I. KITSEE.

TELEGRAPHY.

APPLICATION FILED JUNE 6, 1914.

1,236,575.

Patented Aug. 14, 1917.

3 SHEETS—SHEET 1.

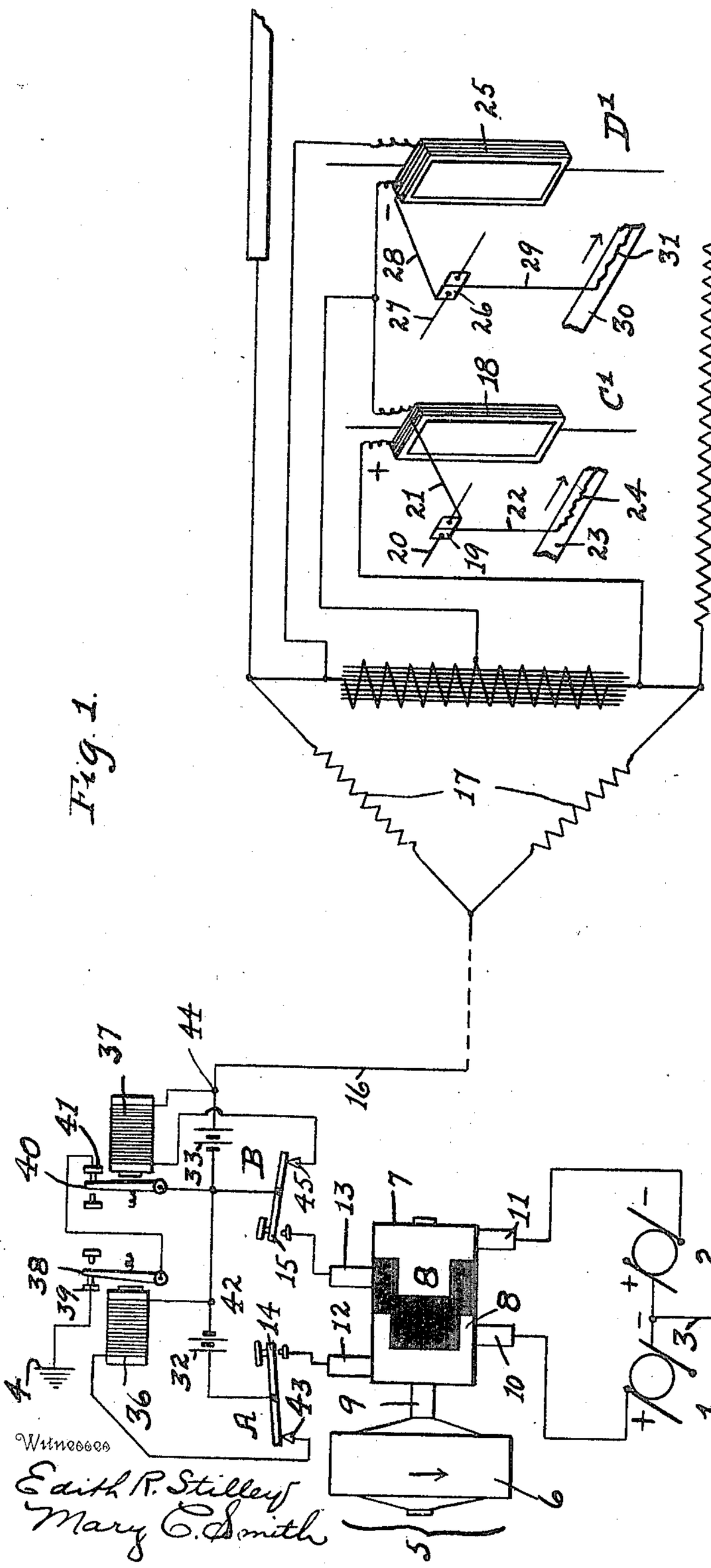


Fig. 1.

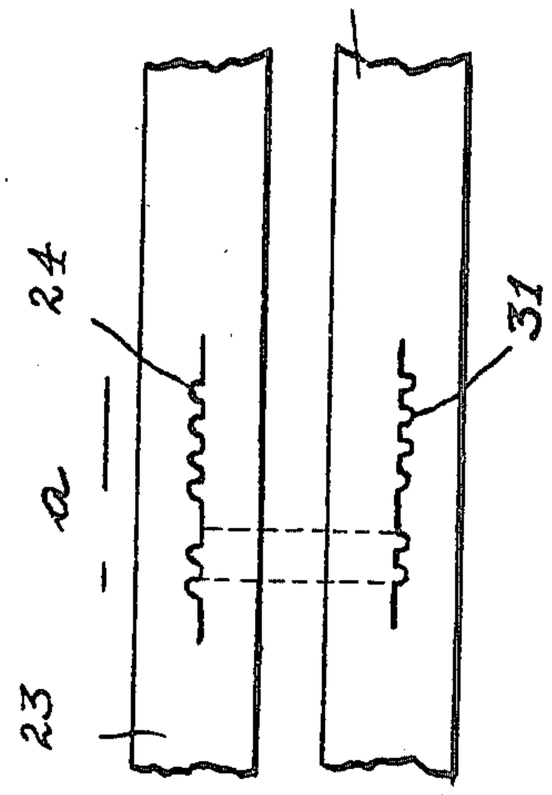


Fig. 2.




Fig. 3.

Witnesses

Edith R. Stilley

Mary C. Smith

Inventor

Isidor Kitsee

I. KITSEE.

TELEGRAPHY.

APPLICATION FILED JUNE 6, 1914.

1,236,575.

Patented Aug. 14, 1917.

3 SHEETS—SHEET 2.

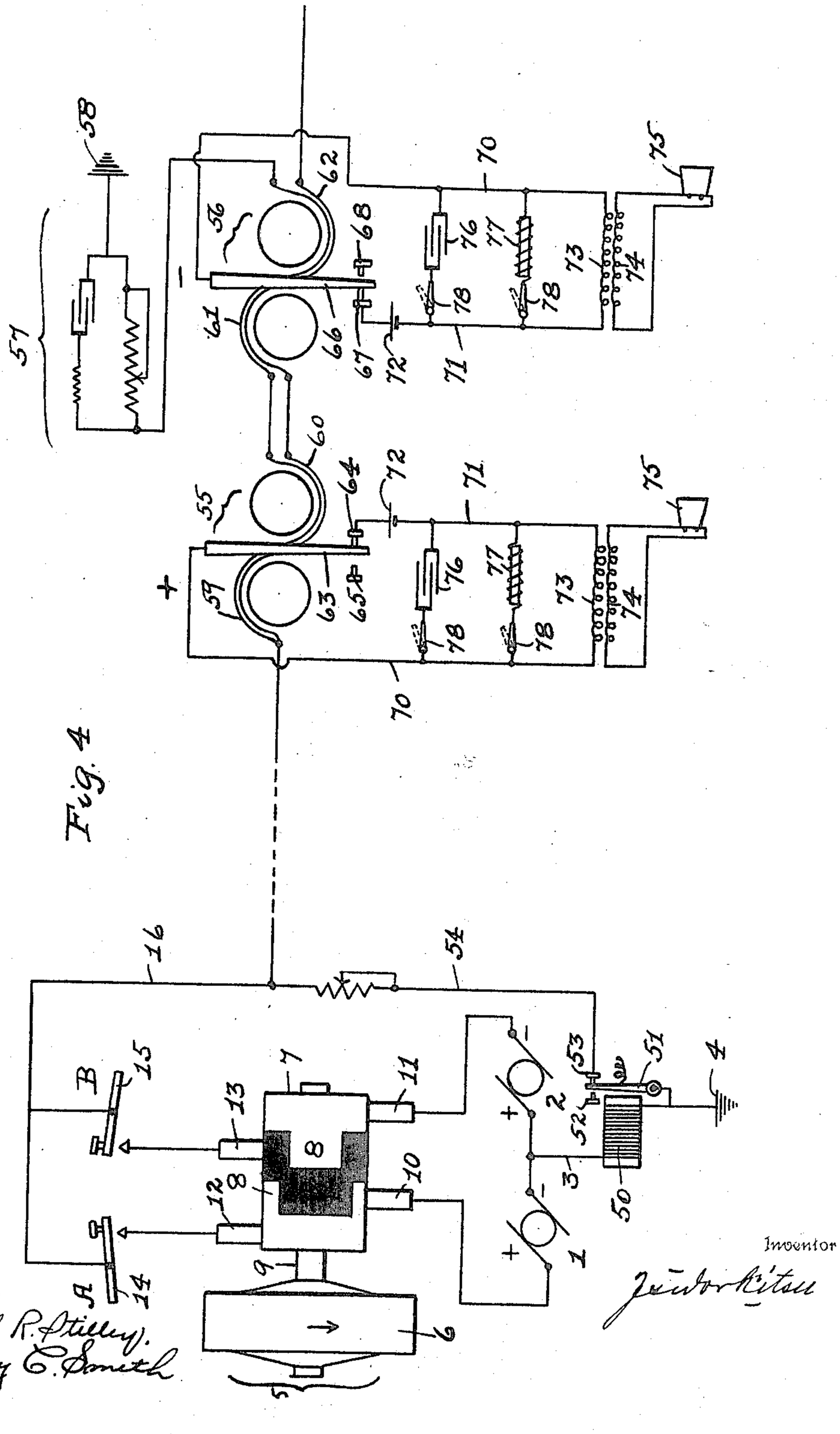


Fig. 4

Witnesses

Edith R. Stilley.

Mary C. Smith

Inventor

Isidor Kitsee

I. KITSEE.

TELEGRAPHY.

APPLICATION FILED JUNE 6, 1914.

1,236,575.

Patented Aug. 14, 1917.

3 SHEETS—SHEET 3.

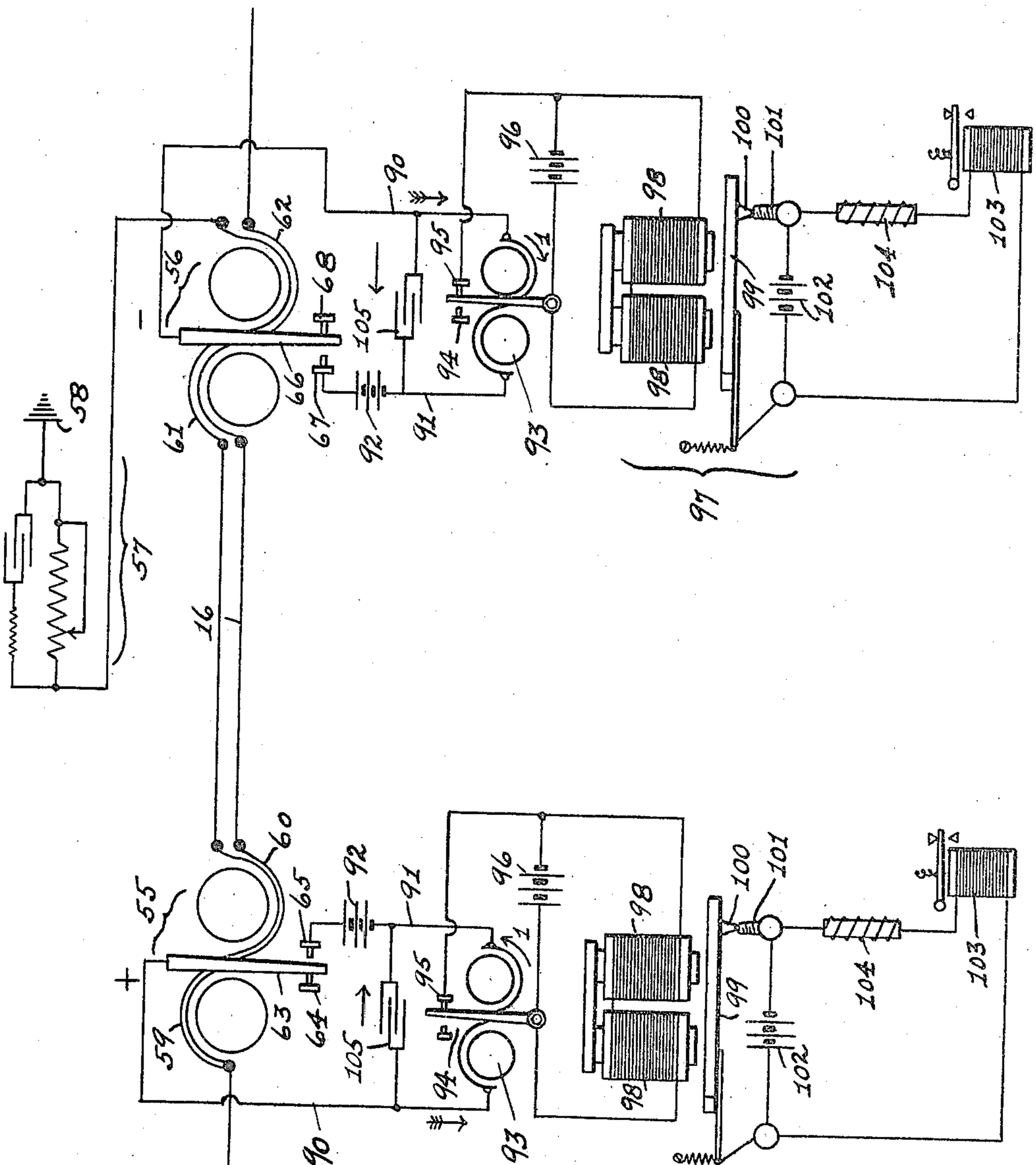


Fig. 5.

Witnesses

Edith P. Stilley

Mary C. Smith

Inventor

Isidor Kitsee

# UNITED STATES PATENT OFFICE.

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.

## TELEGRAPHY.

1,236,575. Specification of Letters Patent. Patented Aug. 14, 1917.

Application filed June 6, 1914. Serial No. 843,492.

*To all whom it may concern:*

Be it known that I, ISIDOR KITSEE, a 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 Telegraphy, of which the following is a specification.

My invention relates to an improvement in telegraphy and has more special reference to a system of telegraphy with the aid of which two messages can be transmitted simultaneously from one terminal and received simultaneously at the far off station. This system is commonly known as "diplex telegraphy".

My invention has also reference to a system known as "quadruplex" in which two messages are simultaneously transmitted from each terminal of the line and simultaneously received at the far off terminal.

My invention is applicable to land lines in which the resistance over-balances the capacity and is also applicable to lines with great capacity, such for instance as submarine cables, in which the capacity outweighs the resistance.

My invention may be practised with the aid of one receiving instrument for two messages, or it may be practised with the aid of two receiving instruments, each for a single message.

To illustrate some forms my invention may take, reference is made to the accompanying drawings in which Figure 1 is a diagrammatic view illustrating one-half of a quadruplex system applied to a cable; Figs. 2 and 3 are plan views of the recording tapes used in that system; Fig. 4 is a diagrammatic view illustrating one-half of a quadruplex system adapted for land lines; and Fig. 5 is a diagrammatic view illustrating a modification of the receiving circuits shown in Fig. 4.

I will first describe my invention as illustrated in Figs. 1, 2 and 3.

It is well known that on lines with great capacity, such as submarine cables, very delicate instruments have to be employed as receivers and today the so-called siphon recorder (the ingenious invention of Lord Kelvin) is generally employed to record on a moving strip of paper the variations of the current impulses arrived.

Broadly speaking, this device consists of a coil delicately suspended in the region of a strong magnetic field. To this coil is connected the cradle (a small metallic square) with the aid of two fibers in a manner so that if the coil deflects to the right the cradle is deflected in one direction, and if the coil deflects to the left the cradle is deflected in the opposite direction. To this cradle is secured a very fine siphon dipping with one end in an ink well and resting with the other end on a moving paper.

In the system of cable telegraphy of today, a positive pulse denotes a dot and a negative pulse denotes a dash, and through the arrival of a positive pulse, the coil and, therefore, the siphon deflects—say to the right—producing one curve on the right side of an imaginary zero line and through the arrival of a negative pulse, the coil and, therefore, the siphon deflects—say to the left—thereby producing one curve on the left side of an imaginary zero line.

In the system as outlined in Fig. 1, it is my desire to use as much as possible the instrumentalities used today in cable telegraphy and I, therefore employ the siphon recorder of today as a receiving device in this my invention. But as the siphon recorder, as constituted, would answer to the positive as well as to the negative pulses, and as, in my system, one siphon recorder should only answer to the positive and the second recorder only to the negative pulse, slight alterations in these recorders are necessary, and I accomplish my purpose of making immune the recorder to one polarity by simply cutting one of the fibers connecting the cradle to the moving coil.

I am aware that the same purpose may be accomplished by providing stops for the coil in such manner as to allow the same to deflect only in one direction, but I have found, in actual tests, that such stops do not answer the purpose well, as invariably a rebound of the delicately suspended coil follows, greatly interfering with the clearness of the signals.

I will first describe the transmitting device as illustrated in Fig. 1. In this device,

1 and 2 are two sources of current, here shown as two direct current generators coupled together in series. 3 is a conductor connecting the junction of these two generators to the ground 4. 5 is a commutating device in its entirety. Of this commutating device, 6 is the motive power, here shown as an electric motor; 7 the revolving drum; 8 the commutating segments on said drum. The drum itself may consist of any desirable insulating material and is operatively related to the motor through the shaft 9. 10 and 11 are two brushes resting on the drum 7; the brush 10 connecting with the positive pole of the generator 1 and the brush 11 connecting with the negative pole of the generator 2. 12 and 13 are two collecting brushes adapted to connect, through the revolution of the drum, with the conducting segments of same; the brush 12 with the conducting segments in contact with brush 10 and, therefore, the positive pole of generator 1; and brush 13 with the conducting segments in contact with brush 11 and, therefore, the negative pole of the generator 2. 14 and 15 are two transmitting keys; the lower stop of key 14 connected to brush 12 and the lower stop of key 15 connected to brush 13. The levers of both of these keys are connected through wire 16, here shown with the interposition of the bridge, to the cable.

For better understanding, I designate the key 14 as appertaining to the transmitting operator A and the key 15 as appertaining to the transmitting operator B.

In this system, the keys 14 and 15 are normally open and, therefore, no current will flow over the line, but the drum 7 is normally revolved by the motor 6.

When the operator of A desires to transmit messages, he manipulates the key in the same manner as is at present the case on land telegraphy, that is, he depresses the key for a short period to denote a dot and for a longer period to denote a dash. Through the depression of this key, a circuit is established with the positive pole of the grounded source of current 1 and the cable, as often as the brush 10 connects with one of the contacts of the revolving drum 7. Each time the circuit between the cable and positive pole of source or generator 1 is made, a short pulse of positive polarity is impressed upon the line and as the speed of the motor and, therefore, the drum is so regulated that even the shortest depression of the key would insure more than one make and break of the contacts, it is obvious that through the depression of key 14, a series of positive pulses will flow over the line or cable and that the number of these pulses will coincide with the length of time the key remains depressed.

When the operator desires to transmit a dot, he, as said above, depresses the key for a short time and during this time, if the speed is regulated accordingly, two or three pulses are impressed upon the line and when the operator desires to transmit a dash and keeps the key closed for a longer period, as many as five or six or more pulses are impressed upon the line.

When the operator of B desires to transmit messages, he manipulates the key in the same manner as the operator of A manipulated his key and the changes in the circuits are similar to the changes in the circuits due to the depression of key 14 with this exception that through the depression of key 15 the line is alternately connected and disconnected from the segments in contact with brush 11 and, therefore, with the negative pole of generator 2. The depression of this key 15 will, therefore, send, for each signal, a series of negative pulses and the number of these pulses will coincide with the closing time of the key.

It is now supposed that both keys are simultaneously closed and that both operators desire to transmit exactly the same signals at one and the same time over the line. The closing of both keys connects the line alternately with the brush 10 connected to a positive pole and the brush 11 connected to a negative pole and the resultant effect will be that "true reversals" will be transmitted over the line,—each reversal comprising a positive and negative pulse and the number of these reversals will again coincide with the closing time of both keys.

We, therefore, have the following conditions:—

First:—When the operator of A alone transmits, a series of positive pulses only are impressed upon the line. Second:—When the operator of B alone transmits, a series of negative pulses only are impressed upon the line. Third:—When both operators simultaneously transmit, a series of positive alternating with negative pulses, that is, "true reversals" are transmitted over the line.

In the receiving arrangement illustrated in Fig. 1, 17 designates the bridge as an entirety; C′ designates the receiving organism for the far off station C (not shown here) and D′ the receiving organism for the far off station D (also not shown here). It is supposed that the station C transmits positive pulses and the station D transmits negative pulses. 18 designates the coil relating to C′; 19 the cradle; 20 the means for suspending the cradle; 21 the fiber attaching the cradle to one side of the coil; 22 the siphon; 23 the moving paper, and 24 the recorded lines on said paper. The arrow indicates the direction in which the paper moves. 25 designates the coil relating to D′; 26 its cradle; 27 the means to support

the cradle; 28 the fiber connecting the cradle on one side to the coil; 29 the siphon; 30 the moving paper; 31 the lines of record. The arrow also indicates here the direction in which the paper moves.

I have not here illustrated the magnetic field or the other instrumentalities used in the improved siphon recorders, as persons versed in the art well know this instrument and well understand its working.

The novel manner of using this instrument consists therein that with a coil moving unobstructed in both directions, the siphon itself is only deflected in one direction and, therefore, records only the movement of the coil in one direction. One coil, therefore, will, through its siphon, translate the message only of one polarity and the second coil, the message only of opposite polarity.

It is supposed that at the far off transmitting stations C and D, both operators transmit at one and the same time the letter "a." This letter consists in the Morse as well as Continental alphabet of a dot followed by a dash and, as in my system, each signal comprises a series of pulses,—a short series for a dot and a longer series for a dash,—it is obvious that the recorder in translating these pulses into readable characters must produce a short series of curves to denote a dot and a longer series of curves to denote a dash. But since (as stated above) at the transmitting station only reversals are transmitted as long as both keys are depressed and as the translating device relating to station C only translates the positive pulse of each reversal and the receiving device relating to station D only translates the negative pulse of each reversal, it is obvious that in producing the curves, the time-unit of the production of the curve by one instrument follows the time-unit of the production of the curve by the second instrument. In other words, the vibrations of the two siphons are in alternate succession.

In Figs. 2 and 3, I have illustrated the recording of the letter "a" by both recorders.

I have purposely illustrated the recorded lines on an enlarged scale, so that it should be apparent at a glance that the time-unit of the recording of the curves on one tape alternates with the time-unit of the recording of the curves on the second tape, it being taken for granted that the speed at which both of these tapes travel is identical.

I have so far described the transmitting as well as receiving arrangement of my invention, it being understood that the transmitting as well as receiving arrangements of the far off stations (not illustrated) are a duplicate of the stations illustrated in this figure. But in practical telegraphy, two points have to be considered when a line of great capacity, such as a submarine cable, has to be quadruplexed.

The first consideration is that the line should always be closed or grounded, no matter if one or both of the transmitting stations are active or idle.

A second consideration is that telegraphing with one polarity can more easily be accomplished if a "clearing current" (no matter of how small a potential) is impressed upon the line after each signal impulse.

For this reason, I have provided the transmitting arrangement as shown in Fig. 1 with means to accomplish both objects.

These means comprise here two sources of current designated by the numerals 32 and 33, respectively. These two sources are connected in series as to the line, but in opposition as to each other, and they consist of a potential far below the signal potential. Should the signal current consist of from fifty to sixty volts, then this clearing current should not have a higher value than from five to ten volts, as otherwise this clearing current may interfere with the proper working of the receiving devices.

These means also comprise here two electromagnets designated by the numerals 36 and 37, respectively; the electromagnet 36 provided with the armature 38 and the forward stop 39; the electromagnet 37 provided with the armature 40 and the forward stop 41. The forward stop 41 is electrically connected to armature 38 and the forward stop 39 of this armature is grounded at 4. The armature 40 of electromagnet 37 is connected to the line. The source of current 32 is normally short circuited in the following manner:

One terminal of the coil of electromagnet 36 is connected to the line at 42 and the other terminal of the coil is connected to contact 43 on which the lever of the key 14 normally,—that is, when not manipulated,—rests. The source 33 is normally short circuited in the following manner:—

One terminal of the coil of electromagnet 37 is connected to the line at 44 and the other terminal is connected to the point 45 on which the lever of the key 15 normally,—that is, when the key is not manipulated,—rests.

The line, therefore, is normally grounded through the armature of electromagnet 37, forward contact 41, armature of electromagnet 36 and forward contact 39. At the same time, both of the sources 32 and 33 are short circuited.

When the operator of station A manipulates key 14, its contact with the point 43 is broken, thereby breaking the shunt circuit including the source 32. Consequently electromagnet 36 is deënergized, armature 36 is drawn by its spring away from the stop 39

and the normal ground of the line is broken. As long as the key 14 is depressed the revolution of the drum 7 sends over the line positive pulses whose potential is reduced by the potential of the source 32. As soon as the key 14 is released, the shunt including the source 32 is again reëstablished, thereby reëstablishing the normal ground of the line, which serves to conduct any residual energy which may still remain on the line at the moment of breaking the connection at key 14 to the ground, and thereby clearing the line.

When the operator at station B depresses key 15, the shunt around the source 33 is broken, deënergizing the electromagnet 37 so that its armature is drawn by its spring away from the stop 41 and breaks the normal connection with the ground. As long as said key remains depressed, the revolution of the drum 7 sends over the line negative pulses whose potential is reduced by the potential of the source 33. When the key 15 is released, the shunt including source 33 is reestablished, thereby reëstablishing the normal ground of the line, whereby any residual energy still remaining on the line at the moment of breaking the connection at the key 15 is conducted to ground, thereby clearing the line.

When both operators, at stations A and B, simultaneously depress their respective keys, the shunts of both sources 32 and 33 are broken, and as before the normal ground of the line is broken. As sources 32 and 33 are connected in opposite direction, no current from these sources will flow over the line, but as long as both keys are depressed the revolution of the commutator 7 transmits over the line positive pulses alternating with negative pulses, that is, alternations.

When applied to land lines the arrangement will be substantially as illustrated in Fig. 4, which, like Fig. 1 shows only one terminal of the quadruplex system, embracing transmitting and receiving stations, but it will be understood that the arrangement at the distant terminal is a duplicate of that illustrated.

The transmitting organism is substantially the same as illustrated in Fig. 1, with the exception that no "clearing" current is employed because the capacity of land lines is a negligible factor and the rapidity with which pulses may be transmitted over a long aerial line is far greater than the rapidity with which pulses can be transmitted over a cable, and no "clearing" of the line is required.

The means for normally grounding the line in Fig. 4 is shown as a single electromagnet 50 interposed in the ground connection from the generators 1 and 2. This electromagnet is provided with armature 51 and two stops 52 and 53. The armature normally rests on the stop 53 which is connected by wire 54 with the line of transmission 16. This electromagnet 50 will be energized whenever either of the keys 14 or 15 is closed, and then acts to draw the armature 51 away from stop 53, thus breaking the normal ground of the line as long as either key is closed.

In all other particulars the transmitting arrangement is the same as shown in Fig. 1, except that no back contacts for keys 14 and 15 are required because of the absence in this modification of the local shunt circuits. The operation of sending here is exactly the same as with the arrangement shown in Fig. 1.

In the receiving arrangement of Fig. 4, 55 and 56 are two polarized relays, the armatures of which are in the form of steel bands or reeds fastened at one end and adapted to vibrate with the other end. In my experience I have found that the working of ordinary relays having an armature adapted to swing on a pivot or fulcrum is not satisfactory and I have therefore substituted the reed form of armature shown in Fig. 4.

Each of the polarized relays is provided with differential coils adapted to neutralize the home impulses with the aid of the artificial line 57 grounded at 58. Of the relay 55, the coil 59 is connected to the artificial line and the coil 60 to the line. Of the relay 56, the coil 61 is connected to the artificial line and the coil 62 to the line. The armature or vibrating reed of the relay 55 is here designated by the numeral 63 and this armature is here provided with the two stops 64 and 65. The armature or vibrating reed of relay 56 is here designated by the numeral 66 and is provided with the stops 67 and 68. Each of these relays is provided with a local circuit. The local circuit of each of these relays is identical, being identified by the same numerals. The circuit consists in each of these cases of the wire 70 connected to the respective armatures and the wire 71 connected to the respective stops. These wires are provided with a source of current, here shown as an electric battery 72 and are joined together by the primary 73 of an inductorium; the secondary 74 of this inductorium being connected to a receiver, here shown in the form of a so-called "howler" 75,—a device adapted to increase the sound. In multiple arc to this circuit, I have here shown the condenser 76 and the impedance 77. Both are connected to the circuit with the interposition of switching devices, here designated by the numerals 78, 78.

It is supposed that the relay 55 will answer to positive pulses and the relay 56 will answer to negative pulses.

As long as the keys at the far-off station are at rest, the armature or vibratory reed 63 will rest on the stop 64 and the arma-

ture or vibratory reed 66 will rest on the stop 67.

When the operator at the far-off station transmits positive pulses, the reed 63 of the relay 55 will be drawn, through the arrival of such pulses, away from stop 64 and toward stop 65. As these pulses are following each other in quick succession, the reed will assume a vibratory movement and will disconnect from and again connect with the stop 64, thereby sending pulses through the primary 73 of the inductorium which, in turn, will generate induced pulses in the secondary 74 and these pulses will actuate the diaphragm of the howler 75.

In experiments made by me the drum 7 made over two thousand revolutions per minute and we, therefore, had, in accordance with the arrangement of the drum, over four thousand positive pulses per minute, giving the reed 63 over four thousand vibrations per minute. The resultant effect on the howler 75 was a continuous buzzing or humming well distinguished by the receiving operator sitting at a table about five feet from the howler.

When the operator at the far-off station transmits negative pulses, the reed 66 of the relay 56 will be drawn, through the arrival of such pulses, away from the stop 67 and toward stop 68. The vibratory movement of this reed will alternately make and break the local circuit and will, therefore, produce in the howler 75 the same buzzing or humming effect as was the case through the vibration of the reed 63 of the relay 55.

When both operators depress their keys simultaneously, then the resultant effect will be the impressing upon the line of pulses of alternate polarity,—a negative pulse following a positive pulse,—and at the receiving station, both of the reeds 63 and 66 will vibrate and the receiving operator stationed at the relay 55 will be able to receive his message at one and the same time as the operator at relay 56.

In the arrangement shown in Fig. 4 messages are received with the aid of telephonic receivers, such as howlers, and the line relays are arranged to normally close the open circuit, and only to open said circuits upon the arrival of pulses of a certain polarity.

In Fig. 5 is illustrated a modified arrangement of the receiving circuits shown in Fig. 4, where in lieu of receiving the messages with the aid of telephonic receivers, such messages are received with the aid of ordinary sounders, and with the line relays so arranged that the local receiving circuits are normally open, and are closed to cause the actuation of the sounders only upon the arrival of pulses of the desired polarity. In this modification the same line relays 55 and 56 as shown in Fig. 4 are employed, relay 55 answering to positive pulses and relay 56 answering to negative pulses, excepting only that the armatures of both relays rest on the back stops and do not normally close the local circuit. The operation of this system is as follows:—

When plus pulses arrive in quick succession, then the armature or reed 63 will vibrate and will connect and disconnect alternately with the contact 65, thereby alternately making and breaking the local circuit. This local circuit consists here of the wires 90 and 91, battery 92 and the delicate polar relay 93. The armature 94 of this polar relay normally connects with the stop 95. To this stop is connected a second local circuit in the following manner:— The armature 94 connects with one pole of the battery 96; the second pole of this battery connects with the stop 95. Normally, therefore, the battery is short circuited through the armature and stop. 97 is what I call a "timing" device in its entirety. Of this timing device, 98 is the coil of the electromagnet. This coil is connected with one terminal to the armature 94 and with the second terminal to one pole of the battery 96. The armature 99 of this timing device is here held by springs in a downward position and has its projecting point 100 normally in contact with the adjustable screw 101. 102 is a battery normally short circuited through the projecting point and adjustable screw. 103 is an electromagnet, such as a common sounder, connected with the interposition of the impedance 104 to the adjustable screw 101 and with the other terminal to one pole of the battery 102.

When the operator of the far-off station transmits positive pulses, the reed of relay 55 will, in quick succession, connect and disconnect with the stop 65. When the operator of the far-off station transmits negative pulses, the reed 66 of relay 56 will vibrate and will connect and disconnect in rapid succession with the stop 67; and when both operators at the far-off station depress their keys simultaneously, then a succession of "true reversals" will be transmitted over the line, thereby actuating the armatures or reeds of both relays 55 and 56, thereby making and breaking in quick succession the local circuits relating to both of said relays.

I will describe the operation of the local circuit as attached to relay 55, it being understood that the arrangement and operation of the local circuit as attached to relay 56 is a duplicate thereof.

When the armature or reed 63 connects with stop 65, then a current will flow through the circuit including the sensitive polar relay 93. This polar relay is so constructed that the armature is so biased that it will normally (that is, when the circuit is open) come to rest at the stop 95. This adjustment is far more advantageous, be-

cause it is more sensitive than the usual spring adjustment.

Through the closing of the circuit, the armature will be drawn away from stop 95, thereby breaking the circuit including the battery 96 and this battery, formerly short circuited, will now be free to exert its electric energy on the timing device 97 energizing its core and drawing the armature 99 away from the adjustable screw 101. The effect of the breaking of the contacts 100 and 101 will result therein that the short circuit of the battery 102 is interrupted and this battery in turn will be enabled to energize the core of the sounder or electromagnet 103, but as the movement of the reed 63 is a vibratory one for each signal transmitted, that is, it will connect and disconnect with the stop 65 more than once for each signal and as it is required that the electromagnet shall only answer for each signal with one stroke, means have to be provided to produce such a result. These means are here illustrated as the condenser 105 and the timing device 97.

The function of the condenser is as follows:—When the circuit including the battery 92 is made, then the condenser 105 is charged in the direction of the unfeathered arrow, and at the same time the current will flow through the coil of relay 93 in the direction of the unfeathered arrow 1. When, now, the circuit of the battery 92 is momentarily broken, then the condenser 105 will discharge in the direction of the feathered arrow and will flow through the coil of the polar relay 93 in the same direction as formerly the current was flowing. It will, therefore, keep the armature of this polar relay out of contact with stop 95.

But to provide further against the chattering of the sounder 103, the timing device is placed in the second circuit and the function of this timing device is as follows:—As long as the battery 96 is short circuited, the point 100 of the armature 99 will rest against the screw 101, but as soon as the short circuit of the battery 96 is opened, then the current will flow through the coil of the timing device, will energize the core and will draw the armature 99 away from the screw 101. The short circuit of the battery 102 will be broken and the sounder 103 will be energized and will remain energized until the short circuit of the battery 102 is again established.

As the screw 101 is adjustable, the time unit elapsing between the dropping of the armature 99 from the core-ends of the timing device to the screw can be so regulated that every irregularity still existing is overcome and the sounder will remain energized until the vibrations of the reed 63 have entirely ceased.

In other words, as long as the operator at the far-off station transmits positive pulses in quick succession, the reed 63 will vibrate in unison with these arrived pulses and the alternate make and break of the reed with the local circuit will be translated at its final point into one continuous pulse as far as the sounder 103 is concerned.

The receiving operator, therefore, will receive the dots and dashes in the same manner as the receiving operator of the systems of to-day receive the same,—a short down-stroke of the armature of the sounder to denote a dot and a longer down-stroke to denote a dash.

It may be stated that with substantially the arrangement as described, messages were transmitted and quadruplexed over part of the line referred to in Fig. 4.

I have illustrated in Fig. 1 the means to normally ground the line directly as to consist of the two electromagnets 36 and 37 with their appended armatures and means to break connection with the ground through the manipulation of one or the other or both keys.

In Fig. 4, I have illustrated the means to ground the line directly as to consist of one electromagnet, but it is obvious that if occasion requires, the arrangement as illustrated in Fig. 1 may be substituted for the arrangement as illustrated in Fig. 4.

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

1. In quadruplex telegraphy, a transmitting station comprising two sources of current connected together in series, two transmitting keys, and rotatable means to transmit with the aid of one key pulses of positive polarity, to transmit with the aid of the second key pulses of negative polarity and to transmit with the aid of both keys pulses of alternate polarity; in combination with electromagnetic means controlled by the keys and adapted normally to ground the line continuously.

2. In telegraphy, two sources of current connected together with their opposite poles, an electromagnet connected with one terminal to the junction of said sources and with the other terminal to the ground, a line of transmission and means to ground said line of transmission through said electromagnet.

3. In quadruplex telegraphy, means to impress upon the line a series of positive pulses to denote one signal, a series of negative pulses to denote a second signal and a series of positive alternating with negative pulses to denote two signals, in combination with means normally to ground the line continuously and to open said ground automatically as soon as one or the other of the transmitting keys is operated.

4. In quadruplex telegraphy, two trans-

mitting and two receiving stations for each terminal of the line, the transmitting stations of each terminal provided with means to impress upon the line "true reversals" to denote the simultaneous transmission of two signals; the receiving stations of each terminal of the line provided with means to receive said "true reversals" and translate a series of positive pulses of said reversals into one readable signal and a series of negative pulses of said reversals into one readable signal, the line of transmission normally continuously grounded at each terminal and means for each terminal to automatically break said ground connection through the operation of one or both of said transmitting means.

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

ISIDOR KITSEE.

Witnesses:
EDITH P. STILLEY,
MARY C. SMITH.