G. E. HINES.

TELEGRAPH SYSTEM.

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918,322. Patented Apr. 13, 1909.

Fig. 1.

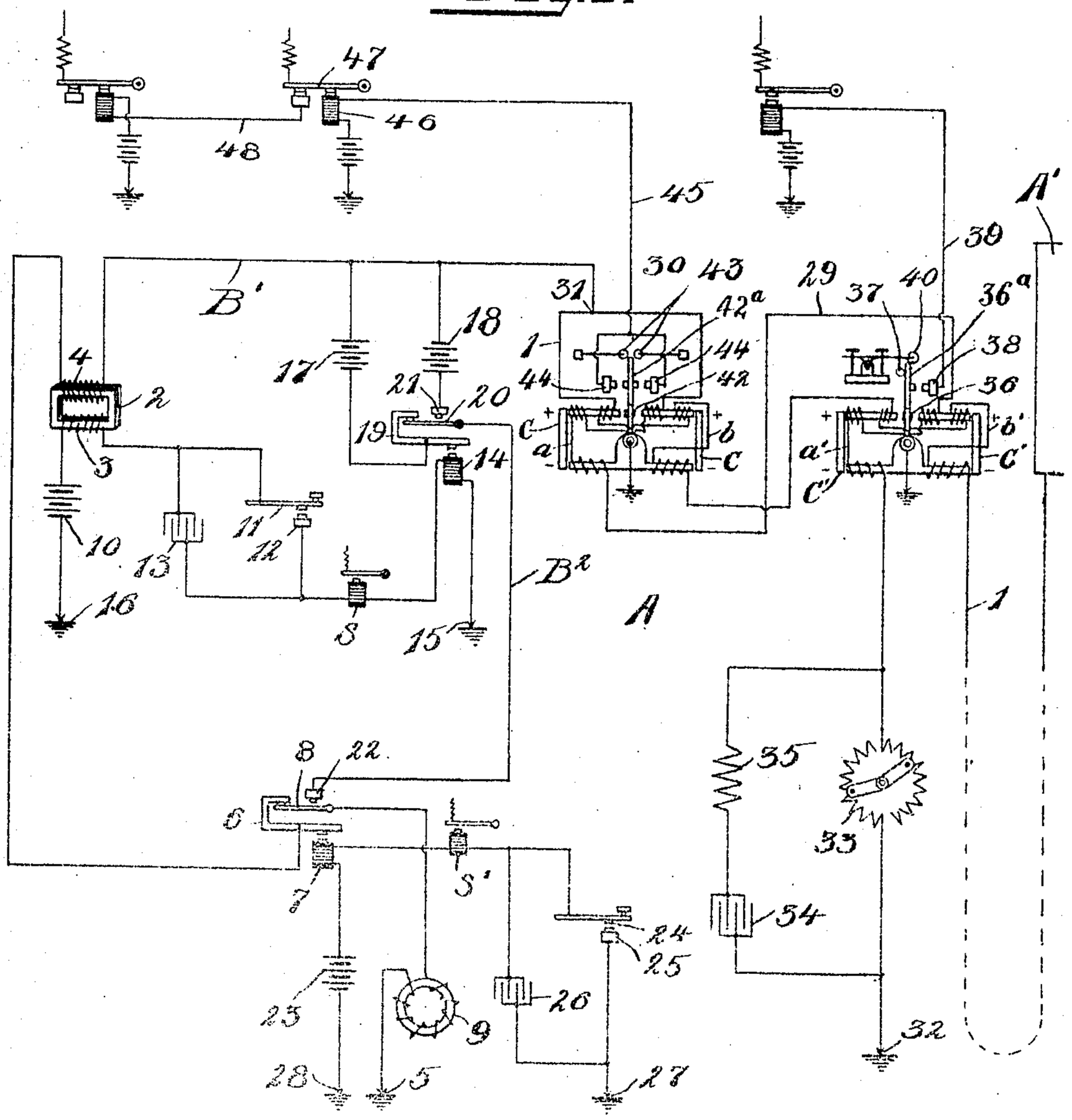


Fig. 2.

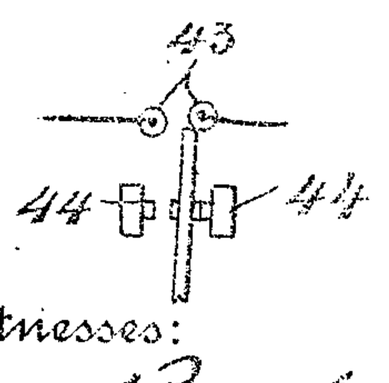
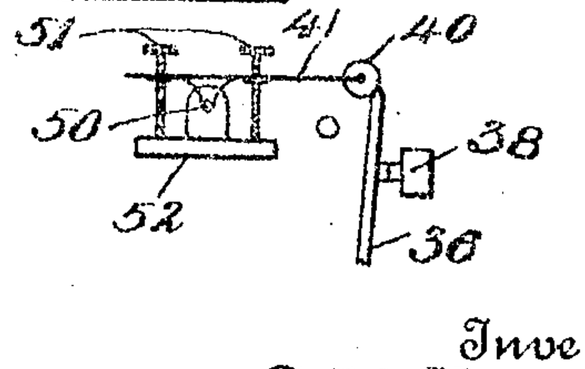


Fig. 3.



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UNITED STATES PATENT OFFICE.

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TELEGRAPH SYSTEM.

No. 918,322. Specification of Letters Patent. Patented April 13, 1909.

Application filed July 30, 1908. Serial No. 446,043.

To all whom it may concern:

Be it known that I, GEORGE E. HINES, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Telegraph Systems, of which the following is a full, clear, and exact description.

My invention relates to improvements in telegraph systems and has for its object to produce a new and improved system which shall be simple in its operation and less expensive to maintain and operate.

It further has for its object to produce a system which can be used as a duplex telegraph system, and further to provide a system which can be used as a quadruplex system.

A further object of my invention is to do away with the necessity in a quadruplex system of having a battery continuously in circuit, whether a message is being sent or not.

It further has for its object to produce various improvements which are hereinafter described in the claims.

The following is a description of my invention, reference being had to the accompanying drawings, in which—

Figure 1 represents diagrammatically the system embodying my invention. Figs. 2 and 3 show details.

Referring more particularly to the drawings, 1 is the line conductor connecting two stations A—A′. The two stations are each equipped in the same manner and on this account it is necessary to specifically illustrate and describe but one of them.

First describing the transmitting mechanism, 2 is a transformer having the usual primary 3 and secondary 4 and a laminated closed magnetic circuit. The primary and secondary windings may have any number of turns, but preferably the secondary winding 4 has the greater number of turns so as to make the transformer a step-up transformer. The secondary of the transformer has one terminal electrically connected by a branch conductor B′ to the line 1, while its other terminal under some conditions of operation is grounded through electrical connections leading to the ground 5, and under other circumstances to be hereinafter described, is open-circuited. In the arrangement shown, it is electrically connected to the pivot of a pivoted armature 6 controlled by a magnet 7. The armature 6, when the magnet 7 is deënergized, makes electrical engagement with a spring contact 8, which is connected to the ground at 5 through an impedance coil 9.

The primary winding 3 of the transformer is in series with a battery 10, this battery being in a suitable source of continuous current such as a dynamo or a series of voltaic cells. It is in series with a transmitting key having terminals 11—12 preferably shunted by a condenser 13 and connected in series with a magnet 14, the circuit being completed in any suitable way, such, for instance, as by grounding its terminals at 15 and 16. A sounder S may be placed in this circuit to enable the operator to hear the signals transmitted. Connected with the line is a battery having two sections 17—18. These parts are connected to the line at an intermediate point, so that they are in reversed position, that is, one has its positive pole connected to the line, while the other has its negative pole connected to the line. These parts when connected in circuit impress upon the line impulses which preferably are of greater strength than those impressed by the transformer 2. The electromotive force of the source 18 is in the same direction as the electromotive force of the coil 3 when the key 11—12 is closed, and the electromotive force of source 17 is in the same direction as the electromotive force of coil 3 when the key 11—12 is opened. The part 17 has its other pole connected to the pivot of a pivoted armature 19, which normally engages a spring contact 20 and holds it out of contact with the terminal 21 connected to the second pole of the battery section 18. The spring contact 20 is connected by a branch conductor B′ to a contact 22 from which the spring contact 8 is normally held out of engagement by the armature 6 when the magnet 7 is deënergized. The magnet 7 is in series with a battery 23, sounder S′ and transmitting key having contacts 24—25, preferably shunted by a condenser 26. The circuit containing these elements is completed in any suitable way, as for instance, by grounding at 27 and 28.

The apparatus as thus described constitutes an apparatus which will transmit impulses suitable for quadruplex telegraphy, and it is to be noted that when signals are

not being transmitted there are no closed battery circuits, that is, all the batteries are open-circuited. The transmission key 11—12 is used for the first side of the quadruplex and the key 24—25 is used for the second side. In transmitting signals for the first side, the key 11—12 is operated in the well-known manner as in systems where a pole changer is used. Upon closing the key an induced current is set up in the secondary 4 and impressed upon the line. This current is a natural or uncommutated alternating current and with the transformer properly constructed so as to have a closed magnetic circuit, properly laminated, and windings of high inductance, rises gradually and falls gradually so as to have a distinctively wave form similar to a sine wave form. The sine form of wave, while not absolutely necessary for the operativeness of my system, is particularly advantageous, inasmuch as it is less liable to produce disturbances in the system and in neighboring conductors. Upon opening the transmitting key 11—12 a second impulse is set up in the secondary 4 and impressed upon the line, this impulse being in the same direction and the same result is produced, as far as direction of impulse is concerned, as though a pole changer had been used. The battery 10 is in circuit only when the key 11—12 is closed and so is therefore always out of circuit when no signal is being transmitted. The sounder S permits the operator to hear the signal which he is transmitting. This key 11—12 with the parts connected thereto may be used in either single, duplex or quadruplex transmission.

When quadruplex transmission is desired, the key 24—25 is also actuated. The magnet 14 is in series with the key 11—12 so that when the circuit through the battery 10 is completed by that key, the armature 19 of the magnet 14 is attracted, disconnecting the battery section 17 from the spring contact 20, permitting the spring contact 20 to engage the terminal 21 connected to the battery section 18. This disconnects the section 17 from the terminal 22 and connects the section 18 to that terminal, thus commutating the continuous current impulse so as to make it synchronous in its changes with what the induced impulses would have been if key 24—25 had not been actuated. If the terminal 22 were connected to the ground, the sections 17—18 under these conditions would send impulses to the line 1, the impulse sent by the section 18 when in circuit being in the same direction and simultaneous with the impulse sent by the secondary 4 when the key 11—12 was closed, and the impulse sent by the section 17 corresponding in time and direction to the impulse sent by the secondary 4 when the key 11—12 was opened. This being the case, corresponding signals may be sent either through the transformer or through the sections 17 and 18, or through one of such means if the other is cut out. This is what happens when the key 24—25 of the second side is operated. When the circuit through the battery 23 is closed by the key 24—25 the magnet 7 is energized, attracting the armature 6, with the result that it is electrically disconnected from the spring contact 8, thereby disconnecting one terminal of the secondary 4 from the ground. The contact 8 is thereby permitted to engage the terminal 22 connecting it to the ground. Since one of the sections 17 or 18 is always connected to the terminal 22, it results that whenever the transmitting key 24—25 is closed, a circuit is completed to the line 1 through either the section 17 or 18. This means that whenever the key 24—25 of the second side is actuated, impulses corresponding to the movement of said key are sent out over the line. This key, however, has no control over the direction of said impulses. They may be sent by currents of either direction or the current corresponding to them may part of the time be in one direction and part of the time in the other direction, this being determined by what is being done at the transmission key 11—12. The sections 17—18 and the transformer 2 therefore supplement one another and take the place of each other when either is cut out of circuit. That is, when the circuit is closed at 24—25, the transformer is cut out of circuit by the action of the armature 6 and the sections 17—18 send the impulses which the transformer would otherwise send, and in addition send an impulse corresponding to the closure of the key 24—25. When the key 24—25 is open, the sections 17—18 are both out of circuit and signals which would otherwise be sent by them upon the operation of the key 11—12 are sent through the transformer 2. Signals can thus be sent by the key 11—12 alone, or by the key 24—25 alone, or the signals sent by the key 24—25 can be modified by the key 11—12. The impulses from the battery sections 17—18 may replace those from the transformer 2, but the replacing impulses will be synchronous in their alternations with those which the transformer would have sent if the key 24—25 had not been actuated. With suitable relays in the line, two separate messages can simultaneously be sent in the same direction and received as desired. At the same time two messages can be sent in the other direction and received, thus making the system a quadruplex system.

Two relays for receiving messages transmitted from the far station A′ are shown at 29 and 30. 29 is the relay for receiving messages from the first side of the station A′, and

30 is the relay for receiving messages from the second side. These relays have magnetic cores surrounded by windings *a*, *b* and *a'* *b'* and permanent magnets C C', which polarize the movable armatures 36 and 42 of the relays. The windings *b* *b'* are in series with the main line conductor, and windings *a* *a'* are in series with a false line connected at the point 31 in multiple to the main line, the windings *a* and *b* and *a'* and *b'* being opposed to one another so that currents transmitted from the home station A through both of these windings produce magnetizing forces in the respective home relays in opposition to one another, thus producing no effect upon the home relays. The false line is of ordinary construction, being grounded at 32 and having an adjustable resistance 33 for making the resistance equal to the main line resistance, this adjustable resistance being shunted by a condenser 34 and resistance 35, as in false lines ordinarily used. The relay 29 has a polarized armature 36, which has its movement in one direction limited by a stop 37, and its movement in the other direction limited by a contact 38, controlling a local relay circuit 39. The movable armature 36, whose upper portion 36^a is of non-magnetic material, is controlled by a jockey 40 carried by a spring 41 (see Fig. 3) and acting to hold the armature 36 into whatever position it may be thrown, that is, to hold it either against the stop 37 or in engagement with the contact 38. This is necessary in my system because the main conductor 1 is grounded at both ends and therefore does not have a current of definite polarity constantly impressed upon it. The absence of such a constantly impressed current makes this system subject to the action of stray currents, which are inevitable in its operation, and may also be induced therein by currents in neighboring conductors. Such stray currents are often times sufficiently strong to move the armature 36, if unrestrained by the jockey 40, so as to result in confusion of the signals. The relay 30 has a movable polarized armature 42 whose upper portion 42^a is of non-magnetic material. This armature is normally held in central position by jockeys 43. These jockeys in this relay tend to return the armature to the central position and are peculiar in their restraining action, in that they exercise the greatest strength at the start of any movement of the armature 42, the restraining influence becoming less and less as the armature 42 moves in either direction from the center. The jockeys each consist of a wheel carried by a spring. The jockeys 43 are so related to the lever of armature 42 that the point of engagement therewith corresponds to the terminus of a radius which is never either in line with the jockey spring, or at right angles thereto, the result being that lateral pressure of the lever always tends to move one of the jockeys, and a downward pressure of the jockey on the lever always tends to move the armature about its pivot. The movement of the armature 42 in either direction is limited by the contacts 44 through which the local circuit 45, containing the relay 46, is completed. This relay controls an armature 47 which, in turn, controls the circuit 48. The jockeys are preferably constructed as in Fig. 3 consisting of a wheel mounted at the end of a spring 41, which is pivoted to a support at 50 and is adjusted by two screws 51 which engage the spring as they pass through it and bear against the base 52. In the operation of these relays 29 and 30, impulses which alternate in direction move the armature 36 of the relay 29 to and fro so as to make and break engagement with the contact 38. The currents of these impulses, when supplied by the transformer, are of less strength than when supplied by the battery and therefore operate the relay 29 without operating the relay 30.

When the transmission key 24—25 on the second side of station A' is actuated, the battery 17—18 of that station is connected in circuit and the currents sent over the line are stronger than the impulses by the transforming device. Such currents are sufficiently strong to actuate the relay 30 of the station A. When the key 24—25 of the distant station is alone actuated, the relay 30 of station A is the only one which responds, since the impulses are all in one direction, which direction is such as to hold the armature 36 against its stop 37, but inasmuch as the armature 42 is free to move in either direction, it forces that armature in engagement with one of the stops, 44. In case the key 11—12 of station A' is actuated at a time when the key 24—25 is closed, the current passing over the line will be reversed in direction, and this reverse current will actuate both the armatures 36 and 42. The armature 42 will thus be moved over so as to make engagement with the other contacts 44. A single movement of the armature 42 is, however, all that is necessary to reëstablish the circuit 45, and this movement is so quick as to not cause the relay 46 to release its armature 47 and, therefore, does not produce any disturbance in the local receiving system, such as heretofore existed where the relays on the second side have been unpolarized relays. In such unpolarized relays the reëstablishment of the local circuit has only been brought about after a complete reciprocation of two movements of the relay armature. These two movements necessarily required a greater lapse of time and also set up in the main line disturbing electromotive forces.

By reason of the fact that the relay 29 is responsive to impulses reversed in direction, and the relay 30 is only responsive to current

values, my system can be operated even when the potential impressed by the battery is no higher than the electromotive forces impressed by the secondary of the transformer, since the time constant of the circuit will prevent the transformer impulses from producing as high currents as those which will be produced by the battery which, when it is in circuit, impresses upon the main line a maximum potential during the entire period. The combination of the two kinds of current, that is, the induced current and the current from constant potential sources, therefore, enables me to secure new results superior to those heretofore secured by the usual constant potential sources only. Where such constant potential sources only are used and the second side is actuated by an increased potential, the maximum potential necessary was much greater than the maximum potential necessary in my system, and the increase in the power and capacity of the battery employed is correspondingly greater.

I believe that I am the first to do various things described, among which are the following, viz: to combine the use of induced currents of definite polarity with battery currents in the manner described; to employ a polarized relay for both sides of the circuit, and also to use polarized relays in connection with devices for sending induced currents over the line when the first side alone is operated, and battery currents over the line when the second side alone is operated, and to substitute battery currents for induced currents, or parts thereof, when both sides are actuated.

My invention results in greater definiteness in the transmission and receiving signals under all conditions and particularly in wet weather when transmission is difficult, since the receiving apparatus on the first side is sensitive to currents of any strength so long as their polarity is reversed, and the receiving apparatus of the second side is responsive to currents from a constant potential source, provided the constant potential is at least as great as the induced potential impressed upon the line at the sending station. Moreover, the relay of the second side does away with disturbance in the main line circuit produced by frequent demagnetization and movement, the demagnetization being eliminated and the movement greatly reduced, and furthermore, does not open the local relay circuit controlled by the second side relay in such a manner as to interfere with its desired action.

What I claim is:

1. In a telegraph system, the combination of a main line, two sources of current, one for sending induced impulses and the other for sending continuous current impulses, a key for controlling said induced impulses and commutating said continuous current impulses and a second key for interrupting said induced and continuous current impulses one kind at a time.

2. In a telegraph system, the combination of a main line, two sources of current, one for sending induced impulses and the other for sending continuous current impulses, a key for controlling said induced impulses and commutating said continuous current impulses and a second key for interrupting said induced and continuous current impulses one kind at a time, and two relays, one responsive to induced and commutated currents only and the other responsive to commutated and uncommutated continuous currents only.

3. In a telegraph system, the combination of a main line, two sources of current, one for sending induced impulses and the other for sending continuous current impulses, a key for controlling said induced impulses and commutating said continuous current impulses and a second key for interrupting said induced and continuous current impulses one kind at a time, and two polarized relays, one responsive to induced and commutated currents only and the other responsive to commutated and uncommutated continuous currents only, the former relay engaging a single contact, the latter engaging forward and backward contacts.

4. In a telegraph system, the combination of a main line, two sending keys, means for impressing induced current impulses controlled by one of said keys, means for impressing continuous current impulses controlled by the other key, means for commutating said continuous current impulses and substituting said commutated continuous current impulses for the induced impulses when both keys are actuated.

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