No. 779,670. PATENTED JAN. 10, 1905.

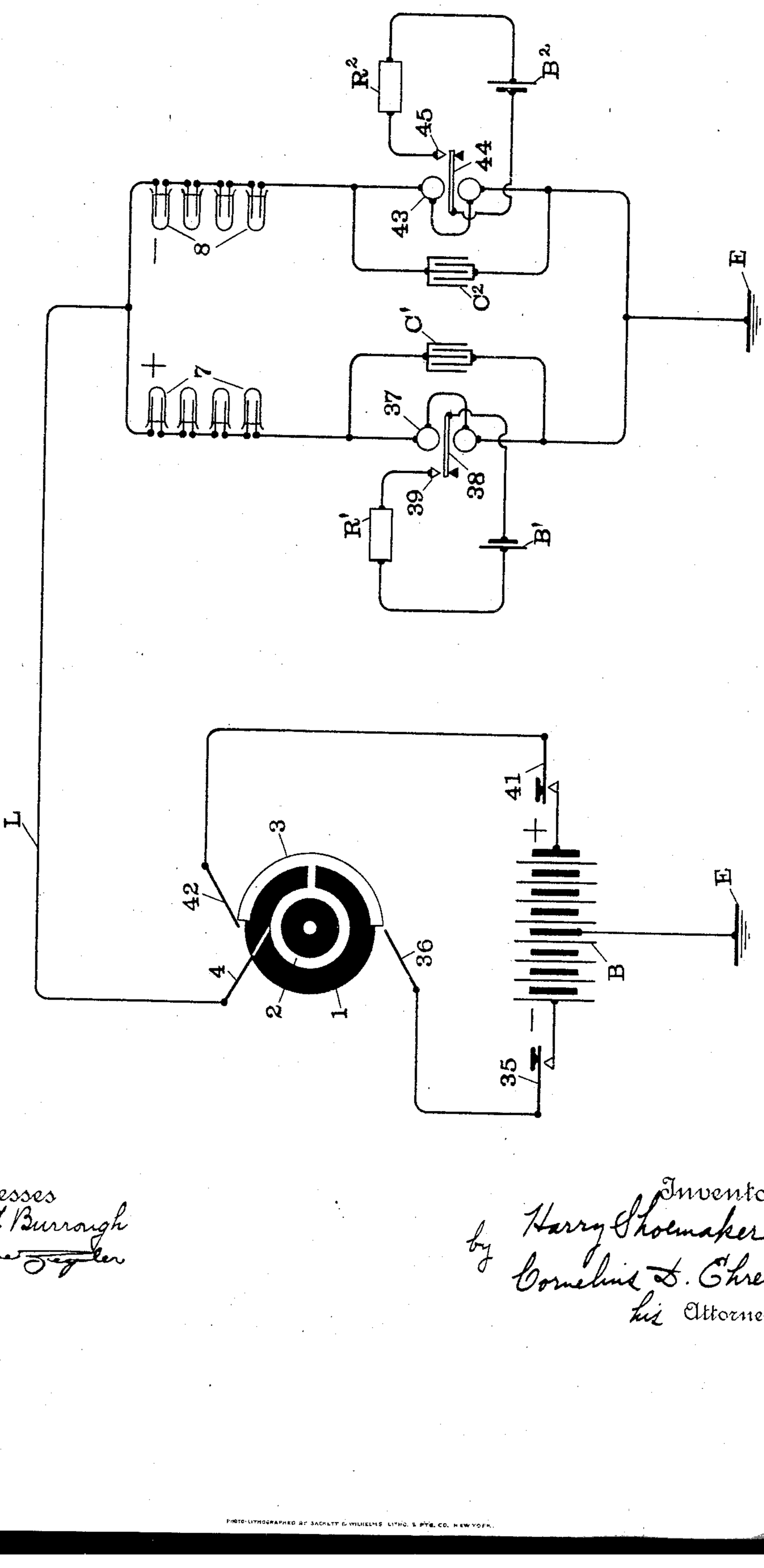
H. SHOEMAKER.

TELEGRAPH SYSTEM.

APPLICATION FILED OCT. 11, 1902.

3 SHEETS—SHEET 1.

Fig 1.



Witnesses
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3 SHEETS—SHEET 2.

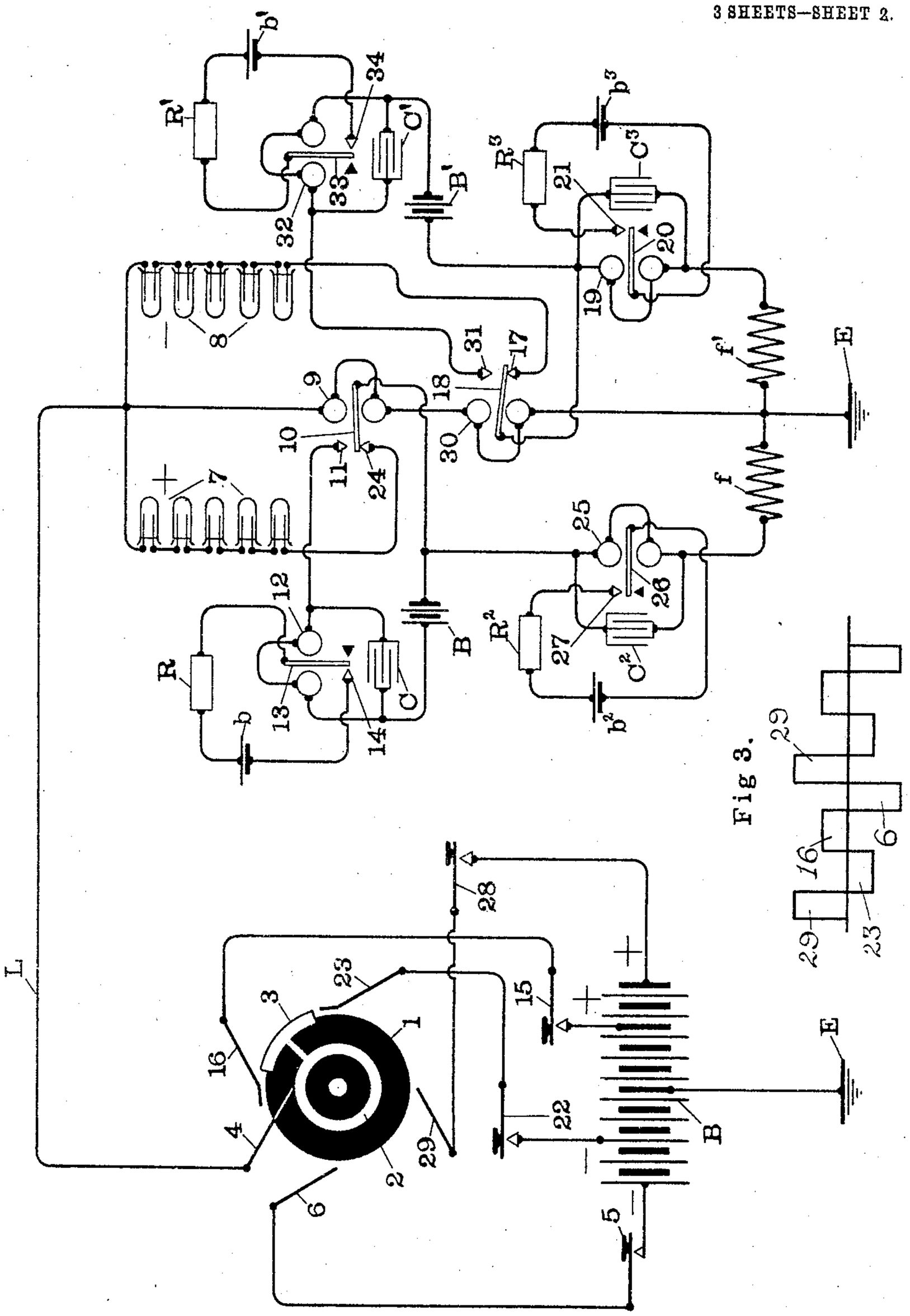

Fig 2.

Fig 3.

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3 SHEETS—SHEET 3.

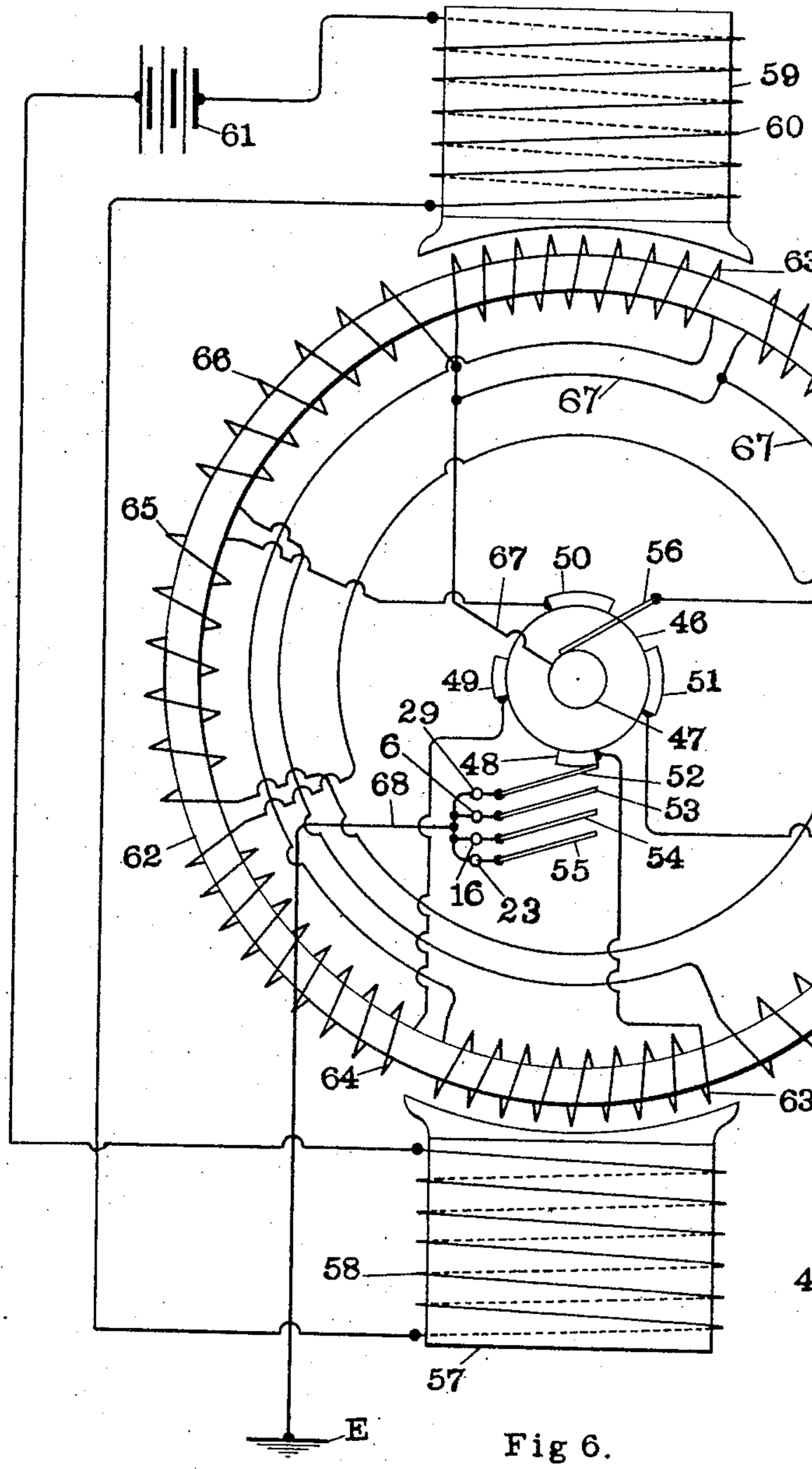


Fig 6.

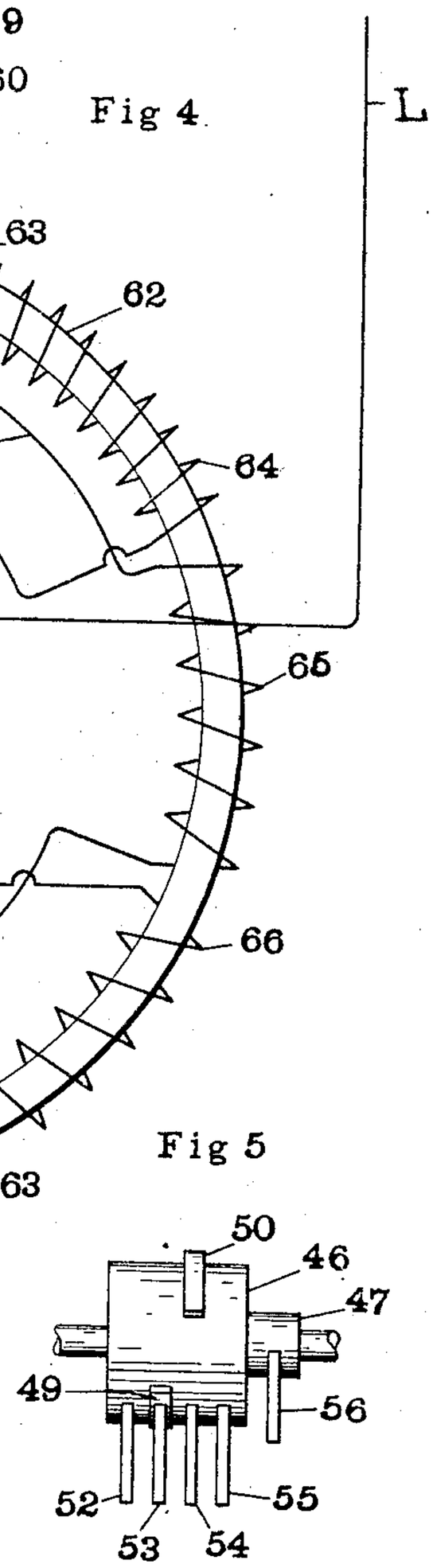
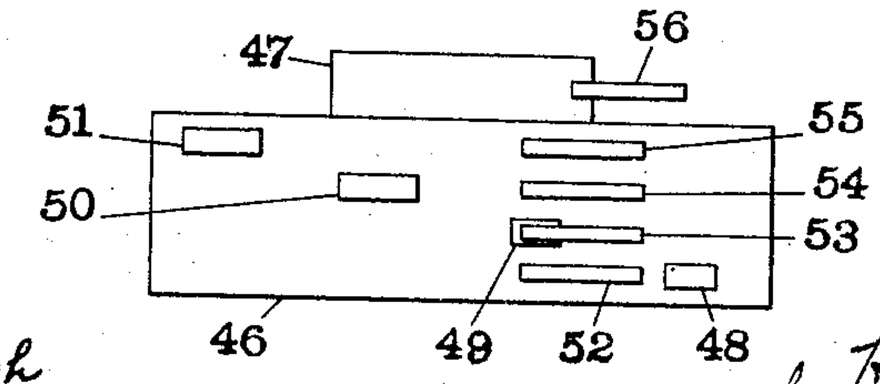


Fig 4.

Fig 5



Witnesses
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No. 779,670. Patented January 10, 1905.

UNITED STATES PATENT OFFICE.

HARRY SHOEMAKER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO MARIE V. GEHRING, OF PHILADELPHIA, PENNSYLVANIA.

TELEGRAPH SYSTEM.

SPECIFICATION forming part of Letters Patent No. 779,670, dated January 10, 1905.

Application filed October 11, 1902. Serial No. 126,834.

To all whom it may concern:

Be it known that I, HARRY SHOEMAKER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Telegraph System, of which the following is a specification.

My invention relates to telegraph systems, more especially those in which a plurality of messages may be simultaneously and independently transmitted over the same conductor.

My invention consists of a telegraph system wherein several messages are simultaneously and independently transmitted over the same conductor, each message being represented by characteristic electrical energy and wherein at the receiving-station there are means for separating out the several messages to independent recorders.

My invention comprises a telegraph system in which different messages are represented during transmission by electric currents differing from each other in strength, polarity, and duration.

My invention consists of a telegraph system in which the receiving apparatus is capable of separating a plurality of simultaneously-transmitted messages to separate and independent recording means, such messages being represented during transmission by electric currents differing from each other in strength, polarity, or duration.

My invention comprises a telegraph system in which the transmitter comprises means for impressing upon the line conductor a plurality of currents each representing a message and differing from each other in strength, polarity, and duration.

My invention comprises a telegraph system in which the receiver comprises apparatus and an arrangement of circuits involving the use of asymmetrical resistances for the purpose of separating into different circuits currents of different polarities representing independent messages, and in connection with such apparatus and arrangement of circuits a proportionment of divided circuits, whereby currents of different duration are separated into separate circuits for the purpose of separating simultaneously-transmitted messages.

In my system I make use of asymmetrical resistances at the receiver for the purpose of deflecting through different circuits currents of different polarities. A current of a definite polarity and strength represents a message, and therefore by transmitting currents of different strengths and polarities I am enabled to transmit four or more messages simultaneously and without confusion.

By impressing the currents of least strength upon the line for greater intervals of time than the duration of the stronger currents and by proportioning the circuits of the receiver as to their time constants I am enabled to select the weak currents to the exclusion of the more powerful ones.

Reference is to be had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of a system in which there may be simultaneously and independently transmitted and received two messages. Fig. 2 represents a diagrammatic view of a system wherein four messages may be simultaneously and independently transmitted and received. Fig. 3 is a graphical representation of the current impulses as impressed upon the line conductor in the system shown in Fig. 2. Fig. 4 is a view, partly in diagram and partly in elevation, of means for diametrically generating electrical impulses of different polarities and different strengths as a substitute for the transmitter shown in Fig. 2. Fig. 5 is a side elevation of the commutator of the generator shown in Fig. 4. Fig. 6 is a development of the commutator shown in Fig. 5.

In Fig. 1, L represents the line conductor extending between the transmitting and receiving station of a telegraph system, which conductor is grounded at each station by the earth-plates E. In place of the ground connections a return-conductor may be employed.

At 1 is shown the body of the transmitting-commutator, which consists of any suitable insulating material. This commutator is mounted upon a shaft and continuously rotated at a relatively high speed by any suit-

able prime mover—such as, for example, an electric motor.

2 is a slip-ring mounted upon the commutator 1, and upon it bears the brush 4, which forms one terminal of the line conductor L. In constant electrical communication with the slip-ring 2 is the metallic segment 3, occupying very nearly one hundred and eighty degrees on the circumference of the insulating-body 1. Brushes 42 and 36 are adapted to engage with this segment 3 during a period corresponding to nearly one-half a revolution of the commutator, and immediately after contact has been broken by one brush the other brush engages the segment 3.

B represents a series of cells from the middle of which connection is made with earth-plate E. The last cell on the right connects through key 41 with the brush 42. The negative end of the battery, or the last cell on the left, communicates through key 35 with brush 36. By this arrangement there are impressed upon the line conductor L in case keys 41 and 35 are held depressed impulses of approximately equal strengths but of different polarities.

The line conductor L divides at the receiver into two parallel circuits. One of these circuits comprises the asymmetrical resistance 7, composed of polarization-cells and the relay 37. The other circuit comprises the asymmetrical resistance 8 and the winding of the relay 43. The cells 7 are so connected that only positive impulses are permitted to pass through them, and the cells 8 are so connected that only negative impulses are permitted to pass through them. The number of cells in each series 7 and 8 is such as to offer a counter electromotive force approximately equal to the electromotive force existing at the receiving end of the line conductor.

The positive impulses passing through cells 7 energize the relay 37, whose tongue 38 then closes circuit with contact 39, causing the energization of the recording device R′ from the battery B′.

C′ is a condenser in shunt to the winding of the relay 37 and which operates to prevent the return of the tongue 38 to open-circuit position unless positive impulses cease to arrive for a considerable interval of time. The arriving positive impulses charge said condenser C′ and also magnetize relay 37. At the cessation of any impulse, however, condenser C discharges through the winding of the relay 37, and therefore maintains the magnetism in said relay until the arrival of the next impulse. In other words, the condenser C′ is a hold-over device. Similarly the negative impulses traversing the cells 8 energize the winding of the relay 43 and simultaneously charge the condenser C^2, which operates as the hold-over device, as in the case of the condenser C′. The energization of relay 43 causes the tongue 44 to close a circuit at contact 45, from which results the energization of recording device R^2 by the battery B^2.

The rotation of the commutator at the transmitting-station is relatively high, so that, for example, by depressing operator's key 35 to make a dot several negative impulses will be transmitted over the line L and will energize relay 43 and produce a record on recorder R^2. These negative impulses, however, are excluded by cells 7 from the winding of relay 37. Similarly a depression of operator's key 41 will result in the transmission of a plurality of positive impulses which are excluded from relay 43 by cells 8, but are permitted to pass through the cells 7 to energize relay 37 and to produce a record by means of recorder R′.

Keys 35 and 41 may be operated simultaneously, but each controls the line during half the time only and alternately with each other. Inasmuch as the impulses controlled by each key succeed each other at a relatively high rate, the result at the receiver is the same as if each key had exclusive control of a separate line-wire. In consequence distinct messages may be sent by keys 35 and 41 and recorded by devices R^2 and R′, respectively.

In Fig. 2, L represents the line conductor, which is grounded at each end at earth-plates E E. 1 represents the body of a commutator and consists of insulating material. 1 is mounted on a shaft which is continuously rotated at relatively high speed by means of any device, such as an electromotor. 2 is a continuous slip-ring which is in constant electrical communication with the outer segment 3, which occupies slightly less than a quarter of the periphery of 1. 4 is a brush constituting a terminal of the line-wire L and bears continuously upon the slip-ring 2. Brushes 6, 16, 23, and 29 are arranged at ninety degrees with respect to each other and are alternately and successively engaged by the metallic segment 3. In consequence the four circuits in communication with these four brushes communicate successively with the line-wire L.

B represents a series of battery-cells from whose middle there is a connection to the earth-plate E. From the positive terminal of the battery there is a conductor communicating through operator's key 28 with the brush 29. From an intermediate cell there is communication through operator's key 15 with the brush 16. From the negative terminal of the battery there is communication through the operator's key 5 with the brush 6, and from an intermediate cell near the negative terminal of the battery there is communication through operator's key 22 with the brush 23. From this arrangement it is possible to impress upon the line-wire L impulses of different strengths and of different polarities. For example, if key 5 is depressed for a sufficient interval of time to produce a dot or a dash of the code there will be impressed upon the line a plurality of negative impulses and of a strength

corresponding to half the cells of the battery B. If key 28 be depressed, there will be impressed upon the line a plurality of positive impulses of a strength corresponding with half the cells in the battery B. If key 22 be depressed, there will be impressed upon the line a plurality of negative impulses, but of a strength less than the strength of the negative impulses controlled by key 5. Similarly by depressing key 15 there will be impressed upon the line a plurality of positive impulses, but of a strength less than the strength of the impulses controlled by key 28.

If all keys were simultaneously depressed and if the commutator rotates in a counter-clockwise direction, there will be impressed upon the line impulses succeeding each other as follows: first, a strong positive impulse; second, a weak negative impulse; third, a weak positive impulse, and, fourth, a strong negative impulse. In other words, there would be impressed upon the line alternate positive and negative impulses, but of different strengths.

For a purpose hereinafter stated the weak positive and negative impulses have a duration in excess of the strong positive and negative impulses. This is accomplished by the extensions of brushes 16 and 23 in a direction parallel with the periphery of the segment 3. When, for example, brush 6 contacts with 3, its duration of contact is equal to the length of time required for a point on the segment 3 to pass a stationary point. With brushes 16 and 23, however, the duration of contact is greater than in the case of brushes 6 and 29 by an amount depending upon the angular width of the extensions on brushes 16 and 23.

A graphical representation of the impulses which would be transmitted if all keys were simultaneously depressed is shown in Fig. 3. Distances in a horizontal direction represent time, and distances vertically measured represent electromotive forces. Distances vertically above the line of reference indicate positive electromotive forces, and distances below the line of reference represent negative electromotive forces. The impulse marked 29 represents the impulse transmitted to line through brush 29. Similarly the impulses designated by 23, 16, and 6 represent the impulses transmitted to line through brushes 23, 16, and 6, respectively.

At the receiver the line-wire L branches into three parallel circuits, constituted as follows: first, the circuit through relays 9 and 30 to the earth-plate E; second, through the cells 7, contact 24, tongue 10, relay 25, inductance *f*, and earth-plate E, and, third, cells 8, contact-point 17, tongue 18, relay 19, inductance *f'*, and earth-plate E. Relays 9 and 30 are each wound and regulated as to strength of spring, &c., so as to respond to currents of great strength only. Relay 9 operates on positive impulses only, and relay 30 operates on negative impulses only, as is possible with relays well known in the art. It follows, therefore, that the weak positive and negative impulses transmitted to line by keys 15 and 22, respectively, will not be of sufficient strength to operate either of the relays 9 and 30.

10 is the armature or tongue of the relay 9 and is normally in contact with point 24. Upon the transmission to line, however, of strong positive impulses under control of operator's key 28 the tongue 10 vibrates, contacting alternately with points 11 and 24. When in contact with point 11, a circuit comprising source of energy B and relay 12 is closed. In shunt to the winding of the relay 12 is a condenser C, which becomes charged at each contact between 10 and 11, and while the condenser is charging the tongue 13 of the relay 12 has been brought into engagement with the contact-point 14. Upon the cessation of an impulse, however, tongue 13 would be released by magnets 12 of the relay 12 were it not for the fact that at this instant condenser C begins to discharge through relay 12, and therefore maintains the magnetism and keeps 13 in contact with 14. In other words, condenser C is a hold-over device.

The relay-tongue 13 controls the circuit including the source of energy *b* and the message-recording device R. From this it is seen that the message transmitted by the operator manipulating key 28 is selected out through the agency of relay 9 to the recorder R. Similarly when strong negative impulses are transmitted to the line under control of operator's key 5 relay 9 does not respond, but there is response by relay 30. Normally the tongue 18 of this relay 30 is in contact with the point 17. Upon the arrival of strong negative impulses, however, tongue 18 contacts with point 31, thereby closing the circuit embracing the source of energy B' and relay 32. In shunt to the winding of the relay 32 is the condenser C', which operates as a hold-over device for such relay 32, just as in the case of the condenser C and relay 12. Relay 32 when energized controls and closes the circuit embracing relay-tongue 33, contact 34, source of energy *b'*, and recorder R'. From this it is apparent that the message transmitted by the operator manipulating key 5 is selected by relay 30 and recorded by R'.

When either weak positive or weak negative impulses arrive, neither of the relays 9 and 30 is operated, and therefore the contacts 10 and 24 and 17 and 18 remain in engagement.

Suppose a weak positive impulse arrives. It cannot traverse the cells 8, nor can it operate either of the relays 9 and 30. It may be permitted, however, to traverse the cells 7 and is therefore conducted through contact 24, relay-tongue 10, winding of relay 25, inductance *f* to earth-plate E. The relay 25 is therefore energized and causes its tongue 26

to engage with contact 27, thereby closing the local circuit, including source of energy b^2 and recording device R^2. In shunt to the winding of relay 25 is the condenser C^2 for hold-over purposes, as previously described. In consequence a message transmitted by operator manipulating key 15 is selected out at relay 25 to the recorder R^2. Similarly, when a weak negative impulse is transmitted under the control of key 22 it is not permitted to pass through cells 7, nor is it able to operate either relays 9 or 30, but is permitted to traverse cells 8, passing through contact 17, relay-tongue 18, relay 19, inductance f' to earth-plate E. In consequence relay 19 is energized, resulting in the closure of a local circuit at points 20 and 21, such local circuit including the source of energy b^3 and recorder R^3. In shunt to the winding of the relay 19 is the condenser C^3 for hold-over purposes, as previously described. In consequence the message transmitted by the operator manipulating key 22 is selected out at relay 19 to the recorder R^3.

The four transmitting-keys may be operated simultaneously and independently, and from the relatively rapid rate of rotation of the commutator 1 there is transmitted for each code character a plurality of impulses which are selected out at the receiving-station to proper relays, which relays then control local recording-circuits.

The circuits of relays 9 and 30 have relatively low time constants—that is, the ratio of the inductance to the resistance of such circuit is small.

In order that relays 9 and 30 may have relatively high resistance and a great many turns, (for the purpose of responding to the higher-potential currents only,) and yet have low time constants, there are placed between the layers of the windings closed circuited sheets of tin-foil, which operates a secondaries of transformers, the primaries being the windings of the relays 9 and 30. As is well known in the art, short-circuited secondaries reduce the impedance of the primaries.

The circuits, including relay 25 and inductance f and relay 19 and inductance f', respectively, are of relatively high time constant compared with the circuit including relays 9 and 30. Inasmuch as relays 19 and 25 are to respond to low-potential impulses they must be wound with relatively fewer turns than relays 9 and 30 and have relatively lower resistances. Yet these relays 19 and 25 are to be in circuits having relatively high time constants and the time constants of their windings being relatively small, it is necessary to insert in their circuits external inductances, which are, in fact, the inductances $f f'$. Since the time constants of the circuits embracing relays 19 and 25 are relatively high, an impulse of very short duration would not have time to build up to a sufficient value to operate said relays 19 and 25. To provide for this, the weak positive and negative impulses are of longer duration than the strong positive and negative impulses, this being accomplished, as above described, by the longer contact by brushes 16 and 23 with the segment 3. These weak positive and negative impulses having longer duration are enabled to reach a sufficiently high value in the high-time-constant circuits, and therefore relays 19 and 25 are operated.

There is sufficient number of cells in both the banks 7 and 8 to offer a counter electromotive force approximately equal to the greatest electromotive force transmitted—namely, the electromotive forces controlled by keys 5 and 28. It is apparent, therefore, that through cells 7 both the weak and the strong positive impulses are permitted to pass, and likewise through cells 8 both the weak and strong negative impulses are permitted to pass. It is to be remembered, however, that the duration of the strong positive and negative impulses is relatively short and are therefore unable to operate relays 19 and 25 because of the high time constants of the circuits in which they are included. The result is that through relays 9 and 30 all impulses pass; but the weak ones are unable to operate such relays. Therefore only the strong impulses are effective in the circuit including relays 9 and 30, and, as previously described, only the strong positive impulses operate relay 9 and the strong negative impulses operate the relay 30. Furthermore, neither weak nor strong negative impulses traverse relay 25. Both weak and strong positive impulses do traverse relay 25; but due to the relatively short duration of the strong positive impulses relay 25 is not operated by them, but does respond to the weak positive impulses having relatively great duration. Neither the weak nor strong positive impulses are permitted to traverse relay 19. Both weak and strong negative impulses do traverse relay 19. Since, however, the strong negative impulses are of relatively short duration, they are unable to operate relay 19, because of the great time constant of the circuit in which relay 19 is included. Weak negative impulses, however, due to their greater duration, do operate relay 19.

With the four keys in operation there are transmitted to line alternate positive and negative impulses of different strengths, and an advantage accrues from this in that a negative impulse succeeding a positive one clears the line of residual charges and makes the behavior of the line better than in the case where simple direct current is used or where impulses of one polarity only are employed.

In Fig. 4, 57 and 59 are the poles of a magnetic field, the remainder of the magnetic circuit being omitted. 58 and 60 are field-coils on said poles 57 and 59, respectively. 58 and 60 are connected in series with each other and

the source of energy 61, the result being a magnetic pole at each end of a vertical diameter of the armature-core 62. The poles are of opposite signs. In other words, Fig. 4 discloses a bipolar dynamo-generator whose armature comprises the core 62 of laminated iron surrounded by the windings 63, 64, 65, and 66. The coils 63 and 64 each contain a greater number of turns of conductor than the coils 65 and 66. The coil 63 is in two halves, one half being shown under the face of pole 59, while the remaining half is under pole 57. These two portions of coil 63 are connected in series with each other, one end of the coil being connected to conductor 67. The remaining terminal of the upper coil 63 connects to one terminal of the lower coil 63, and the remaining terminal of the lower coil 63 connects with segment 48 of the commutator 46. Similarly the coil 64 is in two parts at opposite ends of a diameter of the armature and are connected in series with each other, one end of the combined coil connecting with conductor 67, the remaining end connecting with the segment 49 on the commutator 46. Coil 65 is also in two symmetrically-arranged halves. One end of the combined coil is connected to conductor 67, while the remaining end connects with commutator-segment 50. Coil 66 is also arranged symmetrically in halves, one end of the combined coil being connected with the conductor 67, while the remaining end connects with commutator-segment 51.

Supposing the armature to be rotating in a counter-clockwise direction in the position shown, coil 63 is active and is generating a high-potential positive impulse and the electromotive force generated by such coil is impressed upon the line-wire L to brush 56, which bears continuously upon the slip-ring 47, which is in communication through conductor 67 with one end of the coil 63 and, in fact, with one end of every coil on the armature. The remaining end of coil 63 is connected to commutator-segment 48, which at this time communicates with the brush 52, in whose circuit is the operator's key 29. After coil 63 has passed from under the pole-pieces 57 and 59 coil 64 becomes active and generates an electromotive force equal to that generated by coil 63, but is negative or in the opposite direction. That coils 63 and 64 generate currents flowing in opposite directions is apparent from the drawings, where the direction of winding said coils is shown to differ. While coil 64 is active commutator-segment 49 is in engagement with brush 53, whose circuit is controlled by the key 6. After coil 64 has gone out of action coil 65 comes into action and generates an electromotive force less than the electromotive force of coil 64, and the current in coil 65 is in a direction opposite to the current which was generated by coil 64. In other words, coil 65 impresses upon the line-wire a weak positive impulse, which is conducted from commutator-segment 50 by brush 54, whose circuit is controlled by key 16. Lastly coil 66 comes into action and generates an impulse of the same strength as that generated by coil 65, but in the opposite direction. The impulse generated by coil 66 is conducted through commutator-segment 51 and the brush 55, whose circuit is controlled by the key 23.

It is to be noticed that commutator-segments 48 and 49 have a relatively short bearing-surface, while segments 59 and 51 have relatively greater bearing-surfaces. The result is that the strong positive and negative impulses generated by coils 63 and 64, respectively, have a duration of a relatively short period, whereas the positive and negative weak impulses generated by coils 65 and 66, respectively, have greater duration. It is thus seen that by the apparatus shown in Fig. 4 positive and negative impulses of different strengths are impressed upon the line-wire and in the same order of succession as obtained by the transmitting apparatus. (Shown in Fig. 2.) It is of course to be understood that with the transmitter shown in Fig. 4 a receiver, as shown in Fig. 2, may be employed.

In Fig. 5 is shown the side view of the commutator 46, indicating the true arrangement of the brushes 52, 53, 54, and 55, which are shown diagrammatically only in Fig. 4.

In Fig. 6 is shown a development of the commutator 46 and the brushes 52, 53, 54, and 55 properly arranged with relation to their respective segments 48, 49, 50, and 51.

What I claim is—

1. In a telegraph system, means for impressing upon a circuit a plurality of series of pairs of impulses, the pairs of impulses of a series alternating with the pairs of another series, the impulses of each series differing in strength from the impulses of the other series, and means for recording messages represented by said impulses.

2. In a telegraph system, means for impressing upon a circuit impulses differing in strength and polarity, means for selecting the stronger impulses of each polarity, and means for selecting the weaker impulses of each polarity to branches of relatively great time constant, and means for recording a message controlled by each selecting means.

3. In a telegraph system, means for impressing upon a circuit successive impulses differing both in strength and polarity, means for selecting the stronger impulses of each polarity to branches of relatively small time constant, means for selecting the weaker impulses of each polarity to branches of relatively great time constant, and means for simultaneously recording a plurality of messages, said means being controlled by the several selecting means.

4. In a telegraph system, means for impressing upon a circuit, impulses differing in strength and polarity, means for selecting the stronger impulses and recording messages represented thereby, and asymmetrical resistances included in circuits responsive to the weaker impulses, said asymmetrical resistances separating the impulses of different polarities.

5. In a telegraph system, means for impressing upon a circuit, impulses differing in strength and polarity, the stronger impulses being of a relatively shorter duration, means for selecting from said circuit the stronger impulses of each polarity, each of said selecting means having a relatively small time constant, and means for selecting the weaker impulses in circuits of relatively greater time constants.

6. In a telegraph system, means for impressing upon a circuit impulses differing in strength and polarity, the stronger impulses being of relatively shorter duration, a branch associated with said circuit having relatively small time constant, and including means responsive to the stronger impulses of each polarity, a branch associated with said circuit having relatively great time constant, and including means responsive to the relatively weaker impulses.

7. In a telegraph system, means for impressing upon a circuit impulses differing in strength and polarity, impulses of a certain strength having a relatively shorter duration, a branch associated with said circuit having relatively small time constant, and including a plurality of means responsive to the impulses of different polarities and the shorter duration, and a branch of relatively great time constant including means responsive to the impulses of a certain polarity and greater duration.

8. In a telegraph system, means for impressing upon a circuit impulses differing in strength and polarity, a branch including a relay responsive to the stronger positive impulses and a relay responsive to the stronger negative impulses, a branch including an asymmetrical resistance permitting the passage of positive impulses, and a branch including an asymmetrical resistance permitting the passage of negative impulses.

9. In a telegraph system, means for impressing upon a circuit impulses differing in strength, polarity and duration, a branch associated with said circuit having a relatively small time constant, and including means responsive to the stronger impulses of different polarities, a branch including an asymmetrical resistance permitting the passage of positive impulses, and including means responsive to the weaker impulses, and a branch including an asymmetrical resistance permitting the passage of negative impulses and including means responsive to the weaker impulses.

10. In a telegraph system, means for impressing upon a circuit, impulses differing in strength, polarity and duration, a branch associated with said circuit having relatively small time constant, and including relays responsive to each polarity of the stronger impulses, a recorder controlled by each of said relays, and a branch circuit controlled by each of said relays and including an asymmetrical resistance, and a relay responsive to the weaker impulses.

11. In a telegraph system, means for impressing upon a circuit, impulses differing as to strength, polarity, and duration, a branch associated with said circuit including a relay of small time constant and responsive to the impulses of a certain polarity and greater strength, a recorder-relay controlled by said relay, a hold-over condenser in shunt to the recorder-relay, a branch associated with said circuit controlled by said first-mentioned relay, and including an asymmetrical resistance and a relay actuated by the weaker impulses of greater duration, and a hold-over condenser in shunt to said last-mentioned relay.

12. In a telegraph system, means for impressing upon a circuit impulses differing as to their strength, polarity, and duration, a branch associated with said circuit having small time constant, and including a relay responsive to impulses of a certain polarity and of the greater strength, a recorder controlled by said relay, and a branch associated with said circuit and controlled by said relay, and including an asymmetrical resistance permitting the passage of impulses of a certain polarity, said branch including also a relay responsive to the weaker impulses, and an inductance.

13. In a telegraph system, means for impressing upon a circuit impulses differing as to their strength, polarity, and duration, a relay of low time constant included in said circuit, and responsive to the stronger positive impulses, a second relay in said circuit having low time constant and responsive to the stronger negative impulses, a recorder-circuit controlled by each of said relays, and a branch of high time constant controlled by each of said relays, and including a relay actuated by the weaker impulses of a certain polarity, and a recorder controlled by each of said last-mentioned relays.

14. In a telegraph system, means for impressing upon a circuit impulses differing as to their strength, polarity, and duration, a branch of relatively small time constant associated with said circuit, a relay included in said branch and responsive to the stronger positive impulses, a relay in said branch responsive to the stronger positive impulses, a recorder-circuit controlled by each relay, and a branch from said circuit including an asymmetrical resistance, an inductance, and a relay responsive to weaker impulses, said

last-mentioned branch being controlled by one of the relays responsive to the stronger impulses.

15. In a telegraph system, means for impressing upon a circuit impulses differing in polarity and duration, a circuit of definite time constant and an asymmetrical resistance at a receiving-station for selecting the impulses of a given polarity and duration, and means for recording a message represented by said impulses.

16. In a telegraph system, means for impressing upon a circuit a series of impulses of relatively great strength and short duration, means for impressing upon said circuit a different series of impulses of relatively low strength and greater duration, a circuit of relatively small time constant associated with said circuit for selecting to a recording instrument impulses of great strength and short duration, and a circuit of relatively great time constant for selecting to an independent recording instrument impulses of low strength and short duration.

17. In a telegraph system, means for impressing upon a circuit impulses of short duration, means for impressing upon said circuit impulses of relatively greater duration, a circuit of relatively great time constant and including a polarized relay associated with said circuit for recording a message represented by the impulses of short duration, and a circuit of relatively great time constant including an asymmetrical resistance for recording a message represented by the impulses of greater duration.

18. In a telegraph system, means for impressing upon a circuit a plurality of series of impulses differing as to strength and duration, a receiving-circuit of relatively small time constant, means included in said circuit and responsive to the stronger impulses for recording a message, and a further receiving-circuit of relatively great time constant including means responsive to the weaker impulses for recording a different message.

19. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of each pair being of different polarities, and the impulses of the different pairs being of different strengths, and means for recording a plurality of messages represented by said impulses.

20. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different strengths, the last impulse of a pair having a polarity different from the first impulse of the succeeding pair, and means for recording a plurality of messages represented by said impulses.

21. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different strengths and durations, and means for recording messages represented by said impulses.

22. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different strengths and durations, the last impulse of a pair having a polarity different from the first impulse of the succeeding pair, and means for recording messages represented by said impulses.

23. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of each pair being of different polarities, the impulses of the different pairs being of different durations, and means for recording messages represented by said impulses.

24. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different durations, the last impulse of a pair having a polarity different from the first impulse of the succeeding pair, and means for recording messages represented by said impulses.

25. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different durations, the last impulse of a pair having a polarity and a strength different from the first impulse of the succeeding pair, and means for recording messages represented by said impulses.

26. In a telegraph system, means for impressing upon a circuit alternate pairs of impulses, the impulses of the different pairs having different durations, and means for recording messages represented by said impulses.

27. In a telegraph system, means for impressing upon a circuit a plurality of series of pairs of impulses, the pairs of impulses of a series alternating with the pairs of another series, the impulses of each series differing in duration from the impulses of the other series, and means for recording messages represented by said impulses.

28. In a telegraph system, means for impressing upon a circuit a plurality of series of pairs of impulses, the pairs of impulses of a series alternating with the pairs of another series, the impulses of each series differing in strength and duration from the impulses of the other series, and means for recording messages represented by said impulses.

29. In a telegraph system, means for impressing upon a circuit a plurality of series of pairs of impulses, the pairs of impulses of a series alternating with the pairs of another series, the impulses of each series differing in strength from the impulses of the other series, succeeding impulses being of opposite

polarities, and means for recording messages represented by said impulses.

30. In a telegraph system, means for impressing upon a circuit a plurality of series of pairs of impulses, the pairs of impulses of a series alternating with the pairs of another series, the impulses of each series differing in duration from the impulses of the other series, succeeding impulses being of opposite polarities, and means for recording messages represented by said impulses.

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