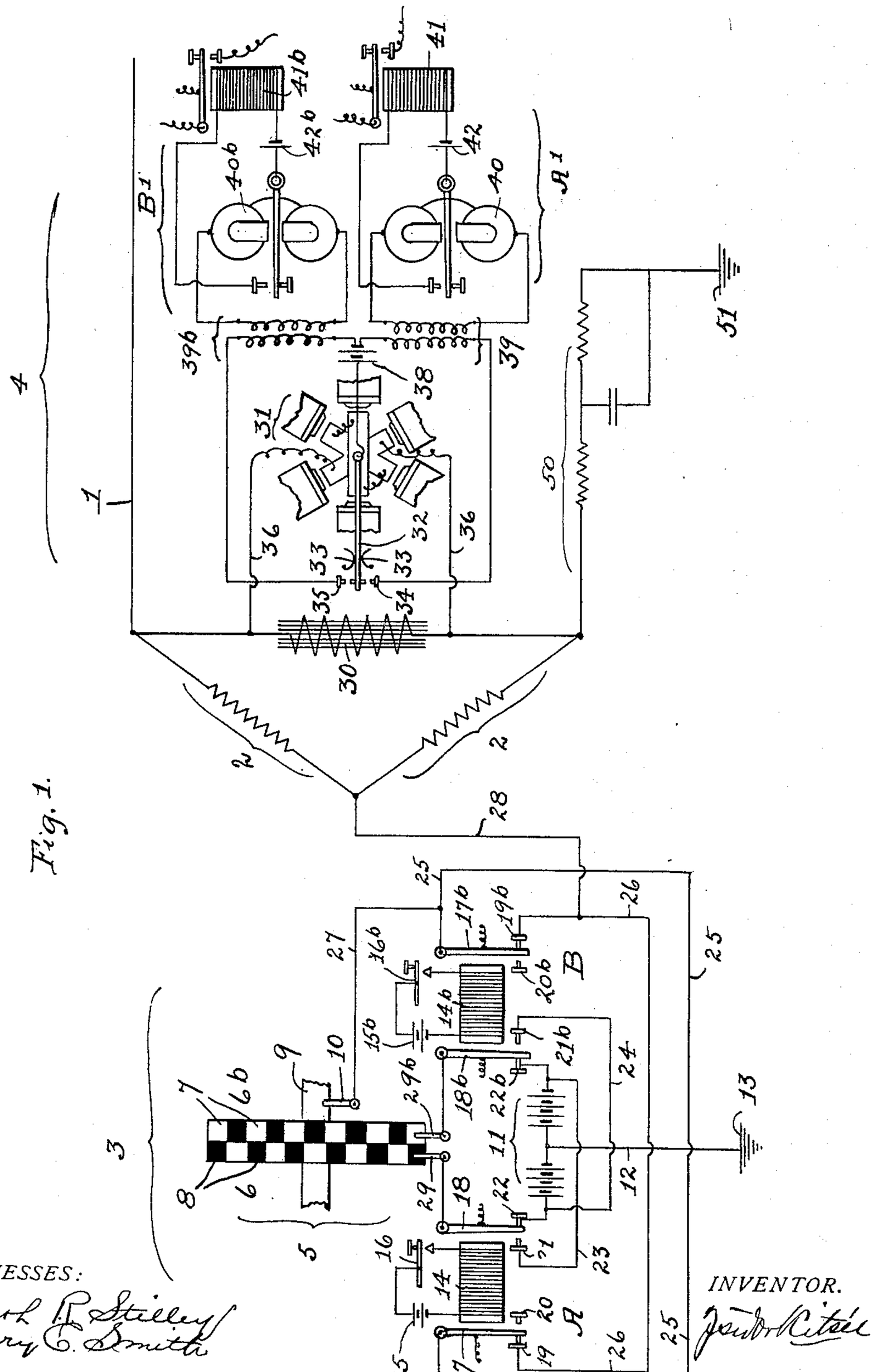

Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 4.

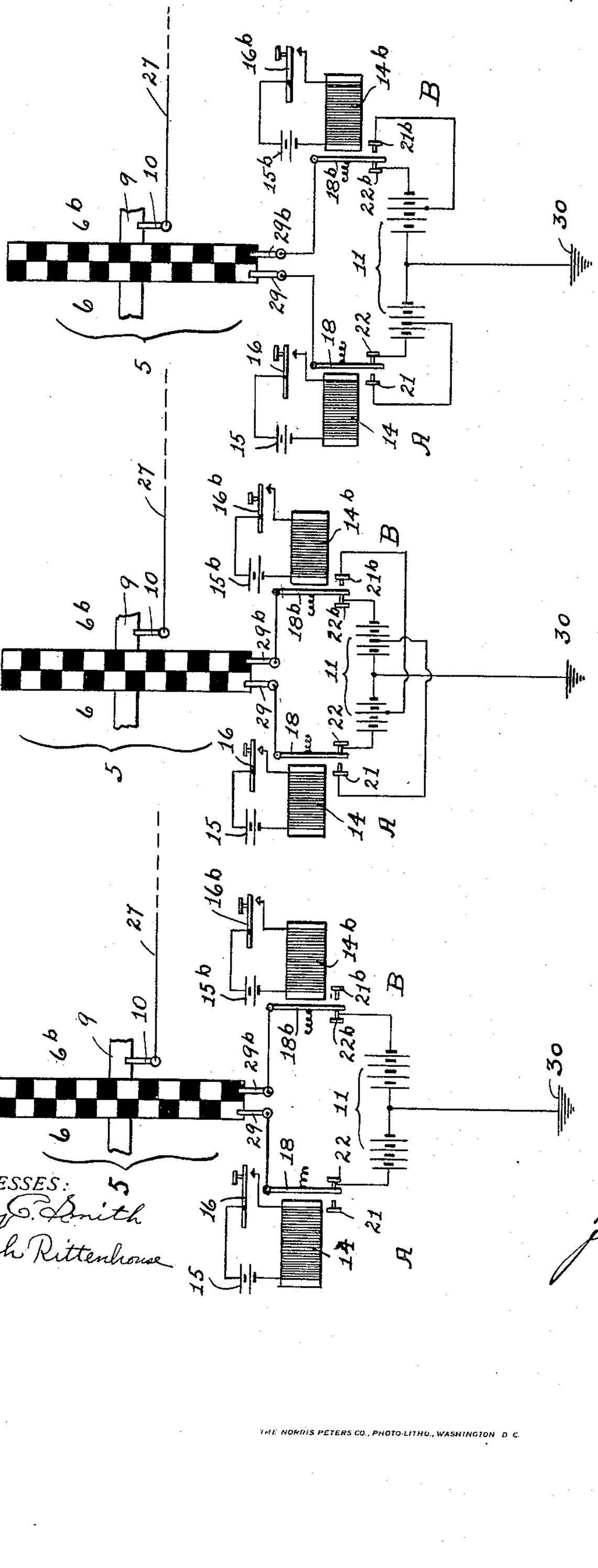

Fig. 3.

Fig. 2.

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ISIDOR KITSEE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

QUADRUPLEX TELEGRAPHY.

1,219,955. Specification of Letters Patent. **Patented Mar. 20, 1917.**

Application filed October 10, 1911, Serial No. 653,823. Renewed December 30, 1916. Serial No. 139,965.

Be it known that I, ISIDOR KITSEE, citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Quadruplex Telegraphy, of which the following is a specification.

My invention relates to an improvement in quadruplex telegraphy.

Its object is to produce an efficient and at the same time simple arrangement for transmitting two messages simultaneously from each terminal of a line and to receive the messages at each terminal with the aid of one single line relay.

My invention is applicable to land lines as well as to lines with great capacity, such for instance as submarine cables.

In the accompanying drawing, Figure 1 is a diagrammatic view of one terminal of a line of transmission provided with my arrangement for transmitting messages and the arrangement for receiving messages from the far-off station.

Figs. 2 and 3 are diagrammatic views of transmitting stations adapted to be used in the place of the transmitting arrangement as illustrated in Fig. 1; these arrangements being suitable mostly for land lines or lines with comparatively low capacity.

Fig. 4 is a diagrammatic view of a transmitting arrangement suitable mostly for lines with great capacity, such for instance as submarine cables.

In Fig. 1; 1 is the line of transmission; 2, 2, the duplexing bridge; 3 the transmitting arrangement as an entirety. 5 is a double commutator consisting here of the parts 6 and 6^b; each of these parts comprising the conducting segments 7 and the nonconducting segments 8. The conducting segments are in electrical connection with each other and with the shaft 9 and the whole commutator is adapted to be revolved by suitable means through this shaft. The brush 10 connects with the shaft 9. The transmitting arrangement 3 comprises the two stations A and B. The devices of the station B are similar to the devices of the station A and are indicated with similar numerals with the exception that the numerals of the station B carry also the letter "b". 11 is a battery connected in the middle through wire 12 with the ground 13. 14 is an electromagnet, the coil thereof connected with the interposition of battery 15 to the key 16. This electromagnet is provided with the two armatures 17 and 18. The armature 17 is provided with the stops 19 and 20; and the armature 18 is provided with the stops 21 and 22. One half of the battery 11 connects with the positive pole to the stop 22 of station A and the other half of the battery 11 connects with the negative pole to the stop 22^b of station B.

Normally, that is, when the keys are open, the armature 18 rests against stop 22 and the armature 18^b rests against stop 22^b. The stop 21 connects through wire 23 with the stop 22^b and, therefore, with the negative pole of that half of the battery which is connected to said stop. The stop 21^b connects through wire 24 with stop 22 and, therefore, to the positive pole of that half of the battery which is connected to said stop. The armature 17 of station A connects with armature 17^b of station B through wire 25 and the stop 19 of station A connects with the stop 19^b of station B through wire 26. The brush 10 of the commutator is connected through the wire 27 with wire 25 and the bridge 2, 2, is connected through wire 28 with wire 26.

The armature 18 of station A connects with brush 29, resting on the commutator part 6, and the armature 18^b of station B connects with brush 29^b, resting on the commutator part 6^b.

Normally, that is, when both keys are open and the commutator revolves at the required speed, reversals are transmitted over the line 1, passing in equal intensity over the bridge sides 2, 2. I have also provided the line of transmission with the artificial line 50 grounded at 51 and it is obvious that the artificial line should duplicate the real line or cable in its electric properties.

The receiving arrangement 4 comprises here the inductive resistance 30 inserted in the cross circuit of the bridge, the receiving device 31 connected in shunt to said inductive resistance.

The inductive resistance is not essential in my system, but I make use of the same because on lines with great capacity, the signals are received better when the receiving

device is provided with such shunt than without this inductive resistance.

As a receiving device, I have here illustrated a relay in which the coils are movable and the outside field magnets as well as the cores are stationary. No doubt, different polarized relays may be used, but I have found, in practice, that the relay used by me on submarine cables is also well adapted for land telegraphy. The only requirement on land telegraphy is, that it should be made less sensitive than on cable telegraphy.

The moving coils are here provided with the armature 32 held at the zero position by the springs 33, 33. 34 and 35 are two contacts in proximity to this armature and the zero position of this armature is such that it is about midway between these two contacts and without touching any of these contacts as long as no current is transmitted over the line. The relay 31 is, as said above, connected in shunt to the inductive resistance 30 and the shunt wires are here designated by the numerals 36, 36. A′ is one of the receiving stations adapted to receive one message and B′ is the receiving station adapted to receive the second message; and it is supposed that A′ is adapted to receive the messages from the transmitting station A at the far-off terminal and B′ the receiving station adapted to receive the messages from the transmitting station B at the far-off terminal.

The armature 32 of the receiving device 31 is provided here with the source of current 38. 39 and 39ᵇ are two inductoriums or converters; the primary of inductorium 39 connecting with the negative pole of said battery and stop 34 and the primary of inductorium or converter 39ᵇ connecting with the negative pole of said battery and stop 35.

40 and 40ᵇ are two polarized relays; the circuit of the coil of polarized relay 40 connected to the secondary of inductorium or converter 39 and the circuit of the coil of polarized relay 40ᵇ connected to the secondary of inductorium or converter 39ᵇ. 41 and 41ᵇ are two translating devices, here shown as sounders. The coil of sounder 41 is connected through battery 42 to the armature and forward stop of relay 40 and the coil of sounder 41ᵇ is connected through battery 42ᵇ with the armature and forward stop of relay 40ᵇ.

I will now describe the operation of this, my system.

As long as both the keys of transmitting station A and transmitting station B are open and the commutator is revolving at the required speed, as said above, true reversals are impressed upon the line and transmitted to the far-off receiving station.

When the operator at the transmitting station A desires to transmit messages, he manipulates his key in the same manner as the operator manipulates his key now, on land lines, closing the same for a short period to denote a dot and a longer period to denote a dash. Through the closing of his key, his electromagnet is energized and the armature 18 of his electromagnet is drawn away from stop 22 and in contact with stop 21, thereby breaking the contact with its own battery and making contact with the battery of the station B. Whereas, before, through the revolving of the commutator, his own brush 29 impressed upon the line positive pulses as soon as it came in contact with one of the conducting segments of the commutator, his brush will now transmit negative pulses if contacting with the conducting segments of said commutator; and as the brush 29ᵇ of station B (the key of said station being open) will also transmit negative pulses, it is obvious that the line of transmission will, during the closing time of the key at station A, receive only negative pulses in quick succession, or practically a long drawn negative pulse.

It is now supposed that the operator at A has ceased transmitting and the operator at B closes his key. Through the closing of this key, the armature 18ᵇ, which formerly connected with the negative pole of its own half of the battery 11, is drawn away from its stop 22ᵇ, thereby breaking this connection and is drawn in contact with stop 21ᵇ, thereby making the connection with the positive pole of the half of the battery pertaining to station A. The brush 29ᵇ, therefore, will impress upon the line positive pulses as soon as it comes in contact with the conducting segment of its own commutator part; and as the brush 29 also impresses positive pulses upon the line, it is obvious that as long as the key of station B is closed, a series of positive pulses will be transmitted over the line practically resulting in one drawn out positive pulse.

It has to be stated right here that at the same time that the armature 18 of electromagnet 14 is drawn away from stop 22 and in contact with 21, the armature 17 is drawn away from stop 19 and in contact with stop 20. Through the breaking of the connection of armature 17 with stop 19, the electrical connection of wire 25 with wire 26 is broken at this point, but as wire 26 still connects with wire 25 through armature 17ᵇ and stop 19ᵇ, no electrical change will take place in the circuit comprising these two wires and the wires connected thereto.

It has also to be stated that when the key 16ᵇ of station B is closed and the armature 18ᵇ breaks its circuit with 22ᵇ and makes the circuit with 21ᵇ, the armature 17ᵇ breaks at the same time with 19ᵇ and comes to rest at 20ᵇ thereby breaking at this particular point the connection between the wires 25 and 26.

But, as in this instance, that is, when only the key of station B is depressed, the connection between wires 25 and 26 remains intact through armature 17 and contact 19 of station A, it is obvious that no electrical change in these two circuits and the wires connected thereto will occur.

It is now supposed that the operators at A and B depress simultaneously their respective keys. Through the depression of key of station A, the armature 18 of its electromagnet disconnects with stop 22 and connects with stop 21. Through the depression of key of station B, the armature 18^b of its electromagnet disconnects with stop 22^b and connects with stop 21^b, but at the same time, the armature 17 of station A breaks its connection with contact 19 and the armature 17^b of station B breaks its connection with contact 19^b. The electrical connection, therefore, of the two circuits 25 and 26 is entirely broken; and as the commutator connects through brush 10 and wire 27 with the circuit 25 and as the line of transmission—or better the bridge circuit of this line—connects through wire 28 with circuit 26, it is obvious that the connection between the line or bridge circuit and the circuit of the commutator is entirely broken and no matter with what source of current the different armatures may connect, no impulse can be impressed upon the line.

The actions above outlined will, therefore, result in the following:—

First:—Normally, both of the transmitting stations A and B being idle and no message being sent, results in impressing upon the line and, therefore, receiving at the far-off receiving station, true reversals, that is, alternately impulses of opposite polarity.

Second:—Messages transmitted only from station A result in impressing upon the line a negative current lasting as long as the key is depressed.

Third:—Messages transmitted only from station B result in impressing upon the line a positive current lasting as long as the key is depressed.

Fourth:—Two messages sent simultaneously will result therein that the connection between the line and the transmitting means is entirely broken as long as both keys are depressed.

I will now describe the operation of the two receiving stations of one terminal.

It has to be taken for granted that, normally, true reversals are impressed upon the line in such rapid succession and with such high electromotive force as will, at the far-off station, actuate the line relay and move its tongue alternately in contact with the right and left stop in quick succession.

It has also to be taken for granted that through the arrival of a positive pulse, the tongue is forced to connect with its stop to the left and through the arrival of a negative pulse, the tongue is forced to connect with its stop to the right and that, therefore, the local circuit operatively related to the circuit of the left hand stop is related to and is made to translate messages delivered from the transmitting station A of the far-off terminal and that, therefore, the local circuit operatively related to the circuit of the right hand stop is related to and made to translate messages delivered from the transmitting station B of the far-off terminal.

When the tongue of the line relay connects with its left hand stop (or stop 34), an impulse will flow through the primary of the converter connected in the circuit of this stop. This impulse will induce an impulse in the secondary of this converter flowing in opposite direction to the prime current and it has to be taken for granted that this impulse will actuate the localized polar relay in a manner so that its armature will be drawn to the left and come to rest at the left hand stop. At this position, the circuit including the translating device or sounder is open. As long as the armature of the line relay will rest against its left hand stop, no current will be developed in the secondary and, therefore, the armature of the localized relay will remain at rest, but as soon as the armature of the line relay breaks contact with its left hand stop, the flow of the current through the primary of the converter ceases and this ceasing of the current induces in the secondary of the converter an impulse in opposite direction to the former induced impulse and it has to be taken for granted that this impulse will drive the armature of the localized relay toward and in contact with the stop connected to the coil of the translator or sounder, thereby actuating this translator or sounder. The armature of the localized relay will remain at the right hand stop until again the armature of the line relay makes connection with its left hand stop 34, thereby inducing again an impulse in the secondary of the converter.

The same operations take place at the station B′ when the armature of the line relay connects and breaks circuit with its right hand stop 35.

The adjustment of the localized relays and translating devices are such that if the induced pulses follow each other in quick succession, the translating device should not be able to answer but should only answer if the time between one induced pulse and the other pulse is prolonged. Different means may be employed for this purpose. Either the stops may be set so far apart that the armature cannot connect for a sufficient time so as to produce a result on the translating device, or impedances may be inserted in the circuit for the purpose of retarding the flow of the current.

I have not shown any of these means, as these means may vary in accordance with requirements and are well understood by persons versed in the art.

It is only required to state:—

It is necessary for the proper working of this system that the translating device should not be able to operate sufficiently for the purpose of translating an impulse when such impulses are following each other in rapid succession.

It is now supposed that a rapid succession of positive and negative pulses arrive at the receiving station. The tongue of the line relay will, therefore, vibrate and connect alternately with the right and left hand stops. Alternate impulses will, therefore, be generated in quick succession in the secondaries of the converters of stations A′ as well as B′; and as the localized circuits are arranged so as not to be operated by such rapid succession of pulses, the translating devices of both stations will remain silent.

It is now supposed that the operator at the far-off transmitting station A transmits a message and that, therefore, only a negative pulse of longer duration arrives at the receiving station. The tongue of the line relay, after breaking connection with the left hand contact 34, will connect with the right hand contact 35, but will remain in contact with same for a time coinciding with the length of time of the negative pulse. Through the breaking of the connection of the tongue of the line relay with the left-hand stop, an impulse is induced in the secondary of converter 39 driving the tongue of the localized relay toward and in contact with that stop to which the translating circuit is connected and as no opposite pulse follows in quick succession, it is obvious that the translating circuit will remain closed until the line relay has again made contact with its left hand stop, but as the length of the negative pulse coincides with the length of the closing time of the key of the operator at A,—a shorter time for a dot and a longer time for a dash,—it is obvious that this time will be translated at the station A′ into a dot or dash, as the case may be.

It is now supposed that the operator at station A has ceased to signal or transmit messages and that the operator at station B of the far-off terminal has depressed his key to produce a signal. As soon as this operator has closed his key, the sequence of the impressed positive and negative pulses is interrupted and only a positive pulse is impressed upon the line coinciding with the closing time of the key. At the receiving station, only this positive pulse will arrive and the tongue of the line relay, after breaking contact with the right hand stop, will be drawn toward and in contact with the left hand stop and will remain there during the whole time that the positive pulse lasts.

The breaking of the tongue of the line relay with the right hand stop induces an impulse in the secondary of the converter 39^b of the station B′ in a direction so as to drive the tongue of the localized relay of this station in contact with that stop which is connected with the translating circuit; and as the tongue of the line relay remains in contact with the left hand stop, the translator connected in the translating circuit will remain active until the tongue of the line relay is released from the left hand stop and comes again in contact with the right hand stop, and as this time also practically coincides with the closing time of the key at the far-off transmitting station, it is obvious that the signals,—the dot and dash,—will be translated correctly into readable characters.

It is now supposed that both operators at the far off transmitting stations have simultaneously depressed their keys, thereby disconnecting the cable from the transmitting apparatus. No current will, therefore, flow over the cable and the tongue of the line relay will assume its zero position and will not connect with any of its stops either to the right or to the left. As the last impulse induced in each of the secondaries of the two converters, due to the breaking of the tongue of the line relay with its respective stop, was in a direction so as to force the tongue of the localized relay of each station in contact with the stop including the translating circuit, it is obvious that the time during which both keys at the transmitting stations are depressed will be translated at the receiving station by both translators in accordance with the length of the depression of said keys as dots or dashes. But as soon as one or the other of the keys at the transmitting stations is open, a positive or negative pulse—as the case may be—will again arrive and actuate the line relay in the usual manner.

The action of the receiving devices, therefore, will be as follows:—

First:—Normally, that is, when no messages are transmitted, impulses of alternate polarity will follow each other in quick succession. The tongue of the relay will, therefore, alternately connect in quick succession with the right and left hand stops and, therefore, both of the translating devices will remain silent.

Second:—If the station A transmits signals, only negative pulses will arrive at the receiving station as soon as the key at station A is depressed and the translating device at the station A′ will become active.

Third:—If the station B alone transmits signals, only positive pulses will arrive at the receiving station during the time that

the key at station B is depressed. The tongue of the line relay will, therefore, be drawn toward the left hand stop and will remain there as long as the key at the far-off transmitting station B remains depressed. The translating device of station B′ will, therefore, translate the time of depression into the required character.

Fourth:—When both of the keys are depressed and no current flows over the line, then the tongue of the line relay will assume its zero position between and out of contact with both of the stops, the right hand as well as the left hand, and the translating devices at both stations A′ and B′ will become active and will translate the time of no current into the required character; if this time lasts for a short period—into a dot—and if this time lasts for a longer period—into a dash.

It is obvious that the translating devices may also act as repeaters.

I have above described my system of quadruplexing as embracing at the transmitting stations means to change the sequence of the normally transmitted reversals into a current, the pulses thereof of equal strength and one polarity.

I consider this system to be well adapted for land lines and believe that the arrangement whereby through the closing of one key a practically uninterrupted current of normal strength but opposite polarity is transmitted, so as to hold over the tongue of the line relay, is to be preferred to other arrangements, but as in some cases, these other arrangements may find a place in quadruplex telegraphy, I have illustrated and will now describe the same, having first reference to Fig. 2.

In this figure, 5 is the commutator as an entirety comprising the parts 6 and 6^b and the shaft 9 against which rests the brush 10 connected, as in Fig. 1, to wire 27. 29 and 29^b are the two brushes; the brush 29 connecting with armature 18 of the coil of electromagnet 14 resting normally against the stop 22. This armature is connected to the positive pole of one half of the source of current 11 and this source of current is grounded in the middle at 30. This station is designated by the letter A.

The coil of electromagnet 14 is connected with the interposition of the battery 15 to the key 16.

So far, the parts of station A coincide with similar parts as illustrated in Fig. 1. But, whereas in Fig. 1, the armature of electromagnet is provided with means to change the connection of the brush 29 from one half of the battery to the second half and, whereas, the second armature for said electromagnet is provided with means to make and break a circuit, this arrangement is omitted here.

Station B of Fig. 2 is a counterpart of station A and similar numerals indicate similar parts with the exception that the numerals of station B carry also the designation "b."

The operation of this arrangement is as follows:—

Normally, reversals are transmitted over the line in the same manner as reversals are transmitted over the line with the arrangement of Fig. 1, but when the operator at station A closes his key, he entirely disconnects his battery from the commutator and, therefore, only pulses of opposite polarity will be transmitted over the line and these pulses, even if they follow each other in quick succession, will be separated and interrupted. At the receiving side, the resultant effect will be that the tongue of the line relay will vibrate and alternately connect and disconnect with that stop to which it was driven by the arrival of the incoming impulses.

The difference, therefore, between the arrangement of Fig. 1 and Fig. 2 is that, whereas in Fig. 1, the armature of the receiving device will be held in contact with the respective stop through the arrival of pulses of the same polarity, here the tongue will vibrate, because a time-unit will elapse between one pulse and the succeeding pulse of the same polarity.

When both keys at the transmitting station are depressed, no current will flow over the line and the resultant effect will be equal to the effect as produced in Fig. 1 by breaking the circuit between 25 and 26.

Coming now to Fig. 3, in which similar numerals also indicate similar parts as in Fig. 1, the only difference between the arrangement in Fig. 1 and the arrangement in Fig. 3 is, that in Fig. 1, the whole force of the opposite battery is transmitted by the closing of the key of one of the stations, whereas, here only part of the force of the opposite battery is transmitted.

The effect of this arrangement may be equal to the effect of the arrangement as illustrated in Fig. 1 provided that the commutator revolves at a high speed, otherwise a slight vibration of the tongue of the relay will result.

Coming now to Fig. 4, it has to be stated that for lines with great capacity, such for instance as long submarine cables, this arrangement has a number of advantages.

On land lines with great capacity, the current wave is such that if a number of pulses of the same polarity are transmitted in quick succession, the same merge—so to speak—at the receiving end into one prolonged wave and if then a short pulse of opposite polarity is transmitted, this short pulse cannot effectually "wipe out" at once the effect of the long drawn out wave of opposite polarity.

For this and other reasons, it is best to send, after each pulse,—even if one or the other of the keys is closed,—a pulse of opposite polarity to "clear" the line, but of such low intensity, so as not to be able to affect the receiving instrument.

In this figure, the armature 18 of station A does not connect when drawn in contact with 21 with the battery of station B, but it connects with part of its own battery and so also does the armature 18^b when drawn toward the contact 21^b not connect with the battery of station A, but with that of the battery of its own station.

The resulting effect, therefore, if—for instance—the key of station A is depressed (the key of station B being left idle) is that the whole force of the battery of station B will be transmitted but only part of the force of the battery of station A will be transmitted. Reversals, therefore, will be the result of the depression of the key of station A. Whereas, when both keys are open, the positive pulse will be of the same electromotive force as the negative pulse. The positive pulse of station A when its key is depressed will be only of part of the force of station B.

The reversals, therefore, will not be "true" but one half of each of the cycles will be of an electromotive force lower than the other half.

When the key of station B is depressed, then the positive pulses from station A will be of their entire force, whereas, the pulses from station B will be of a force reduced in accordance with requirements.

At the receiving station, the effect will be as follows:—

Normally, through the impressing upon the line of true reversals, the movable part of the line relay or receiving device will vibrate.

When one of the keys—say key of station A—is depressed, then reversals will be transmitted over the line of which the negative halves of each cycle are able to actuate the movable part of the receiving device and will drive the same in a direction,—say to the right—or opposite to the direction to make contact or actuate otherwise the translating device and when—say the key of station B is depressed, then the movable part of the line relay will deflect to the left.

As to the ultimate effect on the translating devices of the receiving stations, this effect is exactly similar to the effect on the different translating devices of the transmitting arrangement as illustrated in Fig. 1.

It is obvious that the person in charge may place switches at such points as it seems desirable. It is also obvious that prearranged signals may be sent from the transmitting station or receiving station, for the purpose of informing the person in charge of these stations that they are ready to receive or transmit.

Such arrangements are old in telegraphy and it is unnecessary to either point out the places where switches may be placed or to give the sequence of pulses, for the purpose of signaling between operators.

The broad principle of transmitting by normally impressing upon the line pulses or currents of alternating polarity and thereby at the receiving station normally vibrating a line relay, depressing one of said polarities when sending from one station, depressing the opposite polarity when sending from the other station, and suppressing both polarities when sending from both stations, and the method of receiving by causing a line relay when no signal is being transmitted to vibrate in quick sequence, when at rest in zero position to simultaneously translate two messages into readable characters, when at rest in one deflected position to translate one message into readable characters, and when at rest in the opposite deflected position to translate a second message into readable characters, is not claimed in this application, but is claimed in my copending application Serial No. 766,085, filed May 7, 1913, which said application illustrates a somewhat different arrangement than is illustrated in this application, but in which said application the broad claims common to these two applications are made.

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

1. In quadruplex telegraphy, a line of transmission, a bridge for each terminal of said line, two local receiving stations for the cross circuit of each of said bridges, one line relay for the cross circuit of each of said bridges, both receiving stations of each bridge operatively related to said line relay, and means for said relay to disrupt both local circuits when two messages are being received.

2. The method of telegraphing, which consists in impressing on the line impulses of opposite polarity, thereby causing a line relay, when no signal is being transmitted, to vibrate in quick succession, depressing the impulses of one polarity when one message is being received to cause the relay to close one of two translating circuits, and depressing the impulses of both polarities when two messages are being received to cause said relay to disrupt both translating circuits.

3. The method of telegraphing, which consists in impressing alternately two polarities upon the line to denote that no message is transmitted, causing said alternations to vibrate a line relay in operative relation to two local translating circuits, and depressing both polarities to denote that two

messages are transmitted simultaneously and thereby causing said relay to disrupt both translating circuits.

4. The method of telegraphing, which consists in impressing upon the line a practically uninterrupted current of one polarity to denote the character of one message, impressing upon the line a practically uninterrupted current of opposite polarity to denote the character of a second message, causing said opposite polarities to separately energize two translating circuits, disrupting the line from the translating means to denote the characters of two simultaneous messages, and causing said disruption to deenergize both translating circuits.

5. In quadruplex telegraphy, a line of transmission, a bridge for said line, a single line relay inserted in the cross circuit of said bridge, two local translating circuits operatively related to said line relay, and means for said line relay upon the receipt of positive pulses to energize one of said translating circuits, upon receipt of negative pulses to energize the other of said translating circuits, and upon receipt of two messages to deënergize both of said translating circuits.

6. A telegraphic quadruplex system comprising at the transmitting stations means to transmit normally pulses alternating in polarity, a transmitting key and means to transmit, through the operation of said key, a practically unbroken current of one polarity, a second transmitting key and means to transmit, through the operation of said key, a practically unbroken current of opposite polarity, and means operatively related to both of said keys to stop the transmitting current in its entirety.

7. A system of quadruplex telegraphy comprising a line of transmission and comprising at one of the stations of each terminal means to transmit positive signal pulses, comprising at another station of each terminal means to transmit negative signal pulses, means operatively related to both stations of each terminal to stop the flow of the transmitting current entirely over said line and comprising at the receiving station means to nullify the effect of the home pulses, one single line relay connected to said means, and two translating stations, one adapted to translate the message from one of the far-off transmitting stations and the second adapted to translate the message from the second far-off transmitting station.

8. In quadruplex telegraphy, a transmitting line, two transmitting stations for each terminal, each transmitting station comprising means to transmit signal pulses of one polarity to transmit one message, in combination with means operatively related to both of said transmitting stations to depress the signaling current as an entirety to denote that two messages are sent simultaneously, and a single line relay at each terminal arranged to translate separately the pulses of opposite polarities into intelligible messages.

9. In a quadruplex telegraph, a line of transmission, a bridge for said line, a single line relay inserted in the cross circuit of said bridge and arranged to normally vibrate, two local translating circuits operatively related to said line relay, means for said line relay upon the receipt of positive pulses to disrupt one of said translating circuits, upon receipt of negative pulses to disrupt the other of said translating circuits, and upon receipt of two messages to disrupt both of said translating circuits, and means for each of said translating circuits when disrupted to record a message.

10. In quadruplex telegraphy, a line of transmission, two transmitting stations at one terminal of the line, automatic means operatively related to both stations to impress upon the line practically true reversals, said automatic means including a circuit maker and breaker, transmitting means for each station, means operatively related to both of said transmitting means to automatically cease the transmission of said reversals and substitute therefor a grounding of the line, and a single line relay at the opposite terminal of the line arranged to translate separately the two opposite reversals into intelligible messages.

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

ISIDOR KITSEE.

Witnesses:
MARY C. SMITH,
ALVAH RITTENHOUSE.