

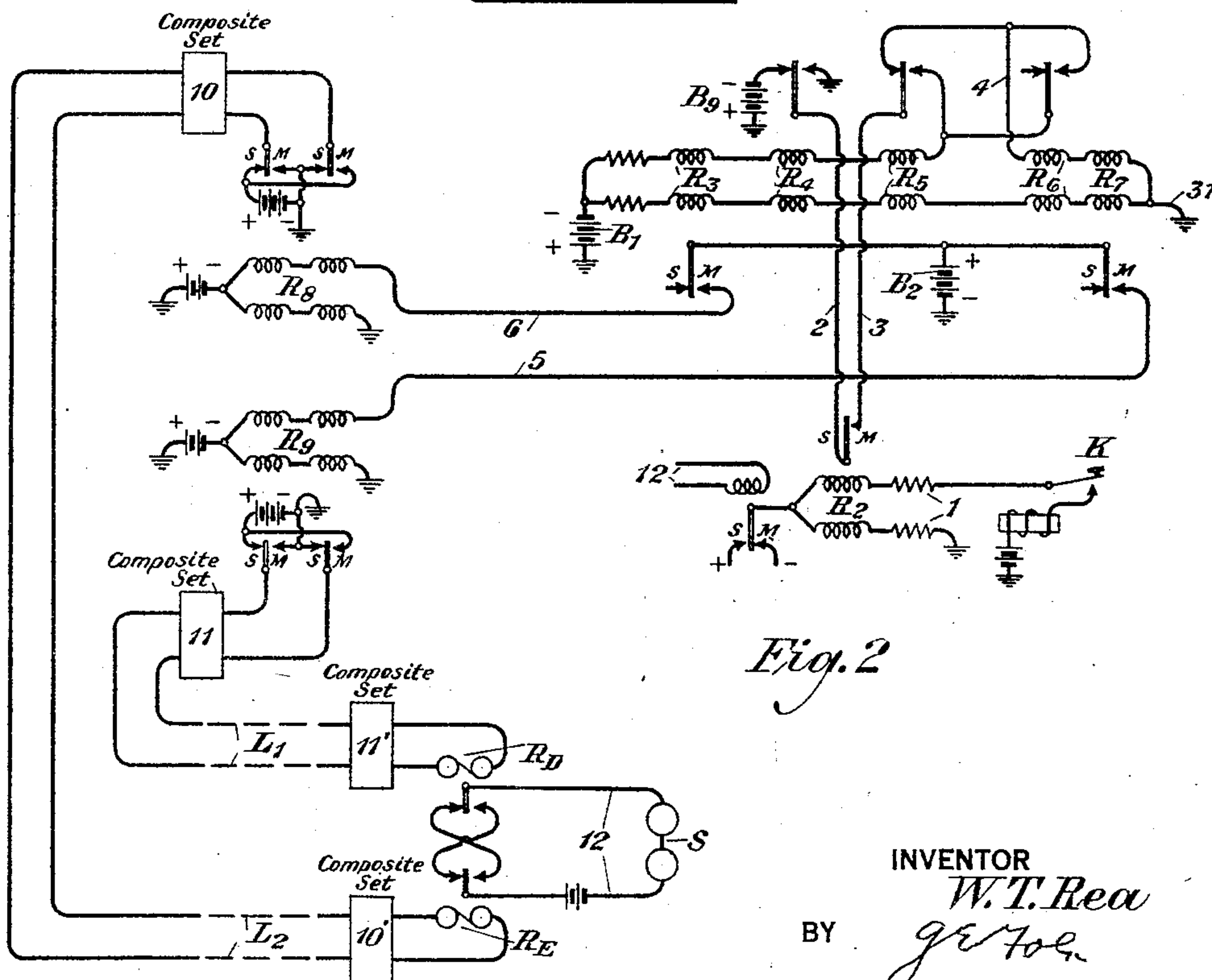
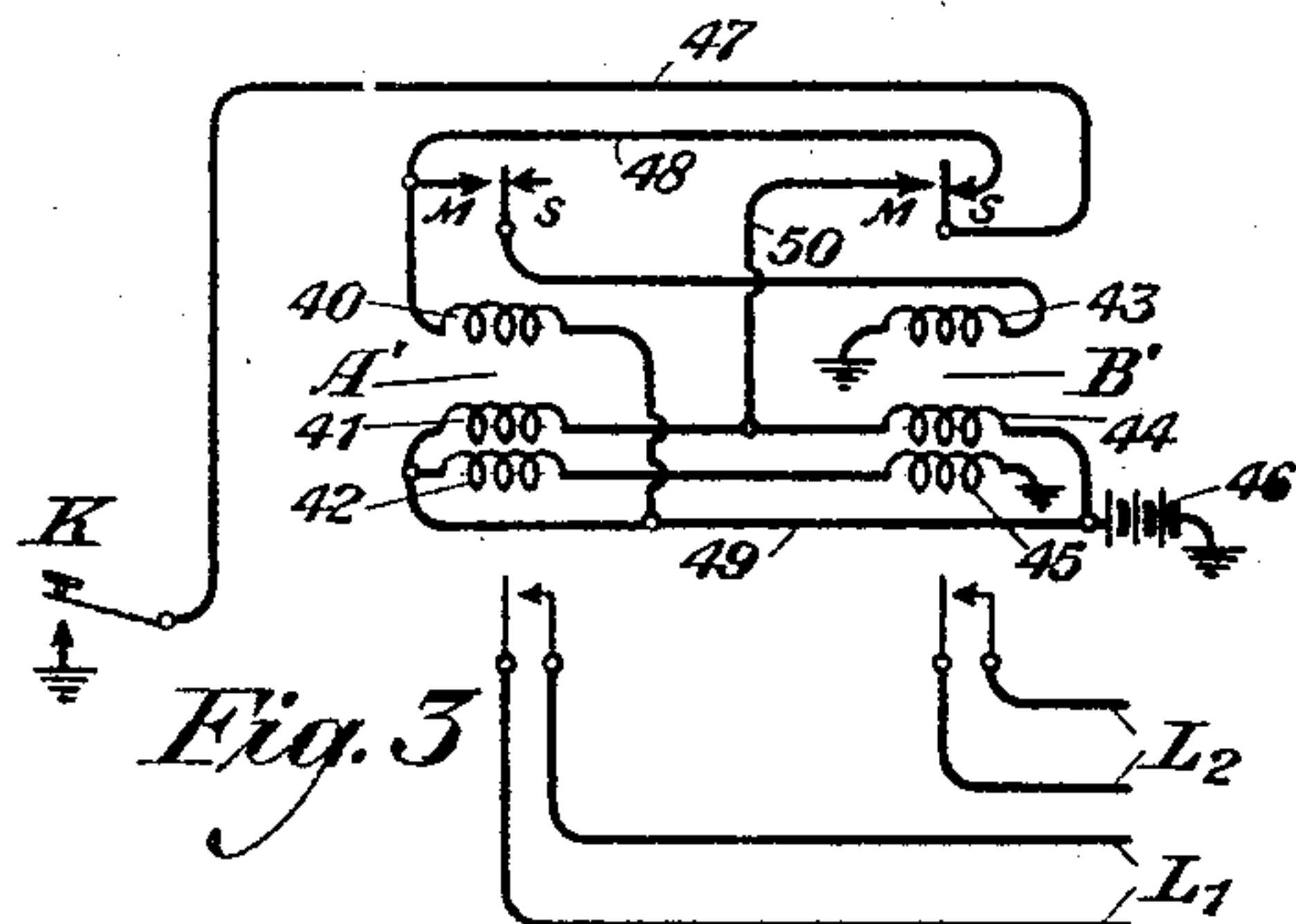
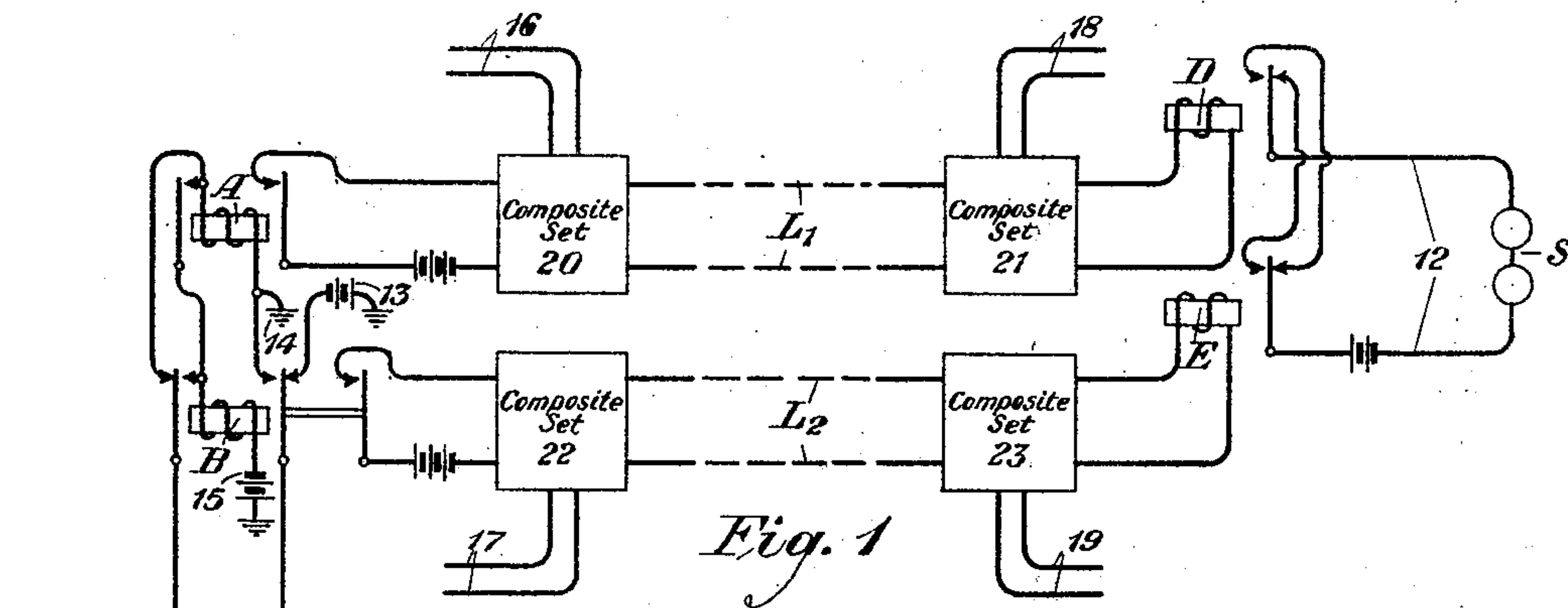
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TRANSMISSION SYSTEM

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TRANSMISSION SYSTEM

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This invention relates to telegraph systems, and more particularly to improved arrangements whereby signals may be originated and received on such systems at a high signaling speed and whereby such high speed signals may be transmitted between stations over lines suitable only for low speed signals.

To distinguish between low speed and high speed telegraph signals and low speed and high speed telegraph lines for the purpose of this invention, it is pointed out that the speed of the signals may be defined as the number of dots or impulses originated per second. The shortest impulse of a set of message impulses would be utilized to fix the maximum speed of the message signals. The number of these shortest impulses that could be transmitted per second could be termed the speed of the signals or could be characterized as the maximum fundamental frequency of the signaling current.

A telegraph line interconnecting two stations would usually have associated therewith certain selective devices, such as filters or composite sets, and these filters or composite sets might be designed to cut off frequencies above 60 to 70 cycles. Accordingly, such a circuit would be suitable for the transmission of telegraph signals having a maximum speed of 60 to 70 impulses per second or, in other words, for a signaling current below such frequencies. This type of circuit might, for the purpose of illustrating this invention, be termed a low speed telegraph circuit. Obviously, it may be desirable to originate and receive signals at a speed faster than 60 to 70 impulses per second and this would result in the utilization of a current of a higher frequency. The use of a higher frequency current would not be possible on the type of circuit heretofore termed a low speed circuit because of the cut-off characteristics of the filters or other apparatus associated with the line. Accordingly, to accommodate high speed signals, the filters or other devices in the line would have to be redesigned to have a higher frequency cut-off characteristic so that the line might be termed a high speed circuit. Obviously, this would necessitate the reconstruction or re-

design of the low speed circuit into a high speed circuit.

One of the primary objects of the arrangements of the invention is to make it possible to utilize the low speed circuit without any change therein for the transmission of high speed telegraph signals. In the arrangements of the invention this is accomplished by resolving a series of high speed signals into a plurality of series of signals of approximately half the original frequency. The signals of this lower frequency may then be transmitted over a plurality of low speed telegraph circuits and may be recombined at the other end of the line to form the original high speed signals. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawings, in the Figs. 1, 2 and 3 of which the invention is illustrated. Fig. 1 shows a simplified form of the invention. Figs. 2 and 3 are modifications thereof.

Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a telegraph system in which two stations are interconnected by the lines L_1 and L_2 . These lines might be used for both telephone and telegraph purposes and would have included therein selective devices, such as filters, or the composite sets 20, 21, 22 and 23. Circuits 16, 17, 18 and 19 might be telephone circuits. If the lines L_1 and L_2 were used as composited telephone and telegraph lines, the selective devices might be designed to have a cut-off frequency characteristic of 60 or 70 cycles, and accordingly, telegraph signals having a greater speed than 60 or 70 dots per second, or in other words, requiring a signaling current with frequency above 60 or 70 cycles, could not be sent over such lines. Lines of this type may, for the purpose of illustrating this invention, be termed low speed telegraph circuits. At the sending end of the system there is associated with the low speed telegraph lines a combination of relays A, B, and C. The relay C

is controlled by a key K in a sending loop circuit 1. At the receiving end of the system there is associated with the lines a combination of relays D and E. These relays control a local circuit 12 including a sounder S. With the arrangement shown signals may be sent by the key K at a higher speed than would be possible for transmission over lines L_1 or L_2 individually. The relay combination A, B, C will resolve this series of high speed signals into two series of signals of a lower frequency suitable for transmission over lines L_1 and L_2 . At the receiving end of the line the relay combination DE will recombine the transmitted signals to form the original high speed signals.

The operation of Fig. 1 is as follows:

The sending loop 1 includes the key K and the winding of the relay C. When the key K is open the relays A, B, and C will be released as shown in the drawings. Under these conditions relays D and E, which are connected to relays A and B by the lines L_1 and L_2 , respectively, will also be released and no current will flow in the receiving loop 12 into which is connected the sounder S.

When the key K is closed for the first time, current will flow through the winding of relay C, operating it. When relay C operates the following circuit will be closed: Battery 13, back contact of relay B, armature and contact of relay C, back contact of relay B, winding of relay A to ground 14. The closing of this circuit will operate relay A. When relay A operates the battery 13 will be connected over the left-hand contact of relay A and through the winding of relay B to the battery 15. The batteries 13 and 15 will oppose each other in the winding of relay B and relay B will not operate at this time. The operation of relay A will close the line circuit L_1 and operate the relay D. The operation of relay D will close the receiving loop 12 and operate the sounder S.

Thus it will be seen that when key K is closed for the first time, operating current will be transmitted over the line L_1 and relay D will be operated. At the same time operating current will not be applied to line L_2 and relay E will not be operated. Under these conditions the sounder S will operate.

If the key K is now opened, the battery 13 will be removed from one terminal of the winding of relay B. A current will flow from battery 15 through the winding of relay B, left-hand contact of relay A, winding of relay A to ground 14. This will operate relay B and hold relay A operated. The operation of relay B will close the line circuit L_2 and cause operating current to be transmitted over said line to operate the relay E. The operation of relay E will open circuit 12 and release the sounder S.

Thus it will be seen that when the key K is opened for the first time in the cycle of op-

erations, that the relay E will be operated. The relay D had previously been operated by the first closing of the key K. Under these conditions the sounder S is released.

When the key K is closed for the second time the following circuit will be completed. From ground 14, right-hand front contact of relay B, armature and contact of relay C, left-hand front contact of relay B, winding of relay B to battery 15. This will hold relay B operated but will short-circuit the winding of relay A and cause relay A to release. The release of relay A will release relay D. This will close the receiving loop circuit 12 and operate the sounder S.

Thus it will be seen that when the key K is closed for the second time in the cycle of operations that the relay D will be released. The relay E is in the meantime held operated. Under these conditions the sounder S will operate.

When the key K is again opened, ground will be removed from the winding of relay B, allowing it to release and returning all the relays to the condition shown in the drawings. This will release the sounder S.

Thus it will be seen that the sounder S will follow the movement of the key K.

In Fig. 2 is shown a modification of the arrangements of the invention. This figure shows a telegraph repeater circuit embodying the invention. In this circuit five polar relays R_3, R_4, R_5, R_6 and R_7 are substituted for the relays A and B of Fig. 1. Relays R_D and R_E correspond to relays D and E of Fig. 1.

The operation of the arrangements of Fig. 2 is as follows: The closing of key K in the sending loop circuit 1 for the purpose of signaling will operate relay R_2 and cause it to close its armature and contact. This will close the following circuit: Negative pole of battery B_9 , contact and armature of relay R_4 , conductor 2, armature and contact of relay R_2 , conductor 3, contact of relay R_5 , conductor 4, windings of relays R_6 and R_7 , to ground 31. This will operate relays R_6 and R_7 . The operation of relay R_6 will connect the negative pole of battery B_9 from the previously traced circuit over the contact and armature of relay R_6 and thence through the windings of relays R_5, R_4 , and R_3 to the negative pole of battery B_1 . As the polarity of batteries B_1 and B_9 are alike, relays R_3, R_4 and R_5 will not operate at this time. The aforementioned operation of relay R_7 will close a circuit from battery B_2 , armature and contact of relay R_7 , over conductor 5 through the winding of relay R_9 to battery, and will operate relay R_9 . The operation of relay R_9 will apply current over the line L_2 to operate relay R_D . The operation of relay R_D will close circuit 12 and operate the sounder S.

Thus it will be seen that the operation of key K for the first time will cause operating

current to be transmitted over line L_1 to operate relay R_D . At the same time no operating current will be transmitted over line L_2 and relay R_E is not operated. Under these conditions the sounder S is operated.

The opening of key K will now release relay R_2 and open the previously traced circuit completed over the contact and armature of relay R_2 . This will disconnect the negative battery B_9 from the windings of relays R_3 , R_4 , and R_5 . A circuit will now be completed for these relays as follows: From negative battery B_1 , windings of relay R_3 , R_4 and R_5 , armature and contact of relay R_6 , conductor 4, windings of relays R_6 and R_7 to ground 31. This will operate relays R_3 , R_4 and R_5 and will also hold operated relays R_6 and R_7 . The operation of relay R_3 will close a circuit from battery B_2 , armature and contact of relay R_3 , conductor 6, windings of relay R_8 to battery, thus operating relay R_8 . The operation of relay R_8 will apply operating current to the line L_2 and operate relay R_E . This will open circuit 12 and release sounder S .

Thus it will be seen that the opening of key K for the first time in the cycle of operation will cause operating current to be transmitted over line L_2 and will operate relay R_E . As has been pointed out, operating current is at the same time being transmitted over line L_1 and is holding relay R_D operated. Under these conditions the sounder S is released.

When the key K is again closed, the relay R_2 will be operated and the following circuit closed: From ground, contact and armature of relay R_4 , conductor 2, armature and contact of relay R_2 , conductor 3, armature and contact of relay R_5 , windings of relays R_5 , R_4 , and R_3 to battery B_1 . This will hold relays R_3 , R_4 and R_5 operated and will short-circuit to ground the previously closed operating circuit for relays R_6 and R_7 and will release these relays. The release of relays R_6 and R_7 will open the previously closed circuit from battery B_2 , over conductor 5, for relay R_9 and will release the latter relay. The release of relay R_9 will reverse the operating current in line L_1 and release relay R_D . This will again operate sounder S .

Thus it will be seen that the closing of key K for the second time in the cycle of operation will reverse the operating current in line L_1 and release relay R_D . As has been pointed out, operating current is at this time being applied to line L_2 and relay R_E is operated. Under these conditions the sounder S is operated.

When the key K is again opened the relay R_2 is released and opens at its armature and contact the operating circuit previously traced from ground and the contact of relay R_4 for the relays R_3 , R_4 and R_5 , thus releasing these relays. The relays R_6 and R_7 will remain released. The release of relay R_3 will

open the previously traced circuit from battery B_2 , over conductor 6, for relay R_8 and will release the latter relay. The release of relay R_8 will reverse the operating current in line L_2 and will release relay R_E . This will open circuit 12 and release sounder S .

Thus it will be seen that the opening of key K for the second time in the cycle of operation will disconnect operating current from line L_2 and release relay R_E . As has been pointed out, operating current is at this time disconnected from line L_1 and relay R_D is released. Under these conditions the sounder S is released.

It will thus be seen that the operation and release of the sounder S corresponds with the closing and opening of the signaling key K .

In Fig. 3 is shown a modification of the relay arrangements A , B , C , of Fig. 1. In the modification two polar relays A' and B' having more than two windings may be used to control the lines L_1 and L_2 in place of the relays A , B and C .

The operation of the arrangements of Fig. 3 is as follows: The operation of key K will close the following circuit, from ground, key K , conductor 47, spacing contact of relay B' , conductor 48, winding 40 of relay A' , conductor 49, to battery 46. This will operate relay A' and close circuit L_1 . Relay B' will not operate at this time as its winding 43 will be short-circuited to ground. When key K is opened again the short circuit to ground over contacts of key K will be removed from winding 43 and relay B' will operate and close line L_2 .

When key K is closed for the second time a circuit will be closed from ground, key K , conductor 47, marking contact of relay B' , conductor 50, and in parallel through windings 41 and 44 of relay A' and B' , to battery 46. The effect of this current on relay A' tends to move its armature to the spacing contact and cancels the effect of the current in winding 40. Relay A' therefore releases and opens line L_1 . The effect of the current in winding 44 aids the effect of current in winding 43. Relay B' therefore remains operated until the key K is again opened. Windings 42 and 45 are merely biasing windings.

The principles embodied in the arrangements of the invention, whereby low speed circuits may be combined to form a high speed circuit, are not limited to the use of two circuits. By varying the relay combinations at the sending and receiving ends of the transmission system a greater number of circuits may be utilized in the combination if necessary. The principles of the invention may furthermore be utilized in connection with secret transmission systems, since the transmitted signal is not understandable except in the presence of all of its components. The arrangements of the invention may be uti-

lized on lines which do not include filters or composite sets if the frequency characteristics of the lines themselves make it desirable. The arrangements of the invention are further-
 5 more applicable to other types of telegraph systems from those illustrated, such for example as carrier telegraph systems.

While the invention has been disclosed as embodied in certain specific forms which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

15 What is claimed is:

1. A telegraph system comprising a sending loop and a receiving loop, two transmission lines, means for transmitting the signals originating in said loop over said lines
 20 so that the maximum frequency of the signal impulses on the lines is less than the maximum frequency of the signal impulses in the loop, said means consisting of a relay arrangement consisting of two relays each of which
 25 controls the frequency of application of signals applied to different ones of said lines, a circuit for operating said relay arrangement completed solely over the contacts of said relays and said sending loop and controlled by
 30 the signals originated in said sending loop, and relay means in each of said transmission lines for jointly controlling said receiving loop.

2. A telegraph system comprising a sending loop and a receiving loop, two transmission lines, and means for transmitting the signals originating in said loop over said lines
 35 so that the maximum frequency of the signal impulses on the lines will be less than the maximum frequency of the signal impulses in the loop, said means consisting of two relays each of which controls the frequency of application of signaling current to said lines,
 40 a circuit for said relays completed solely over the contacts of said relays and said sending loop and controlled by the operation of said sending loop, said circuit for said relays being so arranged that when the sending loop is closed for the first time one of said relays
 45 will operate, when the sending loop is next opened both of said relays will be operated, when the sending loop is next closed the first of said relays to be operated will be released, and when the sending loop is next opened both
 50 of said relays will be released, and relay means controlled by each of said transmission lines for jointly controlling said receiving loop.

3. The combination of a high speed telegraph circuit with two low speed telegraph circuits, and a translating device for resolving the high speed signals originating in said high speed circuit into two series of low speed signals for transmission over said low speed circuits, said translating device consisting of a

relay arrangement of not more than three relays one of which is operated by the high speed signals and the other two of which are controlled by the first relay to apply low speed signals to the low speed circuits. 70

4. A telegraph system comprising a sending loop and a receiving loop, two transmission lines, two relays each of which controls the frequency of application of signaling current to different ones of said lines, a circuit arrangement for said relays completed solely over the contacts of said relays and said sending loop and controlled by the operation of said sending loop, said circuit arrangement for said relays being such that when the sending loop is closed for the first time a circuit for the first of said relays will be closed and a circuit for the second of said relays will be prepared by the operation of said first relay, when the sending loop is next opened said circuit prepared for said second relay will become operative and a holding circuit will be completed for said first relay, when said sending loop is next closed the holding circuit for said first relay will be short circuited and said first relay released and another operative circuit completed for said second relay, when said sending loop is next opened said last mentioned operative circuit for said second relay will be opened, and relay means controlled by each of said transmission lines for jointly controlling said receiving loop. 75 80 85 90 95

5. A telegraph system consisting of a sending loop and a receiving loop, two transmission lines, two relays each of which controls the frequency of application of signaling current to different ones of said lines, operating circuits for each of said relays, a plurality of polar relays for controlling said operating circuits, control circuits for said polar relays separate from said operating circuits completed over the contacts of said polar relays and the contacts of said sending loop and relay means controlled by each of said transmission lines for jointly controlling said receiving loop. 100 105 110

6. A telegraph system consisting of a sending loop and a receiving loop, two transmission lines, two relays each of which controls the frequency of application of signaling current to different ones of said lines, operating circuits for each of said relays, a plurality of polar relays for controlling said operating circuits, control circuits for said polar relays separate from said operating circuits completed over the contacts of said polar relays and the contacts of said sending loop said control circuits being so arranged that when the sending loop is first closed a circuit will be completed for one group of said polar relays and the operating circuit for the first of said two first mentioned relays will be closed and a circuit will be prepared for a second group of said polar relays, when the sending loop is next opened said prepared 115 120 125 130

circuit will become operative and the second group of said polar relays will operate and close the operating circuit for the second of said two first mentioned relays and a short circuit will be prepared for said first group of polar relays, when the sending loop is next closed said short circuit for said first group of polar relays will become effective and said relays will release and open the operating circuit for the first of said two first mentioned relays and a holding circuit for said second group of polar relays will be completed, when said sending loop is next opened said holding circuit for said second group of polar relays will be opened and said relays will release and open the operating circuit for the second of said two first mentioned relays, and relay means controlled by each of said transmission lines for jointly controlling said receiving loop.

that said first relay will be released and said second relay will remain operated.

In testimony whereof, I have signed my name to this specification this 7th day of May 1931.

WILTON T. REA.

7. A telegraph system consisting of two transmission lines, two multi-winding polar relays each of which controls the frequency of application of signaling currents to different ones of said lines, and signaling circuit arrangements controlled by switching means for controlling said polar relays, said signaling circuit arrangements comprising means operable when said switching means is first closed for completing a circuit through a winding of the first of said relays whereby it will operate and for preparing a circuit through a winding of the second of said relays, means operable when said switching means is next opened for rendering said prepared circuit for said second relay operative to operate said relay and to complete a holding circuit for said first relay, means operable when said switching means is next closed for completing parallel circuits through additional windings of each of said relays whereby the direction of current flow in the additional winding of said first relay will be opposed to the current flow in the other winding thereof and said relay will release and whereby the direction of current flow in the additional winding of said second relay will aid the current flow in the other winding thereof and said relay will remain operated, and means operable when said switching means is next opened for releasing said second relay.

8. A telegraph system consisting of two transmission lines, two multi-winding polar relays each of which controls the frequency of application of signaling currents to different ones of said lines, switching means, and means controlled by successive operations of said switching means for successively completing the following circuits, an operating circuit including a winding of one of said relays, an operating circuit including said winding of said first relay and a winding of a second relay, a circuit including in parallel other windings of each of said relays so poled

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