

I. KITSEE.

QUADRUPLEX TELEGRAPHY.

APPLICATION FILED JULY 18, 1912. RENEWED DEC. 30, 1916.

1,221,188.

Patented Apr. 3, 1917.

2 SHEETS—SHEET 1.

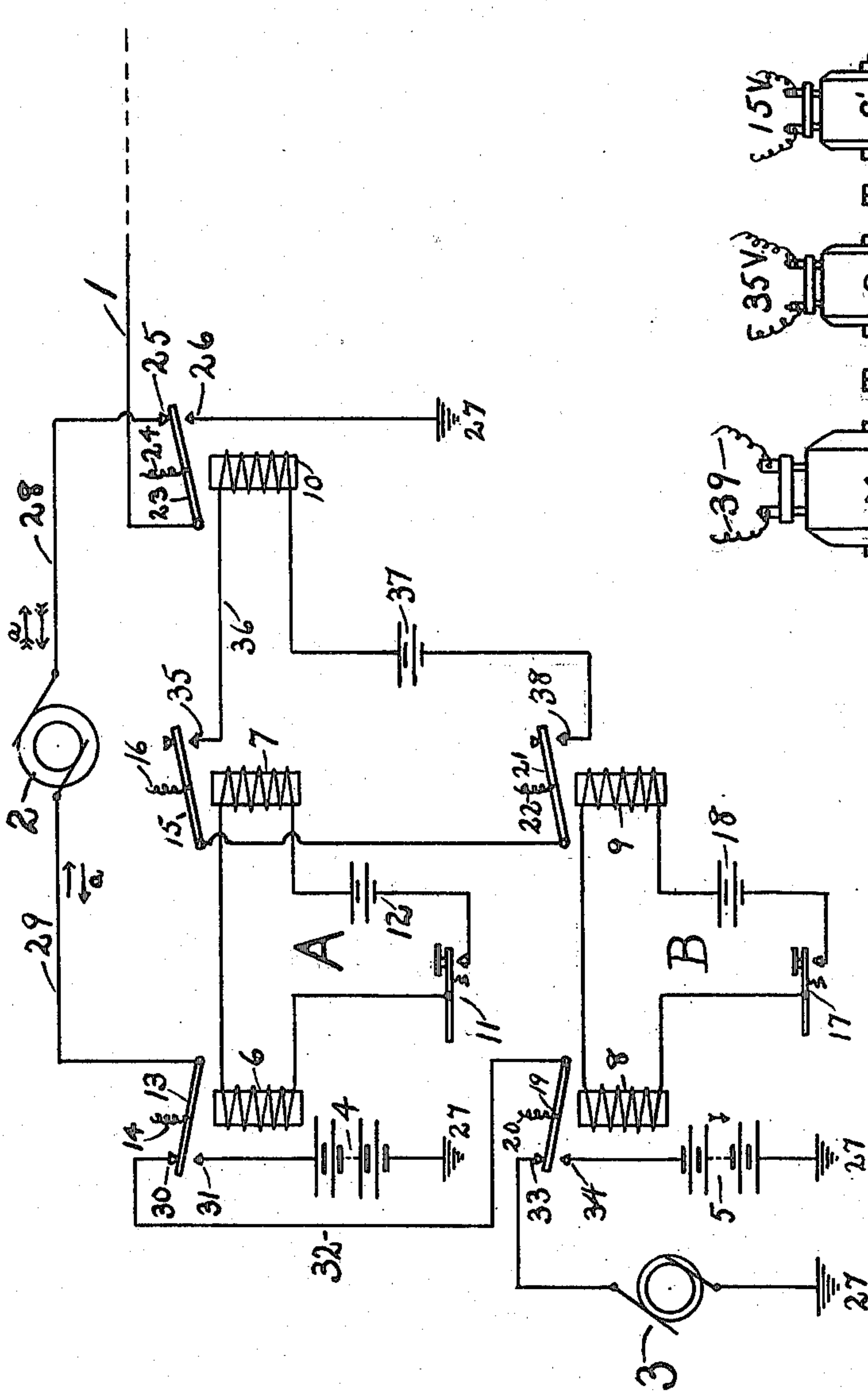


Fig. 1

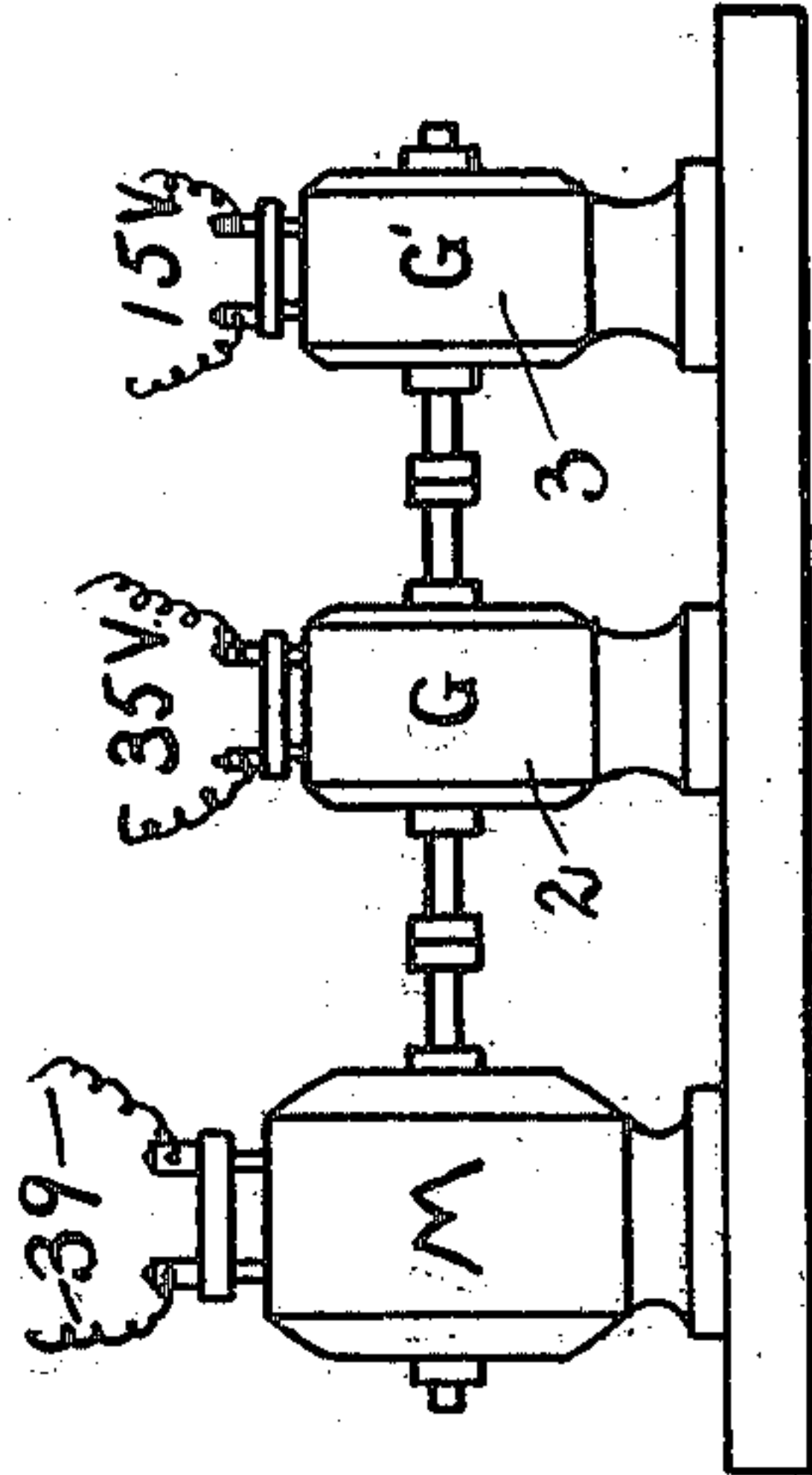


Fig. 2

Witnesses

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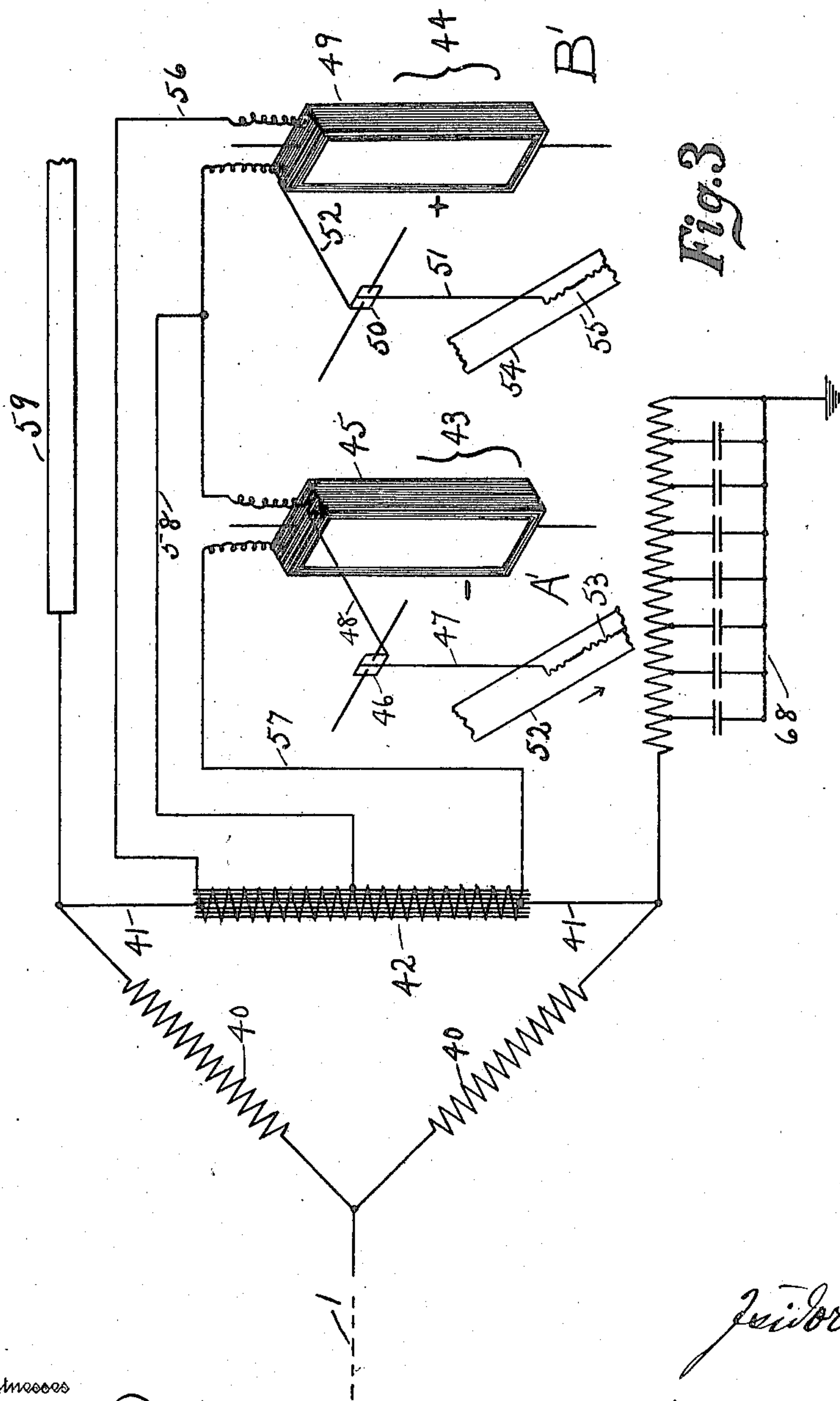
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*I. Kitsee* Inventor



# 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.

## QUADRUPLIX TELEGRAPHY.

1,221,188.

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Patented Apr. 3, 1917.

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### *To all whom it may concern:*

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 and has more special reference to quadruplexing lines with great capacity, such for instance as submarine cables.

To quadruplex land lines, it is only necessary, first, to increase the energy of the transmitting station and to change the polarity of the current. Such procedure was found entirely impractical in the working of lines with great capacity, such as submarine cables. The reason, therefore, is well understood by persons versed in the art and the peculiarity of the cable prevents the working with one polarity if no "clearing" current of opposite polarity is transmitted between the different signals.

In my invention, I have taken care of this peculiarity and have, in fact, so arranged the different parts forming my invention—transmitting as well as receiving means—so as to conform with all peculiarities of such lines.

In cable telegraphy of today, the so-called siphon recorder is generally made use of. The moving coil of this device is deflected to the right or left in accordance with the polarity of the impulse arrived and, in its deflection, moves a recording siphon to the right or left coinciding with its own movement. The movement and, therefore, the recording of the siphon in one direction is then translated as one character, say a dot, and the movement of the siphon in the opposite direction is then translated as a second character, say a dash.

In my system, the siphon recorder of today may be employed or may be replaced with a device capable of operating a local circuit (making or breaking the same), but I will describe my invention here as employing the siphon recorder of today.

In this instrument, the cradle carrying the siphon is connected with the coil through two fibers, one fiber compelling the cradle to move with the coil in one direction and the

other fiber compelling the cradle to move with the coil in the opposite direction.

For the purpose of my invention, it is necessary that the means adapted to translate the message of one coil should only be able to move in one direction and the means to translate the message of the second coil only be able to move in the opposite direction and, for this reason, the arrangement of the coils has to be changed in certain respects, so as to attain this requirement. Different means may be employed, so for instance may the coil be provided with stops allowing the same only to move in one direction, but I have found that the rebound of the coil, if pressed too hard on the stop through the incoming impulse, greatly interferes with the good working of the system and I, therefore, have recourse to the simple expedient of cutting one connection between the cradle and coil, thereby allowing the cradle to be only moved in one direction through the movement of the coil.

As for quadruplex telegraphy, two receiving instruments are required for each terminal of the line, the connection between the cradle and the coil of one instrument is such that the cradle and, therefore, the siphon attached thereto will only follow the movements of the coil, say to the right, and the cradle and the siphon attached thereto of the second coil will only follow the movements of this coil to the left.

For the purpose of illustrating one form my invention may take, I have reference to the accompanying drawing.

In this drawing; Figure 1 is a diagrammatic view of my preferred transmitting arrangement; Fig. 2 a front view of a motor generator used in my invention; Fig. 3 a diagrammatic view of the receiving organism or arrangement at one terminal of the line or cable.

In the drawing, I have only illustrated the transmitting as well as receiving arrangement at one end or terminal of the cable, it being understood that the transmitting and receiving arrangement at the other end or terminal of the cable is a duplicate of the arrangement as illustrated.

In Fig. 1; 1 is the conductor adapted to be connected to the bridge circuit of the cable. 2 and 3 are two generators of alter-



nating current. 4 and 5 are two sources of direct current. 6 and 7 are two electromagnets, such as relays, and relate to one station which is here designated by the letter A. 8 and 9 are two electromagnets, such as relays, and relate to the second station, here designated as station B. 10 is an additional electromagnet and related, through its circuit, to both of said stations. The station A comprises here, besides the two electromagnets 6 and 7, the key 11 and the source of current 12. The electromagnet 6 is provided with the armature 13 held upward by the spring 14 and the electromagnet 7 is provided with the armature 15 held upward by the spring 16. The station B is, besides the electromagnets 8 and 9, provided with the key 17 and the source of current 18. The electromagnet 8 is provided with the armature 19 held upward by the spring 20. The electromagnet 9 is provided with the armature 21 held upward by the spring 22. The electromagnet 10 is provided with the armature 23 held upward by the spring 24. This armature is provided with the upper stop 25 and the lower stop 26. The lower stop is connected to the ground 27. The upper stop is connected through wire 28 with one brush of alternator 2; the other brush of this alternator being connected through wire 29 to the armature 13 of relay 6 of station A. This armature is provided with the upper stop 30 and the lower stop 31. The lower stop 31 is connected through the source of direct current 4 with the ground 27. The upper stop is connected through wire 32 with the armature 19 of electromagnet 8 of station B. This armature is provided with the upper stop 33 and the lower stop 34. The lower stop is connected through the source of direct current 5 with the ground 27 and the upper stop is connected with one brush of alternator 3, the other brush of said alternator being connected with the ground 27. The armature of electromagnet 7 of station A is provided with an upper and lower stop; the lower stop designated by the numeral 35 and connected through wire 36 with the coil of electromagnet 10; the other terminal of this coil being connected to battery 37. This battery is connected with the other pole to the lower stop, here designated by the numeral 38, of the armature 21 of the electromagnet 9 of station B, connected to armature 15 of 7 of station A.

In practising my invention, I have found that it is necessary to adjust the voltages impressed upon the cable, so that the same may not be too high for the safety of the cable and yet sufficiently high for the purpose of allowing the required speed.

In most of the trans-Atlantic cables, the electromotive force with which they are worked today is about fifty volts and I

have taken this voltage as adapted to be applied to my system, it being understood that as conditions require, higher or lower voltages may be substituted.

In Fig. 2, M is the motor adapted to be connected through the terminals 39 to a suitable source of current. G is a generator of alternating current adapted to generate pulses of the required electromotive force, here shown as generating thirty five v. or volts. G' is a generator of alternating current adapted to generate pulses of lower electromotive force, here shown as fifteen v. or volts; and I have designated for better understanding, the generator G by the numeral 2 and the generator G' by the numeral 3, so that at a glance, it is easily ascertained which position one or the other of these generators will take if placed in the transmitting circuit.

Normally, when no message is sent from either station A or B, the cable or bridge of same connects through conductor 1 through both of the alternators 2 and 3 with the ground 27 and, as both of these alternators are driven by one shaft and of suitable design, the alternations of both of these devices are always in alinement with each other and as the alternator 2 generates pulses of thirty five volts and the alternator 3 pulses of fifteen volts and as both alternators are in series with each other, it is obvious that alternations of fifty volts will flow normally over the line.

At the receiving end, 1 is part of the conductor as illustrated in Fig. 1, for the purpose of connecting the transmitting organism to the bridge circuit. 40, 40, are the two sides of the bridge.

I have not shown here in this bridge any means of changing the resistance and I have not placed in this bridge any condensers or similar instruments, as my invention does not relate to the mode or method of producing a bridge, for the purpose of allowing messages from both terminals to travel over the line simultaneously.

It suffices to say that the bridge circuits as now employed may be used with this, my invention, or such circuits as are practical for the employment in cable telegraphy. 41, 41, is the cross circuit of the bridge and I have here provided this cross circuit with the impedance 42. To this impedance are connected the two receiving devices 43 and 44.

As stated at the beginning of this application, it is my purpose to enable the persons in charge of the cable to use the so-called siphon recorder of today with a slight change of cutting one of the fibers connecting the siphon proper to the moving coil and, in this drawing, I have only illustrated in conventional sign the moving coil, the suspended cradle and the siphon attached



to the cradle and, instead of the two connections of the coil with the cradle, I have illustrated one connection of the coil with the cradle and it is supposed that if the coils move to one side, say to the right, only one siphon will answer, say the siphon of station A', and if the coils move to the opposite side, say to the left, only the siphon of station B' will answer; and it is supposed that the coil of station A' is the receiving device for the transmitting station A and the coil of station B' is the receiving device for the transmitting station B.

Of the receiving device 43, the coil is designated by the numeral 45; the cradle by the numeral 46; the siphon by the numeral 47 and the connecting thread by the numeral 48.

Of the receiving device 44, the coil is designated by the numeral 49; the cradle by the numeral 50; the siphon by the numeral 51 and the connecting thread by the numeral 52.

In proximity to the siphon 47 is the paper 52 supposed to be moved in the direction of the arrow with the record line 53, and in juxtaposition to the end of the siphon 51 is the paper 54 with the record line 55. Both coils are connected to the impedance 42; but in a manner so that each coil shall have its own circuit.

Experiments have taught me that if both coils are connected in series as to each other and in one circuit, the moving of one coil induces a slight movement in the second coil and the operation of the two coils together is not as efficient as if each coil be connected to its own circuit.

In the drawing; one terminal of coil 49 is connected to the impedance through wire 56 and with the other terminal to one terminal of the coil 45. The coil 45 is connected to the impedance through wire 57; and 58 is the common return for both of said coils.

With this arrangement, the pulses generated, through the moving of a coil, are short circuited—so to speak—and will only flow through their own circuit.

59 is the cable or line of transmission. 68 is the artificial line here shown only in conventional manner.

The operation of my invention, as described, is as follows:—

Normally, that is, when no messages are transmitted over the cable, true reversals or alternations following each other at required speed are transmitted over the line and, therefore, both siphons will answer and each of these siphons will record a vibratory line; the siphon answering to the positive pulses vibrating through the arrival of positive pulses and the siphon answering to the negative pulses vibrating through the arrival of negative pulses. We will, therefore, have, when no messages are trans-

mitted over the line, a vibratory record on both receiving instruments.

When, now, the operator of station A desires to transmit messages, he manipulates his 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 the key, the following changes take place in the arrangement as illustrated. The circuit of the battery 12 is now closed. Through the closing of this circuit, the current will flow from this battery through coil of electromagnet 6 and coil of electromagnet 7. Through the flow of this current, the cores of both coils will be energized. The armature 13 of coil 6 will be drawn away from the stop 30 and in contact with stop 31. At the same time, the armature 15 of electromagnet 7 will be drawn downward and in contact with stop 35.

As stated above, it is my aim to use a transmitting energy of the usual voltage. The alternator, therefore, has a voltage of thirty five volts and the source of direct current 4 should have a voltage of fifteen volts, but, as in practice, secondaries will be employed and the voltage of each secondary being two, then the source 4 should consist of eight secondaries giving sixteen volts.

As shown in the drawing, the source 4 is connected with the positive pole to the stop 31 and, therefore, when the key of station A is closed, the positive pole will be connected with the interposition of the alternator 2 to the cable proper.

As the alternator will revolve at the required speed, it is obvious that when a pulse will be generated in this alternator flowing in the direction of the long unfeathered arrow, then this pulse will be augmented by the force of the battery from 4 and when the alternator develops a pulse flowing in the direction of the long unfeathered arrow  $\alpha$ , then the force of the current from 4 will oppose this pulse.

During the period that the key is closed, we will, therefore, have the following pulses flowing over the line:—

First:—Pulses of a direction flowing as the current from 4 flows, adding their force to the force of the current of 4 which will give thirty five volts plus sixteen, equal to fifty one volts.

Second:—Pulses flowing in a direction opposite to the direction of the flow of the current of 4 and, therefore, having their force reduced by the force of the current from 4, which will give thirty five volts minus sixteen, equal to nineteen volts.

As long, therefore, as the key of station A is depressed, unbalanced alternations will flow over the line; the plus sign of these alternations having a force equal to about fifty



one volts and the minus sign of these alternations having a force equal to about nineteen volts.

It is taken for granted that the receiving device at the far off receiving station, relating to the transmitting station A, is adapted to vibrate the siphon through the arrival of a negative pulse of proper intensity, but will not answer to positive pulses; and it is taken for granted that the force of fifty one volts of the plus sign will be able to move, at the receiving station, the coil of station B' at the proper distance and proper frequency, but the pulse of nineteen volts of the negative sign will not be able to move the coil relating to station A the required distance, but will only be able to "clear" the line from the effect of the former positive pulse of higher voltage. Therefore, as long as the key at station A is depressed, positive pulses of high electromotive force, alternating with negative pulses of low electromotive force, will be transmitted over the line; the plus pulses of high electromotive force of sufficient strength to actuate the receiving means (station B'), but the electromotive force of the minus sign insufficient to move the means adapted to respond to minus pulses, that is, the receiving device at A'.

As long, therefore, as the key at the transmitting station A remains depressed, the receiving device of the corresponding station, in the drawing designated as A', will record a straight line and the length of this straight line will correspond with the length of time that the key at station A is depressed.

Usually, signals are recorded on the receiving device when the required pulses are transmitted at required strength; in my system, the signals are only recorded when the strength of such pulses is reduced to such an extent that the instrument remains passive.

In my system, the receiving device corresponding to the transmitting station will trace a straight line (if a recorder is employed) as long as the key of its station remains depressed, but will record vibrations or ripples as soon as the key is opened.

In reading the signals, the receiving operator only has to read or translate the straight lines, as the vibratory lines between said straight lines only represent the spaces between the signals.

When station B desires to transmit messages, then the operator also manipulates his key in the usual manner,—closing the key for a short time to denote a dot and for a longer time to denote a dash.

Through the operation of this key, the following changes will take place in the arrangement as illustrated:—

The closing of this key closes the circuit including the battery 18. A current will, therefore, flow through the coil of electro-

magnet 8 and through the coil of electromagnet 9. The flow of the current through electromagnet 8 will result in the moving of the armature 19 from the upper stop 33 to the lower stop 34. The connection of the cable with the source of alternation 3 is, therefore, broken and the connection of the cable with the source of direct current 5 is made. At the same time, the armature 21 of electromagnet 9 will also be drawn downward and in contact with 38, but no electric change will take place in the circuit connected to 38, and the armature of coil 10 will still remain at its normal position connecting the cable with the source of alternation 2.

Through these connections, the pulses from the alternator 2 will flow over the line in the following manner:—

When a negative pulse is developed in the alternator flowing in the direction of the long feathered arrow, then this pulse will be augmented by the force from the direct current 5, for the reason that this source of direct current is connected with the negative pole to the source of alternation 2 and with the positive pole to the ground and its current will flow in the direction of the short feathered arrow, that is, in the same direction that the pulse from the alternator flows, but when a positive pulse is developed in the alternator 2 flowing in the direction of the long feathered arrow *a*, then its force will be reduced by the force of the current from 5, because this current will flow in a direction opposite to the direction of the pulse developed in this alternator.

The electromotive force of the source of direct current 5 should be equal to the electromotive force of the source of direct current 4 and if secondaries are employed, the source 4 should consist of eight cells, equal to sixteen volts.

During the period that the key at station B is closed, we will also have the following pulses flowing over the line:—

First:—Pulses of a direction flowing as the current from source 5 flows, adding their force to the force of the current from 5, which will give thirty five volts plus sixteen volts, equal to fifty one volts.

Second:—Pulses flowing in a direction opposite to the direction of the flow of the current from 5 and, therefore, having their force reduced by the force of the current from 5, which will give thirty five volts minus sixteen volts, equal to nineteen volts.

As long, therefore, as the key of station B is depressed, unbalanced alternations will flow over the line. The negative sign of these alternations will have a force equal to about fifty one volts and the plus sign of these alternations will have a force equal to about nineteen volts.

At the far-off receiving station relating



to the transmitting station B and designated here as B', the receiving device answers only, as said above, to positive pulses of the required intensity (about fifty volts) and as these pulses are, during the closing of the key at the transmitting station B, reduced to nineteen volts, it is obvious that as long as this key remains depressed, the siphon recorder relating to B' will not vibrate and will trace a straight line. The length of this straight line will coincide with the length of time that the key at B is closed,—a short length for a dot and a greater length for a dash.

To read, therefore, the signals, the operator only needs to take into consideration the straight lines which are, in reality, the characters transmitted; the vibratory lines denoting only the spaces between the characters.

When both, the operator at station A and station B, transmit simultaneously messages, that is, depress simultaneously their transmitting keys, then the following changes will take place at the transmitting station:—

Through the depression of the key at station A, the armature 13 of electromagnet 6 will be drawn downward and in contact with 31, but at the same time, the armature 15 of electromagnet 7 will also be drawn downward and in contact with 35. At the same time, through the closing of the key of station B, the armature 19 of electromagnet 8 will be drawn downward into contact with 34 and the armature 21 will be drawn downward and in contact with 38. Through the contacting of armature 15 with 35 (station A) and armature 21 with 38 (station B), a circuit will be established including the following:—coil of electromagnet 10, wire 36, contact 35, armature 15, armature 21, contact 38 and battery 37. Through the closing of this circuit, the core of electromagnet 10 is energized and its armature 23 will be drawn from the contact 25 and in contact with 26 grounded at 27, thereby breaking the connection of the line of transmission or cable with the source of alternation 2 and grounding this line directly and without the intervention of any transmitting means.

As long as both keys remain depressed, no current will flow over the line and if a recorder is employed, the siphon will trace at both the station A' and B' a straight line, thereby indicating that a message was received from the transmitting station A as well as the transmitting station B and as long as both keys remain depressed, the siphon of both instruments will record straight lines, but as soon as one or the other of the keys are opened, the receiving device pertaining to this key will resume its vibratory movement.

In telegraphing in accordance with my system, we will, therefore, have:—

First:—If no message is transmitted, true reversals or alternations impressed upon the line from the transmitting station at an electromotive force high enough so as to actuate the receiving device at the far off receiving station answering to the plus sign as well as the receiving device answering to the minus sign.

At these receiving stations, we will, therefore, have (if siphon recorders are employed) a vibratory line traced by each of the siphons on its respective paper.

Second:—If one message is transmitted, the pulses which actuate the receiving device of its own station are so reduced in electromotive force that the receiving instrument will not be actuated and will only trace a straight line.

Third:—If two messages are transmitted simultaneously, then the line is cut off from all transmitting means and grounded directly and, at the receiving stations, both instruments will trace straight lines.

The principle, therefore, on which this, my invention, is based is, that normally both receiving devices are active and that when a transmitting station transmits signals, the receiving device pertaining to said station remains passive during the time that such signals are transmitted.

I am well aware that instead of a siphon, the coil may be provided with means so as to operate a local circuit and such means may be substituted for the means shown without departing from the scope of my invention.

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

1. In quadruplex telegraphy, the improvement, which consists in normally impressing upon the line alternations of comparatively high electromotive force to denote that no signal is transmitted, impressing alternations of different voltages for each half of each cycle to denote that one signal is transmitted and practically ceasing the alternations entirely to denote that two signals are simultaneously transmitted.

2. In quadruplex telegraphy, a line of transmission, two transmitting stations for each terminal of said line, two sources of alternations relating to both of said stations, a source of direct current for each of said stations, means for each of said stations to connect the source of direct current to one of said sources of alternations and means operatively related to both of said stations to ground the line directly.

3. In quadruplex telegraphy, a line of transmission, two alternators connected normally in series with each other and with the line, two transmitting stations, a source of



direct current for each of said transmitting stations, means for one of said transmitting stations to connect one of said alternators to one pole of the direct source of current, means for the second of said stations to connect the source of direct current with the opposite pole to said alternator and means adapted to be operated by both of said stations to disconnect the line from said alternator and ground the line directly.

4. In quadruplex telegraphy, two transmitting stations for each terminal of the line, each transmitting station comprising two electromagnets, a source of direct current and transmitting means, in combination with two alternators, a line of transmission connected thereto normally and an electromagnet adapted to break said connection of the line with the alternator and make a direct connection to the ground with said line.

5. In quadruplex telegraphy, a line of transmission, means to impress upon said line normally alternations of high electromotive force, two stations for said line, means at one station to reduce the electromotive force of the positive pulse of said alternations, means at the second station to reduce the negative pulse of said alternations and means relating to both stations to disconnect the line from said alternations entirely and connect said line directly with the ground.

6. In quadruplex telegraphy, two generators of alternating current, one adapted to generate pulses of higher electromotive force than the other, both generators in phase with each other, a line of transmission, said line connected normally to said generators and through said generators to the ground, and transmitting means associated with the circuit of each generator.

7. In quadruplex telegraphy, a line of transmission, two generators of alternating current, means to connect said two alternators normally to the line, means for one transmitting station to disconnect one alternator from the line and connect said line through the other alternator with one pole

of a direct source of current, means for the other transmitting station to disconnect one alternator from the line and connect said line through the other alternator with the opposite pole of a direct source of current.

8. In quadruplex telegraphy, wherein straight alternations are normally transmitted over the line, two receiving devices for each terminal of said line, each receiving device comprising a movable coil, a cradle, and as a translator a siphon, and means to move the cradle and therefor the siphon only in one direction, the coil itself adapted to move in both directions.

9. In quadruplex telegraphy, in which normally true alternations are impressed upon the line, two receiving stations for each terminal of the line, each station provided with a moving coil and a recorder, the recorder of one station adapted to trace vibratory lines through the arrival of a positive pulse and the recorder of the other station adapted to trace straight lines if practically no current is impressed upon the line.

10. In quadruplex telegraphy, the improvement, which consists in normally transmitting true alternations of comparatively high electromotive force, reducing the electromotive force of one-half of the cycles to denote one message, reducing the electromotive force of the other half of the cycles to denote a second message and depressing the alternations entirely to denote the simultaneous transmission of two messages.

11. In a system of quadruplex telegraphy for cable, two moving coils as receivers, each coil adapted to move to the right or left in accordance with the polarity of the pulse arrived, each of said coils provided with a translator mechanically associated with the coil and adapted to follow the movements of the coil in one direction only.

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

ISIDOR KITSEE.

Witnesses:

MARY C. SMITH,

GEORGE T. GRAVENSTINE.