(No Model.) 4 Sheets—Sheet 1.

G. S. TIFFANY.

TELAUTOGRAPH.

No. 570,072. Patented Oct. 27, 1896.

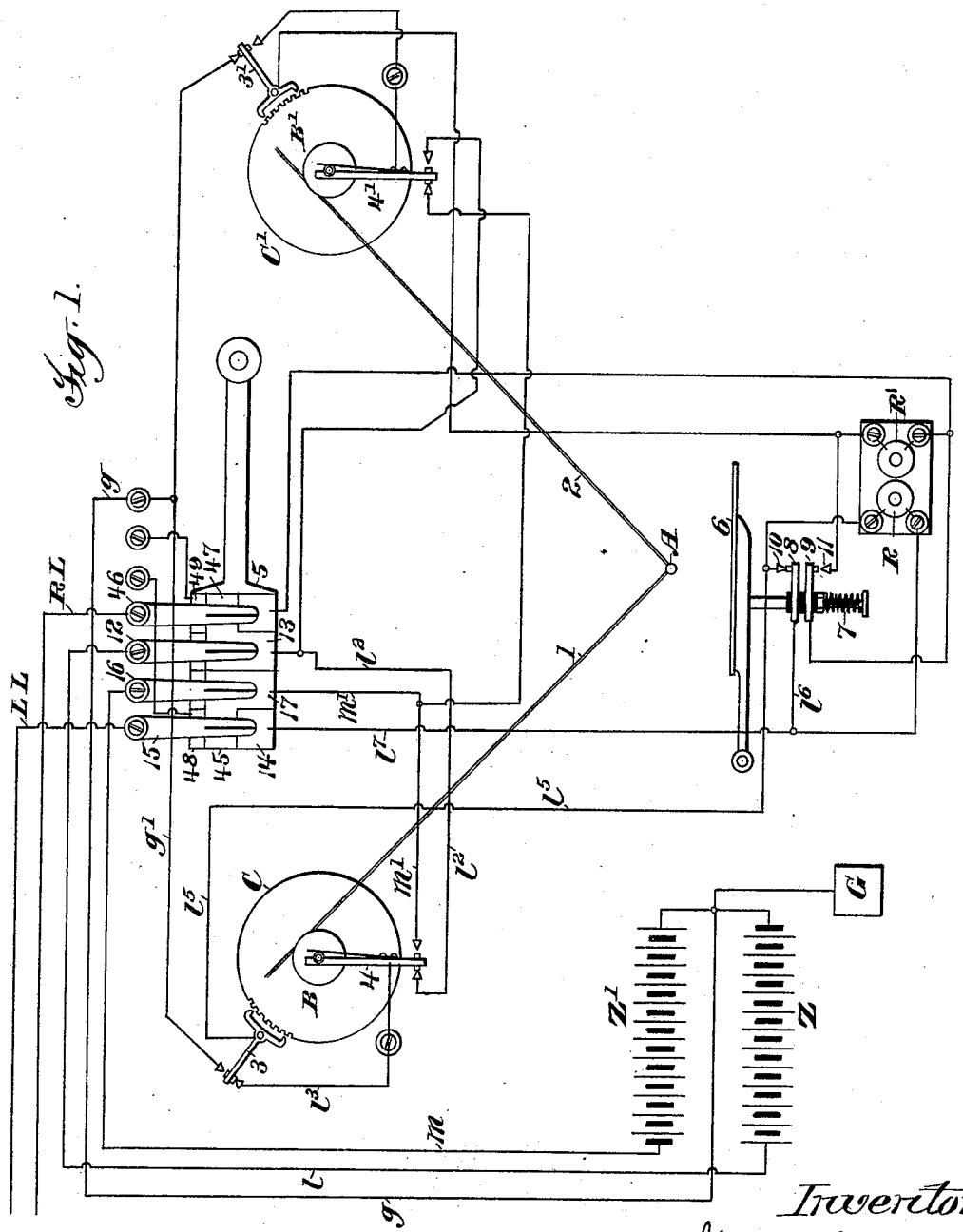

Fig. 1.

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(No Model.)

4 Sheets—Sheet 2.

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TELAUTOGRAPH.

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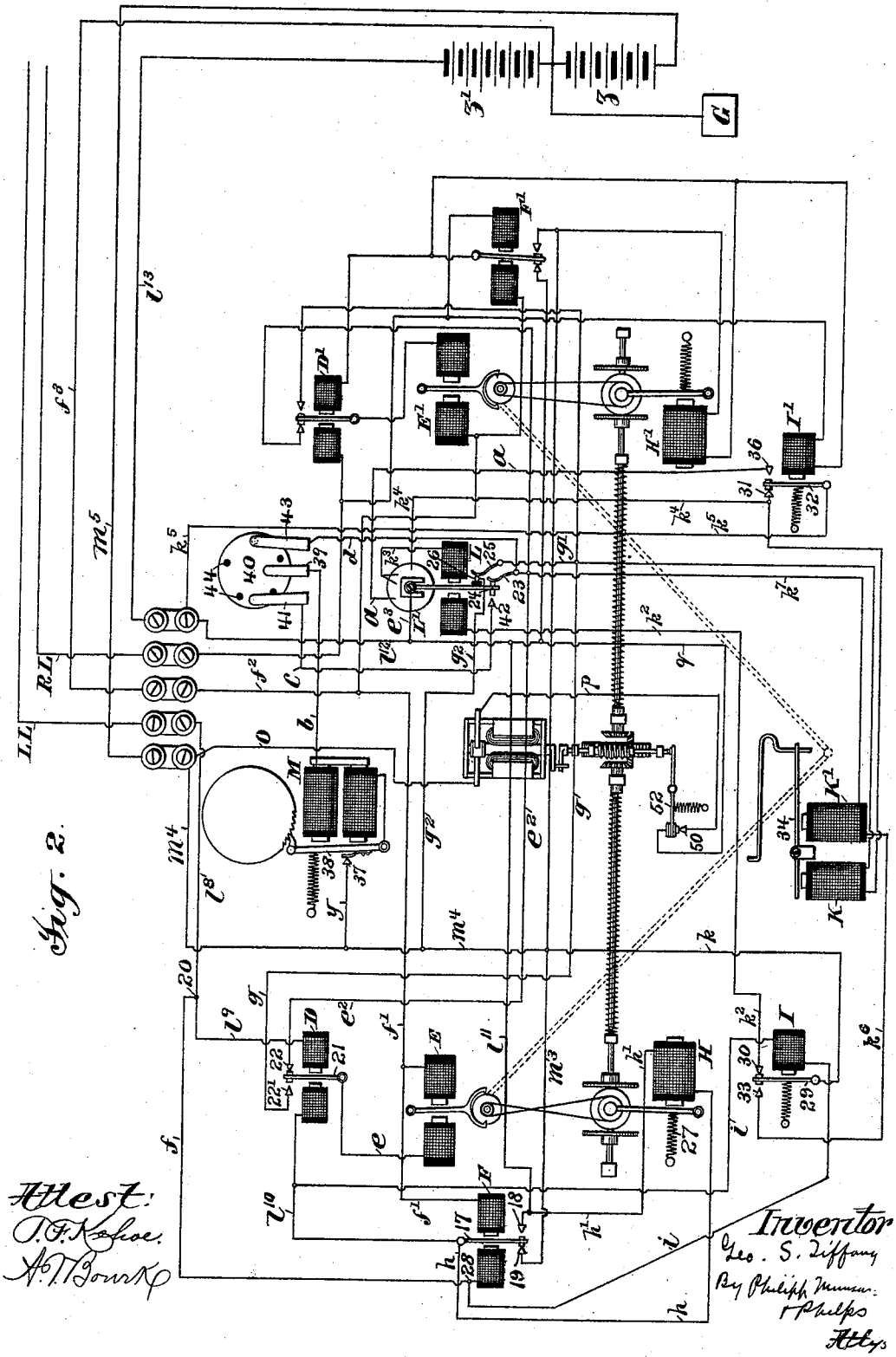

Fig. 2.

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(No Model.) 4 Sheets—Sheet 3.

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TELAUTOGRAPH.

No. 570,072. Patented Oct. 27, 1896.

Fig. 4.

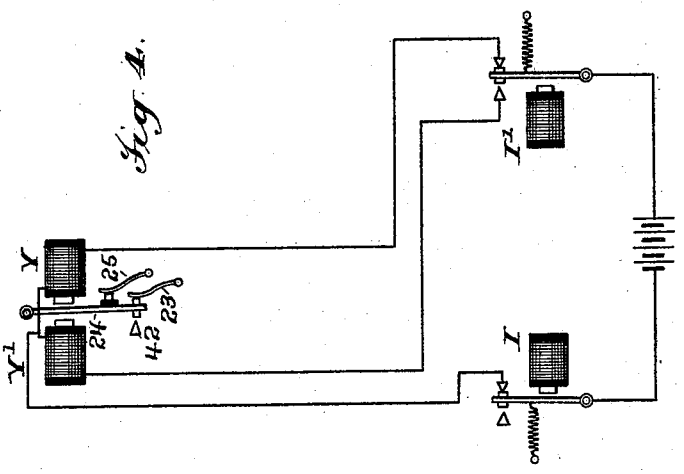
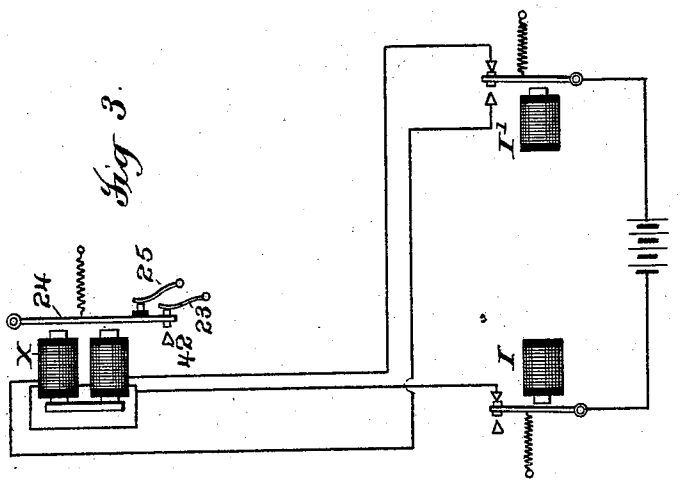


Fig. 3.



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(No Model.) 4 Sheets—Sheet 4.

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TELAUTOGRAPH.

No. 570,072. Patented Oct. 27, 1896.

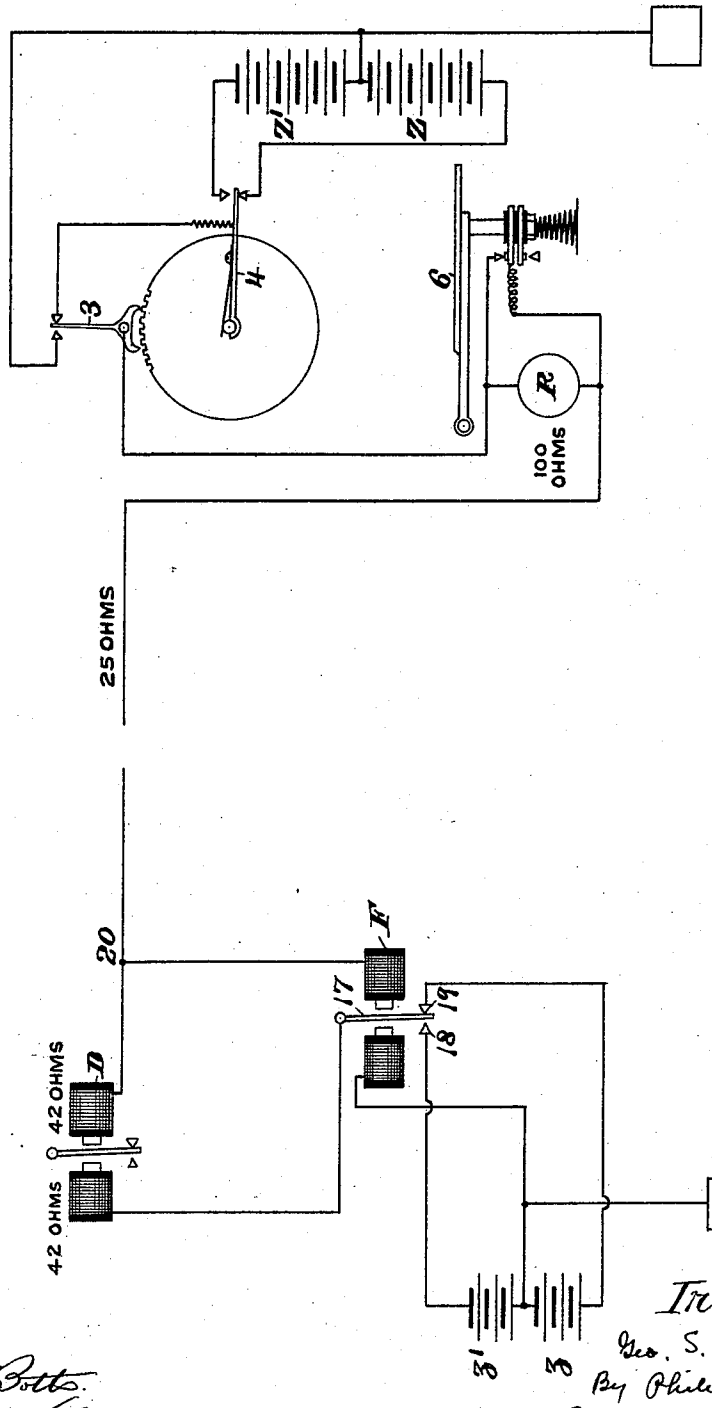

Fig. 5.

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UNITED STATES PATENT OFFICE.

GEORGE S. TIFFANY, OF HIGHLAND PARK, ILLINOIS, ASSIGNOR TO THE GRAY NATIONAL TELAUTOGRAPH COMPANY, OF RICHMOND, VIRGINIA.

TELAUTOGRAPH.

SPECIFICATION forming part of Letters Patent No. 570,072, dated October 27, 1896.

Application filed January 6, 1896. Serial No. 574,442. (No model.)

To all whom it may concern:

Be it known that I, GEORGE S. TIFFANY, a citizen of the United States, residing at Highland Park, county of Lake, and State of Illinois, have invented certain new and useful Improvements in Telautographs, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

My invention relates to telautographic systems of the same general description as that which I have patented in Letters Patent No. 548,729.

My present invention has for its object the improvement of the telautograph in the devising of a new method and means for transmitting the impulses for regulating the progressive movement of the receiving-pen in the same direction, and also the electrical variations which control the reversal of the direction of movement of the receiving-pen, over the same line-wire, thus increasing the simplicity and the certainty of operation of a two-wire telautographic instrument.

I have discovered that it is possible in a telautographic instrument in which the receiving instrument is driven or the progressive movements of the pen controlled by to-and-fro pulsations to govern the reversing mechanism by means of the same pulsations without increasing or decreasing the strength thereof, which has never before been done and which is in many respects advantageous. It is difficult in systems of this kind, where pulsations of opposite polarity are employed, to introduce variations in the strength of impulses sent from the transmitter for the purpose of performing a series of operations over the same line-wires, owing to the inductive effects of those currents upon the magnets which they operate, and where several such variations of strength are required, each variation affecting all the receiver-magnets, as has been the case in the systems heretofore proposed, complexity of mechanism and uncertainty of operation are likely to result. My invention very greatly lessens the effect of the necessary variations in strength upon the receiver-magnets and secures comparative simplicity and certainty of operation.

Broadly my invention consists in causing the polarity of the current sent from the transmitting-station to dominate at all times the condition of the reversing mechanism at the receiving-station, while at the same time these currents are so modified by opposing currents introduced at the receiving-station that they operate to produce pulsations of successively opposite polarity in the magnets controlling the escapement, these pulsations corresponding in number with the extent of movement of the transmitting-pen, and I effect this by placing the reversing-magnet in a branch from the main line which taps the main line at such a point that the current flowing through the branch shall be at all times of the same polarity as the current sent from the transmitting-station, notwithstanding the existence of constant reversal of polarity in that part of the main line which operates the escapement-magnets at the receiving-station.

My invention consists also in certain other improvements, which will be hereinafter pointed out.

In the drawings annexed to this specification my invention is diagrammatically illustrated.

Figure 1 is a representation of an arrangement of circuits embodying my improvements at the transmitting-station, and Fig. 2 representing such an arrangement of circuits at the receiving-station. Figs. 3 and 4 are modified forms of the automatic switch. Fig. 5 is a diagrammatic sketch of a portion of the circuits.

The transmitting-pen is shown at A and is connected by the pen-arms 1 and 2, as is usual in these instruments, with the drums B and B′, on the shafts of which are carried the interrupter-disks C and C′, magnetically controlling the interrupters 3 and 3′ and the Prony brakes 4 and 4′. The usual master-switch is shown at 5 and the transmitting-platen at 6, the platen being supported by the usual spring 7 and carrying the insulated contacts 8 and 9, which rest, respectively, against the contact-points 10 11 in the elevated and depressed positions of the platen. R and R′ are the usual resistances for use in causing the operation of the pen-rest at the receiving-station. The position of the master-switch is that in which the instrument is used for

sending messages. The source of electricity employed, which may be batteries or other generators, is shown at Z and Z′, it being adapted to send currents of either polarity.

In the position shown the circuit on the left main line is from battery Z, through wire l to contact-spring 12, switch-segment 13, wire l^2, Prony brake 4, wire l^3, interrupter 3, wire l^5, contact 10, contact 8, wires l^6 l^7, switch-segment 14, spring 15, main line LL. When the interrupter moves to its opposite contact, the line LL is connected through the platen-contacts and the interrupter directly to ground through the wires g g'. When the Prony brake is shifted to its opposite contact, the battery Z is cut out of circuit and the battery Z′ is cut into circuit, the circuit of the latter being through the wire m, spring 16, switch-contact 17, wire m', Prony brake, wire l^3, interrupter 3, wire l^5, and so on, as before. When the interrupter rests against its opposite contact, the left line is connected, as before, to ground. The operation of the transmitter thus organized is to send to line pulsations of successively like polarity as long as the transmitting-pen continues to move in the same direction, the number of these pulsations depending upon the extent of movement of the transmitting-pen, and when there is a change in such direction of movement another set or group of pulsations of opposite polarity from the last set, but also of successively like polarity as regards each other, are produced. Each two successive pulsations are separated from each other by an interval, and for convenience they may be termed, therefore, "intermittent" pulsations.

The connections of the right line RL are precisely similar to those above described. In the position of the transmitting-platen shown the resistance R′ is a part of the right-line circuit and the resistance R is short-circuited from the left line. When the platen is depressed, the resistance R is in the circuit of the left line and the resistance R′ is short-circuited from the right line.

Referring now to the receiving instrument, Fig. 2 of the drawings, the escapement-magnets are shown at E E′ on the two sides of the instrument, respectively, and the polarized relays which govern these magnets are shown at D D′.

I may say here that it is a part of my present invention to use a separate escapement-magnet and a relay rather than to govern the escapement-magnet directly by the line-pulsations, for the reason that it is frequently found in practice, especially in long lines, that the line-current is liable to become so reduced that it does not hold the escapement-pallets and that the receiving-pen is thus liable to move without reference to the movements of the transmitting-pen. Moreover, the strength of current required for the operation of the relay is at all times very much less than that necessary for controlling the escapement-magnet, and therefore both certainty of operation and economy of current are secured by the introduction of the relay. For convenience I term the magnets D D′ "repeating-relays."

The reversing-relays of the instrument are shown at F F′, the magnets directly governing the reversing mechanism at H H′, the Morse relays for operating the pen-lifter, and which also control the paper-shifting mechanism, at I I′, the pen-lifter magnets at K K′, the automatic switch-magnet at L L′, and the paper-feeding magnet at M.

The left-line circuit after entering the receiving instrument passes through wires l^8 l^9, through the coils of magnet D, wire l^{10}, armature 17 of magnet F, whence it may take two paths. If the armature 17 lies against the contact-point 18, opposite to that shown in the drawings, the circuit continues through wires l^{11}, l^{12}, and l^{13} to battery z' and ground. If armature 17 lies against its contact 19, as shown in the drawings, the circuit continues through wires m^3 m^4 m^5 to battery z and ground. A branch is taken from the main-line circuit at 20, in which is placed magnet F, the circuit being through wire f, coils of magnet F, wires f', f^2, and f^3 to ground.

The circuit through which the repeating-relay controls the escapement-magnet E passes from ground through wire f^3, wire f^2, wire f', coils of magnet E, wire e, armature 21 of magnet D. Here the circuit divides, one branch passing through contact 22, wire e^2, contact-spring 23, armature 24 of automatic switch-magnet L, wire e^3, wires l^{12} and l^{13} to battery z'. The other branch of this circuit is through contact 22′, wires g g', contact-spring 25, insulated contact-point 26, carried by armature 24, wire g^2, wires m^4 and m^5 to battery z. Therefore it will be seen that the polarity of the current flowing through the coils of magnet E from the batteries z z' will be controlled by the position of the armature 21 against one or the other of its contacts.

The circuits of the magnet H, whereby reversal is directly effected, are from battery z, through wires m^5 m^4 m^3, contact-point 19, armature-lever 17, wire h, coils of magnet H, wire h', wires l^{11} l^{12} l^{13}, and battery z'. When the armature-lever 17 is against contact 18, no circuit is closed through magnet H, and the armature of that magnet, which carries the reversing-clutch, is then drawn back by its spring 27.

The operation of the instrument as thus described will now be stated: In the position of the instrument shown in Figs. 1 and 2 the positive current of battery Z is, as I have stated, on line from the transmitting-station. This current passes through the coils of magnet D, armature 17, contact-point 19, and the wires m^3 m^4 m^5 to the positive battery z. The batteries z z' of the receiver are about one-half the strength of the batteries Z Z′ of the transmitter. Consequently the effective current in this circuit, being reduced from the

strength of the battery Z by the strength of the battery z, operates upon the magnet D as a positive current of about one-half the strength of the battery Z and draws the armature of this magnet against the stop 22. The next succeeding movement of the interrupter 3 at the transmitting-station connects the main line at the transmitting-station with ground, and the only battery on the line, therefore, is the positive battery z, which has an opposite effect upon the magnet D, drawing the armature 21 against the contact-stop 22′ and effects a movement of the escapement-pallet through the agency of magnet E. In the position shown in the drawings a current is flowing through the reversing-relay branch from 20 through the wire f and the coils of magnet F from the transmitting-battery Z to ground, throwing the armature 17 against contact 19. On the change of the interrupter 3 throwing battery Z out of circuit, part of the current of z flows through wires m^5 m^4 m^3, contact-point 19, armature 17, wire l^{10}, coils of magnet D, wire l^9, wire f, coils of magnet F, wire f', wire f^2, wire f^3 to ground. This current as it passes through magnet F is also positive, and therefore leaves the armature in the positon in which it is shown in the drawings. When now the direction of movement of the transmitting-pen is changed and the Prony brake 4 at the transmitter is thrown against the contact-point opposite to that upon which it is shown as resting, a negative current is thrown to line from battery Z′, which traverses the main circuit in the same direction as does the current of battery z, which is then in circuit. It will be understood that at this moment the direction of the current through the repeating-relay branch will depend upon the relative resistance in the line-circuit between the branch point 20 and the receiving and transmitting ends of the lines, respectively. If the resistance between the point 20 and the receiving-ground is relatively small enough, the influence of battery z will preponderate over the influence of battery Z′ at point 20 and the current flowing to ground through the branch will be positive, tending to retain armature 17 in the position shown. If, on the other hand, the resistance between the point 20 and the receiving-ground is large enough in proportion to the remainder of the resistance on line, the current of battery Z′ will overcome the current of battery z at that point and the flow of current through the branch will be negative, causing the armature to shift to contact-point 18. I so arrange the resistances that this latter effect will be produced. If the resistance between the point 20 and the receiving-ground be more than one-third of the resistance between the point 20 and the transmitting-ground, the relative strength of batteries Z Z′ z z' being as stated, the current of battery Z′ will preponderate at point 20; but in order to allow a proper working margin I prefer to so apportion the resistance that about forty per cent. of the line resistance shall be between the point 20 and the receiving-ground and sixty per cent. of the same between said point and the transmitting-ground. With this arrangement of the resistance the current flowing through the coils of magnet F will be at all times of the polarity of the transmitting-battery, and the armature 17 of magnet F will vibrate in accordance with the changes of polarity at the transmitting-station and correctly follow the changes of direction of the transmitting-pen. Otherwise expressed, the pulsations traversing the main line will be of successively opposite polarity, while those traversing the branch line and magnet F will be of successively like polarity so long as the transmitting-pen moves in one direction.

The description contained in the last two paragraphs will be perhaps more readily understood if read in connection with the diagram of a portion of the circuits contained in Fig. 5, in which the letters of reference sufficiently indicate the different parts of the apparatus.

The resistance controlled by the transmitting-pen is represented as one hundred ohms, that of the main line from the transmitting-ground to the point 20 as twenty-five ohms additional to the said one hundred ohms of the transmitter-resistance, and the resistance from the main line from the point 20 to the receiving-ground as eighty-four ohms.

The repeating polar-relay D is in the main line and the reversing polar-relay F is in the branch from the main line, as above described.

While the point 20 at which the reversing-relay branch is taken from the main line must have at least more than one-third of the total resistance of the line between it and the receiving-ground, the batteries Z Z′ being about double in voltage the batteries z z', it is desirable that this proportion of resistance should not be very much greater than one-third, in order that the proper proportions of the organization, permitting an effective action of the pen raising and lowering resistances, may be preserved. It will be understood that in fixing the point 20 at which the reversing-relay branch is taken the line-resistance considered is that existing when the resistance R at the transmitting-station is in circuit.

From one point of view of this part of my invention the current of batteries z z' may be regarded as the normal current, always on line while the instruments are in operation, while the pulsations which transmit the messages are effected by sending intermittent impulses of greater strength than the line-current and of opposite polarity. It will be observed that this construction of apparatus and organization of circuits enables me to control the extent of movement of the receiving-pen by means of alternate pulsations and the direction of movement of the receiving-pen by means of identically the same pulsations; that

is, by pulsations which in the latter case are sent to line for the purpose of performing the function of changing the direction of motion of the receiving-pen from the same source of energy without increase or decrease of strength. This has been accomplished before in organizations wherein the movements of extent were controlled by impulses of like polarity by changing the polarity of these impulses on change of direction; but it has never been accomplished where the movements of extent were controlled by to-and-fro pulsations. Now it is found that to-and-fro pulsations for controlling extent of movement have very great advantages over impulses of like polarity, and my present invention has the signal advantage that it employs to-and-fro pulsations for movements in extent and does not resort to a variation in strength to control the direction of movement, but leaves all the effects which can be produced by variation in strength to be utilized in effecting the operation of the other parts of the receiver. This is an important gain in the simplicity of the apparatus and its certainty of operation.

In a telautographic system it is necessary to provide not only for the horizontal movements of the pen in forming characters, but for certain supplementary operations—viz., the raising and lowering of the receiving-pen and the shifting of the paper. Generically speaking, I term the mechanisms which effect each of these functions a "supplemental" part of the apparatus.

The pen lifting and lowering mechanism will now be described. The magnets K K′ for effecting the elevation and depression of the receiving-pen are governed by local circuits controlled by the Morse relays I and I′. The relay I is placed in a branch of the circuit LL, taken at point 28 from wire *f* through the wires *i*. Relay I′ is placed in a similar circuit taken from the circuit of line RL. The circuit of the magnet K is from battery *z* through wires m^5 m^4 *k*, armature 29, wire k^2, coils of magnet L, wire k^3, one of two oppositely-wound coils of magnet L′, wire k^4, back stop 31, armature 32 of magnet I′, wire k^5, wire l^{13}, and battery *z*′. This circuit, it will therefore be seen, passes through the front stop of the armature of relay I and the back stop of the armature of relay I′, and is therefore only closed when the resistance R′ is in the circuit RL and the resistance R is cut out of the circuit LL.

The energization of magnet K causes the receiving-pen to be elevated corresponding to the position in that state of the circuits with the transmitting-pen. The circuit of the magnet K′ is from battery *z* through wires m^5 m^4 *k*, armature of magnet I, back stop 33, wire k^6, coils of magnet K′, wire k^7, contact-spring 23, automatic switch-lever 24, wire e^3, wires l^{12} l^{13}, to battery *z*′. The circuit of this magnet is therefore only closed when the armature 29 of the relay I is on its back stop corresponding to the position of the transmitter in which the platen is depressed and the resistance R cut out of the line LL. In this position the magnet K is deënergized and the magnet K′ acts upon the armature-lever 34 to depress the receiving-pen.

The automatic switch will now be described: In the form shown it consists of a two-coil magnet L, the armature 24 of which is pivoted to the core of magnet L′, which latter magnet is provided with two oppositely-wound coils, one end of each of which is connected to wire k^3 and the opposite end of one of which is connected to wire k^4, and the opposite end of the other of which is connected to wire *a* and by it to front stop 36 of the armature 32. The armature 24 is polarized by the coils of magnet L′ and is given one or the other polarity, according as the current passes through one or the other of the two coils of magnet L′, before described. The armature 24 carries an insulated contact-point 26, which is flexibly connected with the wire g^2. The circuit-energizing magnet L passes from battery *z* through wires m^5 m^4 *k*, armature 29, front stop 30, wire k^2, coils of magnet L, wire k^3, one or the other of the oppositely-wound coils of magnet L′ and their wires k^4 or *a* to the stops 31 or 36, armature 32, wire k^5, wire l^{13}, to battery *z*′.

The paper-shifter, of which the magnet is shown at M, is operated by the automatic switch, the circuit of the paper-shifter being from battery *z* through wires m^5 m^4 *y*, contact 37, armature 38 of magnet M, coils of magnet M, wire *b*, contact-spring 39, bearing on the center of disk 40 and contact-spring 41, wire *c*, contact 42 to automatic switch-lever 24, or through spring 43, wire *d*, contact-spring 23 to automatic switch-lever 24. From the automatic switch-lever the circuit continues through wire e^3, wires l^{12} l^{13} to battery *z*′. The disk 40 is provided with a convenient number of insulating-pins 44, which come in contact with the springs 41 43 and raise them out of contact with the disk at intervals as the disk 40 rotates, it being rotated by connection with the paper-shifting mechanism. It results from this construction that each movement of the automatic switch-lever to the left, making contact between it and the stop 42, will close the circuit of the paper-feeding mechanism through that one of the springs 41 43 which happens to be resting upon the disk 40, and the paper-feeding mechanism will then operate until the contact-spring resting upon the disk is elevated by one of the insulating-pins 44, when the circuit is broken. When the automatic switch-lever 24 returns to its right-hand position, the paper-shifting circuit will again be closed and the operation repeated. It requires this double operation of the paper-shifter to shift the paper through a normal space. If it is desired to shift the paper more than the usual space, the operation is repeated as often as required.

The paper-shifting position of the auto-

matic switch-lever 24 is secured from the transmitting-station by movement of the master-switch into its middle position, in which contact-springs 15 and 16 both rest upon plate 45 and springs 12 and 46 both rest upon plate 47, in which position a strong battery-current will flow from batteries Z Z' through both the line-wires RL and LL. The two relay-magnets I I' will then be energized, drawing their armatures against their front stops and will close the circuit of magnet L' through that one of its two coils which polarizes its armature, so as to cause it to take the left-hand position.

The operation of the automatic switch can now be more fully explained. The circuits are so arranged that while the operation of writing is proceeding the current controlling the automatic switch can pass through that one only of the coils of magnet L' which biases the armature 24 to hold its right-hand position, this coil having its circuit through wire k^4. This circuit is closed only when the armature 32 is on its back stop and the armature 29 on its front stop. The circuit of the other coil of magnet L' cannot be closed during the use of the instrument for writing, because it is necessary for the closing of the circuit of this coil that the armature 32 should be against its front stop at the same time that the armature 29 is against its front stop, which condition does not occur. When, however, the paper is to be shifted, the two armatures 29 and 32 are simultaneously drawn up and the circuit is then made through the second coil of magnet L', giving the armature-lever 24 a change of polarity and throwing it into its left-hand position.

If, now, after the shifting of the paper the use of the instrument is to be discontinued, the master-switch of the transmitter is pushed to its third position, in which the contact-springs 15 and 46 rest against the plates 48 and 49, respectively, connected with the receiving instrument at the same station, and the springs 12 and 16 rest upon insulated plates. In this position no current is sent to line, and the receiving instrument therefore remains in the position in which it was left by the strong impulses simultaneously sent from both line-wires. In this position the local circuits of the escapement-magnets and the pen-lifting magnets are interrupted at the contact-springs 24 and 25. In this position of the receiving instrument, also, the magnets H H' are held out of circuit for the reason that the last impulses sent from line when the contact-springs at the transmitting-station were in contact with the plates 45 and 47 are of such a polarity as to leave the armature 17 of the magnet F against its contact 18 and the armature of magnet F' against its corresponding contact, in which position the circuits of magnets H H' are broken.

The motor-circuit passes from battery z through wires m^5 o, coils of the motor, wire p, contact 50, lever 52, wire q, wires l^{12} l^{13} to battery z'. The lever 52 and contact-pin 50 are for the purpose of opening the motor-circuit when the springs which operate the escapement have been given sufficient tension, the construction of these parts of the apparatus being the same as that shown in the patent to Gray, No. 522,893.

I do not, of course, limit myself to any particular construction of the various magnets with regard to their resistance or other features or the current strength employed, but I may mention the following as an organization of the apparatus which I have used with good results:

I have employed resistances R R' of one hundred ohms each; a line-resistance up to the point 20 of twenty-five ohms; a magnet D, having a resistance of forty-two ohms in each coil or a total resistance of eighty-four ohms; a magnet F, having a resistance of five hundred ohms in each coil or a total resistance of one thousand ohms, and a relay I, having a resistance of five hundred ohms, the corresponding resistances and magnets on the other side of the instrument being similarly constructed and arranged, and I have used successfully batteries Z Z', having an electromotive force of about twenty-four volts each, and batteries z z', having an electromotive force of about twelve volts each.

Fig. 3 shows a modification of the automatic switch in which the magnet X is provided with steel cores and two windings, a coarse winding and a fine winding, wound in opposite directions, that is, so connected that the current traverses the coils in opposite directions. When the armatures of both relays I I' rest against their front stops, corresponding to the paper-shifting position, the battery-current passes through the coarse coil of the magnet, powerfully energizing the coils and attracting the armature 24. If, now, the master-switch is moved to the third position, that is, to "discontinuance," the armatures of both relays drop and the current of the battery is cut off from both of the coils of magnet X, but the residual magnetism remaining in the steel cores retains the armature 24 in its left-hand position. When the use of the instrument is resumed and the relay-armatures take the positions corresponding to that in which the transmitting-pen is elevated from the paper, that is, with the armature of magnet I against its front stop and the armature of magnet I' against its back stop, the current will flow through the fine-wire coil of magnet X in an opposite direction to that in which the current flowed before through the coarse-wire coil, and will neutralize the residual magnetism in the cores, releasing the armature 24 and placing the receiving instrument in its working position.

In Fig. 4 another modification of this switch is shown in which the armature 24 is pivoted between two coils Y Y', the circuit connections in the ordinary receiving position being that shown in the drawings. The magnet Y

is energized, drawing the switch to the right. In the paper-shifting position the magnet Y' is energized, drawing the switch to the left. If the master-switch is then moved to its third position, the automatic switch remains in its left-hand position until the use of the instrument is resumed.

It will be observed that in all these forms of construction the position of the automatic switch is determined by two coils, the respective effects of which upon the switch are opposed to each other.

The general organization of the apparatus will of course not be modified if the pulsations operate the escapement-magnets E E' directly instead of indirectly through the relays D D', and such an organization is to be understood as within my invention.

The circuit connections of the right-hand side of the receiving instrument, which have not been specially described, are the same as the corresponding circuits on the left-hand side.

What I claim is—

1. In a telautographic system, the method of operating two separate electromagnetic mechanisms over one line-wire which consists in placing one of said mechanisms in the main line and the other in a local branch and causing pulsations of successively opposite polarity to traverse the main line and groups of pulsations of successively similar polarity to traverse the branch line, the main-line mechanisms being operated by the changes in polarity of the successive pulsations, and the branch-line mechanism being operated by the changes in polarity of the successive groups, substantially as set forth.

2. In a telautographic system in which the escapement-magnet is operated by to-and-fro pulsations, the method of governing the escapement-magnet and the reversing-magnet over a single line-wire which consists in employing two sets of opposed generators to furnish pulsations of unequal strength, the two generators of each set being placed at opposite ends of the line-wire, the stronger generator of each set being at the transmitting end, and said two stronger generators being of opposite polarity, placing the escapement-magnet in the main line and the reversing-magnet in a branch of the main line, adjusting the resistances in the main line so that the polarity of the current traversing the branch shall be controlled by the generators at the transmitting end, and changing the connection of the line at the transmitting end from one set of generators to the other on each change in direction of movement of the transmitting-pen, whereby the reversing-magnet at the receiving instrument is operated in accordance therewith, substantially as set forth.

3. The method of sending telautographic messages which consists in sending to line impulses of successively the same polarity while the transmitting-pen is moving in a given direction, reversing the polarity of said impulses when the direction of movement of the transmitting-pen is reversed, reducing said impulses by a current of lesser strength and opposed polarity introduced into the line at the receiving-station, alternating said impulses from the transmitter with impulses of opposed polarity from the receiver and placing the reversing mechanism in a branch from the main line, the resistance being so adjusted that the branch is traversed only by currents having the same polarity as the impulses sent to line from the transmitting instrument, whereby the escapement-magnet at the receiving-station is operated by pulsations successively of reversed polarity, while the reversing mechanism responds only to the changes of polarity in the impulses sent from the transmitting-station, substantially as set forth.

4. The method of sending telautographic messages which consists in providing a constant current upon line applied at the receiving-station, transmuting the movements of the transmitting-pen into electrical intermittent pulsations applied to line at the transmitting-station of greater strength than the said constant current and opposed thereto in polarity, changing the polarity of the impulses sent from the transmitting-station upon each change in direction of movement of the transmitting-pen, and controlling the action of the reversing mechanism by means of the changes in polarity of the impulses sent from the transmitting-station, substantially as set forth.

5. The method of operating the reversing-magnet of a telautographic mechanism which consists in providing a normal current on line applied at the receiving-station, causing line pulsations by alternately grounding the line at the transmitting end and connecting thereto an electrical generator furnishing a current opposed in polarity to the line-current and of sufficient strength to neutralize the line-current and furnish a pulsation of opposite polarity, changing the polarity of the predominating pulsations sent from the transmitting-station according to the direction of movement of the transmitting-pen, and controlling reversal of the receiving-pen through the agency of the changes of polarity of the said predominating pulsations, substantially as set forth.

6. The method of sending telautographic messages which consists in transmuting the movements of the transmitting-pen into intermittent pulsations, introducing to line from the receiver a constant normal current of lesser strength than said pulsations and of a polarity opposed thereto, transmuting the alternate pulsations so obtained into movements of the receiving-pen, reversing the polarity of said normal current on each reversal of direction of the movement of the transmitting-pen, and controlling the direction of movement of the receiving-pen through the

changes in polarity of the said pulsations, substantially as set forth.

7. The method of sending telautographic messages, which consists in transmuting the movements of the transmitting-pen into alternate pulsations effected by the alternate action on line of opposed generators of unequal strength, transmuting said alternate pulsations into movements of the receiving-pen, changing the polarity of the predominating generator-current in accordance with changes in direction of movement of the transmitting-pen, and controlling the direction of movement of the receiving-pen through the agency of said changes in polarity, substantially as set forth.

8. In a telautographic system, the combination of line-wires, generators of unequal strength at the two terminals of said wires respectively, means for transmuting the movements in extent of the transmitting-pen into pulsations of alternately opposite polarity through the alternate action on line of said generators, means for transmuting said alternately opposite pulsations into movements in extent of the receiving-pen, means for reversing the polarity of the dominating pulsations on reversal of the direction of movement of the transmitting-pen, and means for reversing the direction of movement of the transmitting-pen in accordance with said changes in polarity, substantially as set forth.

9. In a telautograph, the combination of two line-wires, generators of unequal strength and opposed polarity arranged at opposite terminals thereof, means for producing pulsations of successively opposite polarity by intermittently cutting out the stronger generator, means for transmuting said alternate pulsations into movements of the receiving-pen, means for reversing the polarity of the current from the stronger generator on reversing the direction of movement of the transmitting-pen, and means for reversing the direction of movement of the receiving-pen through the agency of said reversals of polarity, substantially as set forth.

10. In a telautographic system, the combination of means for causing the impulses of one polarity to traverse the line-wires from the transmitting-station and alternate pulsations of reversed polarity to traverse the line-wire from the receiving-station, said pulsations varying in number with the extent of movement of the transmitting-pen and controlling the movements of the receiving-pen in extent, means for reversing the polarity of the pulsations sent from the transmitting-station in accordance with changes in direction of movement of the transmitting-pen, and means for causing the direction of movement of the receiving-pen to change in accordance with the polarity of the pulsations sent from the transmitting-station, substantially as set forth.

11. In a telautographic system, the combination of a transmitting-pen, a receiving-pen, mechanism for controlling the extent of movement of the receiving-pen situated in the main line, mechanism for controlling its direction of movement situated in a branch of the main line, means for causing pulsations of successively opposite polarity to traverse the main line and pulsations of successively like polarity to traverse the branch line, and means for reversing the polarity of the pulsations traversing the branch line upon a change in the direction of movement of the transmitting-pen, substantially as set forth.

12. In a telautographic instrument, the combination of a transmitting-pen, a receiving-pen, a line-wire, mechanism for controlling the extent of movement of the receiving-pen, mechanism for controlling the direction of movement of the receiving-pen, means for causing pulsations of like polarity to be sent to line from the transmitting-station dependent in number upon the extent of movement of the transmitting-pen, means operating in conjunction with said pulsations for producing on line alternate pulsations of reverse polarity and means for reversing the polarity of said pulsations sent from the transmitting-station upon a change in the direction of movement of said transmitting-pen, the direction of movement of the receiving-pen being controlled by the polarity of said last-mentioned pulsations, substantially as set forth.

13. In a telautograph, the combination of a transmitting-pen, a receiving-pen, a line-wire, mechanism for controlling the extent of movement of the receiving-pen, mechanism for controlling the direction of movement of the receiving-pen, a current of normal strength flowing over the line-wire from the receiving instrument, means for producing intermittent pulsations upon line from the transmitting-station, said pulsations being successively of like polarity but of polarity opposed to the normal line-current and of greater strength than the same, means for changing the polarity of said pulsations dependent upon change in the direction of movement of the transmitting-pen and means for changing the polarity of the normal current when the polarity of the said pulsations is changed, the mechanism for controlling the direction of movement of the receiving-pen being controlled by the polarity of the said pulsations, substantially as set forth.

14. In a telautograph, the combination of a transmitting-pen, a receiving-pen, a line-wire, mechanism for controlling the extent of movement of the receiving-pen in the main circuit, mechanism for controlling the direction of movement of the receiving-pen in a branch of the main circuit, a current of normal strength flowing over the line-wire from the receiving instrument, means for producing intermittent pulsations upon line from the transmitting-station, said pulsations being successively of like polarity but of polarity opposed to the normal line-current and of

greater strength than the same, means for changing the polarity of said pulsations dependent upon change in the direction of movement of the transmitting-pen and means for changing the polarity of the normal current when the polarity of the said pulsations is changed, the resistances of the main line on the two sides of the branch being such that the polarity of the current flowing through the branch will be controlled by the pulsations sent from the transmitting-station, substantially as set forth.

15. In a telautographic system, the combination of the batteries or equivalent generators Z, Z′, *z*, *z*′, a line-wire, an interrupter, a device for shifting the line connection from battery Z to Z′, or vice versa, on a change in the direction of movement of the transmitting-pen, *e. g.* the Prony brake 4, mechanism controlled by the pulsations on line for controlling the step-by-step movements of the receiving-pen, and a reversing-magnet in a branch of the line-circuit taken therefrom at such a point that the polarity of the current flowing through the same is determined by the batteries Z, Z′, substantially as set forth.

16. The combination of batteries or equivalent generators Z, Z′, *z*, *z*′, a line-wire, an interrupter, a device for shifting the line connection from battery Z to Z′, or vice versa, on change of the direction of movement of the transmitting-pen, a magnetic escapement-controlling device, a reversing-relay, as F, in a branch of the main circuit, and circuit connections between these various parts, all substantially as set forth.

17. In a telautographic system, the combination of two line-wires, means for causing impulses of one polarity to traverse each of the line-wires from the transmitting-station and alternate pulsations of reverse polarity to traverse said line-wires from the receiving-station, said pulsations varying in number with the extent of movement of the transmitting-pen and controlling the movements of the receiving-pen in extent, means for reversing the polarity of the pulsations sent from the transmitting-station in accordance with change in direction of movement of the receiving-pen, and means for causing the movement of the receiving-pen to change in direction in accordance with the polarity of the pulsations sent from the transmitting-station over each line-wire, substantially as set forth.

18. In a telautographic system, the combination of two main-line wires, a transmitting-pen, a receiving-pen, mechanism for controlling the movement of the receiving-pen in extent situated in each main line, mechanism for controlling its movement in direction situated in a branch from each main line, means for causing pulsations of successively alternate polarity to traverse the main lines and pulsations of successively like polarity to traverse the branch lines, and means for reversing the polarity of the pulsations traversing the branch lines on changes in the direction of movement of the transmitting-pen, substantially as set forth.

19. In a telautographic system, the combination of a transmitting-pen, two line-wires, a receiving-pen, mechanism for controlling the movement of the receiving-pen in extent connected with each line-wire, mechanism for controlling the movement of the receiving-pen in direction connected with each line-wire, means for causing pulsations of like polarity to be sent to each line from the transmitting-station dependent in number upon the extent of movement of the transmitting-pen, means for causing pulsations to traverse the lines from the receiving-station intermediate of the pulsations sent from the transmitting-station and opposed in polarity thereto, said alternate pulsations together operating the mechanism for controlling the movements of the receiving-pen in extent, and means for reversing the polarity of said pulsations sent from the transmitting-station upon a change in the direction of movement of the transmitting-pen, the direction of movement of the receiving-pen being controlled by the polarity of said last-mentioned pulsations, substantially as set forth.

20. In a telautographic system, the combination of a transmitting-pen, a receiving-pen, two line-wires, mechanism for controlling the movements of the receiving-pen in extent and direction connected with each line-wire, a current of constant strength flowing over each line-wire from the receiver, means for producing on each line intermittent pulsations from the transmitting-station, said pulsations being successively of like polarity but of polarity opposed to the normal line-current and of greater strength than the same, means for changing the polarity of said pulsations in accordance with changes in direction of movement of the transmitting-pen, and means for changing the polarity of the normal current when the polarity of said pulsations is changed, the mechanism for controlling the direction of movement of the receiving-pen being controlled by the polarity of said pulsations, substantially as set forth.

21. In a telautograph, the combination of a transmitting-pen, a receiving-pen, two line-wires, mechanism for controlling the movement of the receiving-pen in extent in each line-wire, mechanism for controlling the receiving-pen in direction in a branch from each line-wire, a current of normal strength flowing over each line-wire from the receiving instrument, means for producing intermittent pulsations on each line from the transmitting-station, said pulsations being successively of like polarity but of polarity opposed to the normal line-current and of greater strength than the same, means for changing the polarity of said pulsations in accordance with changes in direction of movement of the transmitting-pen, and means for changing the polarity of said normal currents when the polarity of said pulsations is changed, the re-

sistances of the main line on the two sides of the branch being such that the polarity of the current flowing through the branch will be controlled by the pulsations sent from the transmitting-station, substantially as described.

22. In a telautographic instrument, the combination with a transmitting-pen, a receiving-pen, two line-wires, mechanism for controlling the extent of movement of the receiving-pen, mechanism for controlling the direction of movement of the receiving-pen, means for causing pulsations of like polarity to be sent to line from the transmitting-station dependent in number upon the extent of the movement of the transmitting-pen, means operating in conjunction with said pulsations for producing on line alternate pulsations of reverse polarity, means for reversing the polarity of said pulsations sent from the transmitting-station upon a change in direction of the transmitting-pen, the direction of movement of the receiving-pen being controlled by the polarity of said last-mentioned pulsations, means for performing supplemental operations at the receiver and means for electrically controlling the operation of the supplemental parts over the same line-wires, substantially as set forth.

23. In a telautographic instrument, the combination with a transmitting-pen, a receiving-pen, two line-wires, mechanism for controlling the extent of movement of the receiving-pen, mechanism for controlling the direction of movement of the receiving-pen, means for causing pulsations of like polarity to be sent to line from the transmitting-station dependent in number upon the extent of the movement of the transmitting-pen, means operating in conjunction with said pulsations for producing on line alternate pulsations of reverse polarity, means for reversing the polarity of said pulsations sent from the transmitting-station upon a change in direction of the transmitting-pen, the direction of movement of the receiving-pen being controlled by the polarity of said last-mentioned pulsations, means for performing supplemental operations at the receiver and means for varying the strength of the transmitting-current on one or both of the line-circuits to actuate the supplemental parts of the receiver, substantially as set forth.

24. In a telautographic system, the combination of two line-wires, means for transmitting currents over the said line-wires which control the movements of the receiving-pen in extent and direction by changes in the polarity thereof, and means for changing the resistance in one of said line-wires to raise the receiving-pen and in the other of said line-wires to lower the said receiving-pen, substantially as set forth.

25. In a telautographic system, the combination of two line-wires, means for transmitting currents over said line-wires which control the movements of the receiving-pen in extent and direction by changes in polarity thereof, a paper-shifting magnet, and a relay in each main line at the receiving-station, electrical connections for the paper-shifting magnets controlled by the two relays, and means for adjusting the resistance of said two line-wires to shift the paper at the receiver, substantially as set forth.

26. In a telautographic system, the combination of two line-wires, means for transmitting currents over said line-wires which control the movements of the receiving-pen in extent and direction, means for changing the resistance in one of said line-wires to raise the receiving-pen, means for changing the resistance in the other of said line-wires to lower the receiving-pen, and means for adjusting the resistances in the two line-wires simultaneously so as to cause the paper to be shifted at the receiver, substantially as set forth.

27. The combination of relays I and I′, a switch magnetically controlled by two coils having opposed action thereon and circuit connections, the circuit of one of said coils passing through one of the relay-armatures and one of its contact-stops, and the circuit of the two coils passing through the other relay-armature and its front and back stops respectively, substantially as set forth.

28. The combination of relays I and I′, a switch controlling local circuits, electromagnetic devices for controlling the switch and consisting in part of two coils producing opposed effects upon the switch when respectively excited, and circuit connections; the circuit of one of said coils passing through one of the relay-armatures and its front contact-stop and the circuits of the two coils passing through the other relay-armature and its front and back contact-stops respectively, substantially as set forth.

29. The combination of two telautographic line-wires, a switch controlling local circuits at the receiver, magnetic devices for operating the switch provided with two coils, which, when respectively excited, act oppositely upon the switch, relays I, I′ one in each line-circuit, and circuit connections between the relays and the said two coils, one of said coils being in circuit with the armature of one of the relays in one of its positions and one or the other of said coils being in circuit with the armature of the other relay according as the latter is on its front or back stop, substantially as set forth.

30. In a telautograph, the combination of two line-wires, a polarized magnet effecting the movements of the receiving-pen in extent in each line-circuit, a polarized magnet controlling the movements of the receiving-pen in direction in a branch from each line-circuit, and means for sending currents from the transmitter to operate said magnets, substantially as set forth.

31. In a telautograph, the combination of two line-wires, a polarized magnet effecting

the movements of the receiving-pen in extent in each line-circuit, a polarized magnet controlling the movements of the receiving-pen in direction in a branch from each line-circuit, means for sending currents from the transmitter to operate said magnets, means for effecting supplemental operations in the receiver, and means for electrically controlling the supplemental parts of the receiver from the transmitting-station over the same line-wires, substantially as set forth.

32. In a telautograph, the combination of two line-wires, a polarized magnet effecting the movements of the receiving-pen in extent in each line-circuit, a polarized magnet controlling the movements of the receiving-pen in direction in a branch from each line-circuit, means for sending currents from the transmitter to operate said magnets, means for effecting supplemental operations in the receiver, and means for varying the strength of the currents sent over the two line-wires for controlling the supplemental parts of the receiver, substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GEORGE S. TIFFANY.

Witnesses:
G. M. BERST,
A. L. KENT.