(No Model.) 2 Sheets—Sheet 1.

T. EWING, Jr.

WRITING TELEGRAPH.

No. 543,231. Patented July 23, 1895.

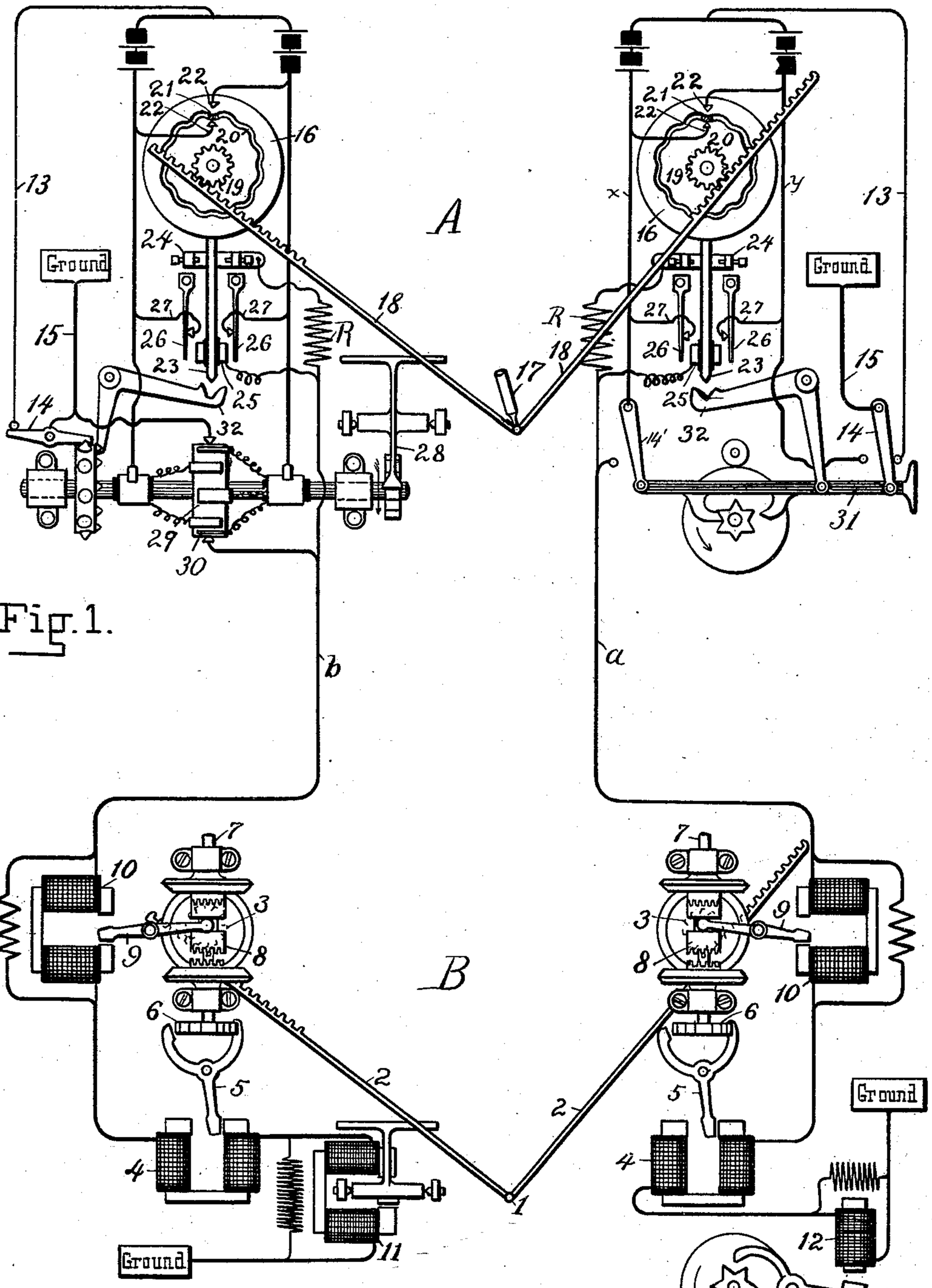

Fig. 1.

Witnesses:
Samuel W. Balch
Hy St. Whitman

Inventor.
Thomas Ewing, Jr

(No Model.) 2 Sheets—Sheet 2.

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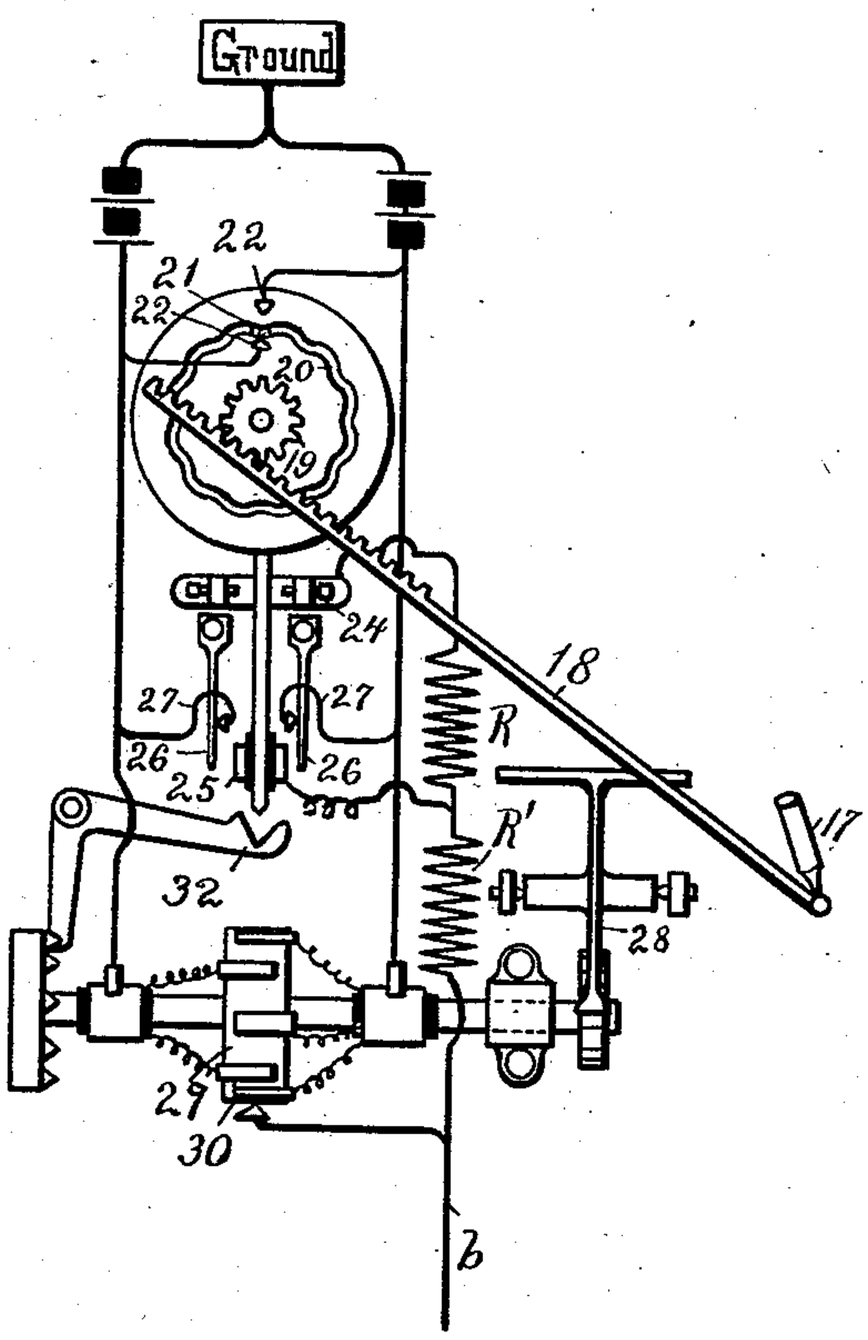

Fig. 2.

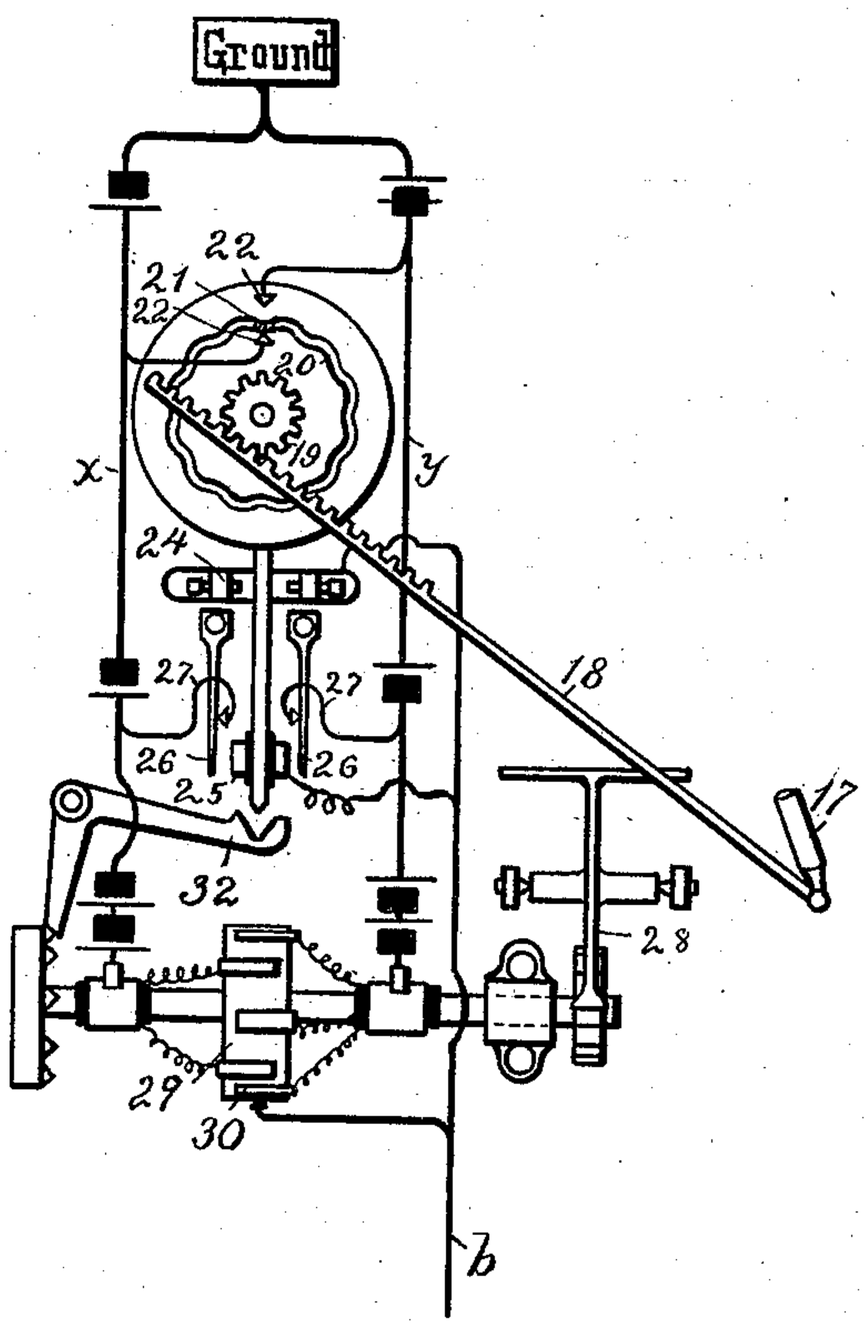

Fig. 3.

Witnesses:
Samuel W. Balch
Hy St. Whitman.

Inventor
Thomas Ewing, Jr

UNITED STATES PATENT OFFICE.

THOMAS EWING, JR., OF YONKERS, ASSIGNOR TO WILLIAM E. GUMP, OF BROOKLYN, NEW YORK.

WRITING-TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 543,231, dated July 23, 1895.

Application filed January 9, 1894. Renewed December 24, 1894. Serial No. 532,892. (No model.)

To all whom it may concern:

Be it known that I, THOMAS EWING, Jr., a citizen of the United States of America, residing at Yonkers, county of Westchester, State of New York, have invented certain new and useful Improvements in Writing-Telegraphs, of which the following is a specification.

The apparatus in which my improvements are embodied consists of a transmitter and a receiver connected by two circuits wherein certain of the movements of the pen and paper at the receiver are effected by electrical pulsations transmitted over one circuit, and the remaining movements are effected similarly over the other circuit, these circuits being electrically independent, so that the currents on one are not operatively affected by the currents on the other.

The movements of the transmitting-pen in the plane of the paper are resolved into two components by attaching to the pen two bars placed at an angle, preferably nearly at right angles, to each other. The bars in moving forward and back operate transmitting mechanism, which sends currents that move similar bars attached to the pen of the receiving-instrument. The mechanism operated by one of the component bars at the transmitter sends its currents over one of the circuits and that, operated by the other bar similarly operates to send its currents over the other circuit. These two sets of currents, sent independently of each other and simultaneously, when required, over the two circuits, effect the transmitting of the movements of the transmitter-pen in the plane of the paper. In addition, two other classes of movements have to be effected at the receiver. One of them is the lifting and lowering of the receiver-pen and the other the feeding of the receiver-paper. The lifting and lowering of the pen is effected by sending from the transmitter extra-strong positive and negative currents over one of the circuits and receiving them on a polarized magnet, which responds to these stronger currents, but will not respond to the weaker currents that control the movements of the pen in extent and direction. The paper-shifting is effected by sending a strong current over the other circuit, which in this case operates a magnet that need not be polarized.

One feature of my invention consists in the grouping of the mechanisms which effect the several operations in two substantially separate circuits, as above explained; and my invention further consists in the combination, with the pen-lifting and paper-shifting transmitter mechanism, of means for returning to neutral position the movable member of another transmitter-switch, as hereinafter more fully described.

In the accompanying drawings, which form a part of this specification, Figure 1 is a diagrammatic view showing the transmitter and receiver and the manner of connecting them in this system. Figs. 2 and 3 are detail diagrammatic views of modified systems.

Construction of the Receiver.

The two halves of the receiver are identical, except that in the circuit through the line *a* there is a non-polarized magnet which operates the paper-shifting device and in the circuit through the other line *b* there is a polarized magnet which operates the pen lifting and lowering device.

The tracing pen, pencil, or stylus 1 is connected with two rods 2, which make at their common point of junction with the pen approximately a right angle with each other. These rods are pushed or pulled backward and forward along their length by two pinions 3 3. (Shown in dotted lines.) These pinions are each actuated by miter-wheels. The miter-wheels are driven by polarized magnets, which are actuated by weak alternating line-currents. When the rods 2 are pushed or pulled they move the pen in straight or curved lines, according to the relative operation of the mechanisms.

In each mechanism a polarized pen-moving magnet 4 vibrates an anchor-escapement 5, and through the ratchet-wheel 6 rotates the shaft 7, on which two miter-wheels are loosely mounted. Each of these miter-wheels engages with a third, to which the pinion 3 is attached. The shaft 7 revolves in one direction only. A clutch 8 is splined to this shaft, and may be made to engage with either of the two miter-wheels, and the one of these with which it is

engaged determines the direction of revolution of the lower miter-wheel and of its pinion, and thereby determines the direction to which the rod will be driven. The clutch is shifted by the lever 9, which carries an armature controlled by the polarized direction-controller magnet 10.

From the foregoing it will be seen that the direction in which the rod of either mechanism moves is determined by the position of the armature of the direction-controlling magnet 10, and the extent of movement of the rod in either direction is determined by the number of oscillations of the escapement by the pen-moving magnet 4.

The pen-moving magnet 4 and direction-controlling magnet 10 are both polarized magnets, and some means must be provided for preventing the armature of magnet 10 from being operated by the ordinary currents which operate the magnet 4. To effect this I introduce a shunt around this magnet 10, which carries so much of the current around this magnet that it is not operated except when a quite heavy current is thrown into the circuit.

The foregoing mechanism, respecting which I make no claim of invention, is sufficient if operated by suitable transmitting mechanism to cause the receiver-pen to follow the movements of the transmitter-pen, both as to extent and direction, in the plane of the paper in the operation of writing and in a plane parallel to the plane of the paper in the operation of positioning the pen; but it is necessary in addition to provide elements to lift and lower the pen and to shift the paper. My claim to novelty is to the location of these elements—one in one circuit and one in the other circuit.

The pen-lifting device of Fig. 1 consists of a polarized magnet 11, which is connected in the circuit through the line *b* in any convenient location relatively to the magnets 4 and 10. A suitable shunt connects the ends of the coils of magnet 11. To magnetize this magnet 11 so as to cause it to lift or lower the pen there must be thrown onto the line *b* a stronger current than is necessary to operate the magnets 4 and 10. The device for doing this will be described later.

In operating the magnet 11 the magnet 10 is also magnetized, and in operating either magnet 11 or magnet 10 the magnet 4 is magnetized. The armature of magnet 10 is thrown only when the current sent to operate magnet 11 is the reverse of the last current which operated 10. When the armatures of magnets 4 and 10 are thrown together, the pen is not moved, as the clutch is out of gear. The only effect of operating magnet 4 once is to move the pen one unit of distance, which is trifling. The transmitter is constructed to correct the untimely operation of magnet 10 with magnet 11.

To shift the paper it is necessary to throw onto line *a* a current of sufficient strength to operate the magnet 12. This magnet is not polarized. It is provided with a suitable shunt, so that it is not operated by the weaker currents which operate the magnets 4 and 10 in line *a*. The remarks above made respecting the untimely operation of magnets 4 and 10 in line *b* apply equally to similar untimely operation of magnets 4 and 10 in line *a*.

Construction of Transmitter.

The transmitter must send over each of the circuits alternating pulsations to control the extent of movement of the receiving-pen, a distinct set of polarized impulses to control the direction of its movement, over one of them a third set of polarized impulses to lift and lower the pen, and over the other circuit must be sent a third set of impulses to shift the paper.

The transmitter-pen by its horizontal movement sends the impulses that effect the horizontal movements of the receiver-pen. It is not feasible in practice to impose on the operator conditions respecting the position of the transmitter-pen at the time when it is lifted or lowered or when the paper-shift is operated or when the direction of movement of the pen is reversed. Therefore, with the apparatus and system shown, where not less than two of the sets of currents are polarized currents, it is necessary in order to avoid short circuits that the three sets of impulses be transmitted to line through three branches, and provision must be made to prevent the simultaneous closure of any two of these branches. The principle may be stated generally thus—that where there are connected up to a single line two branches, through either of which positive and negative currents are sent to line or through one of which positive currents are sent and through the other negative currents by mechanisms operating independently of each other, it is necessary in order to avoid short circuits that these two branches be not closed simultaneously.

My invention consists in providing the pen-lifter and paper-shifter of the transmitter with attachments operating to open those switches which in the operations of the transmitter-pen are closed to transmit the currents which control the horizontal movements of the receiver-pen.

The construction and operation of the transmitter will now be described. It consists of two halves, which are connected with the corresponding halves of the receiver by separate circuits. Each of these halves of the transmitter consists, broadly, in a battery of cells connected in series with an intermediate ground, a transmitter-disk and switches operated by movements of the transmitter-pen in the horizontal, and a commutator which when operated opens these switches, breaks the normal ground, and grounds one end of the series of cells and connects the other end of the series to line. The only difference between the two parts is that the commutator in the circuit through line *a* is mechanically

attached to a paper-shifter and always connects the battery in the circuit in the same direction and is operated by the pressure of the finger on a switch-arm. The commutator in the circuit through *b*, however, is a pole-changer operated by the lifting and lowering of the transmitter-pen, which momentarily throws the whole battery into the circuit in one direction or the other, according as the pen is lifted or lowered, and immediately re-establishes the normal condition of the line.

The normal connections to ground are by wire 13, switch 14, and wire 15. To each line is connected one of two transmitting-disks 16. Each disk is revolved by moving the transmitter-pen 17. This pen like the receiver-pen is connected with two rods 18, on the end of which are racks that engage with pinions 19. These transmitter-pen rods impart rotation to the pinions with which they engage, instead of having motion imparted to them thereby, as is the case with the similar rods attached to the receiver-pen. Upon the same axes with these two pinions are disks 16, above mentioned, around each of which is cut a sinuous slot 20. This slot engages the end of a pivoted metal rod 21. (Shown in section.) When the disk is rotated, this rod 21 is vibrated between the two contact-points 22 22, which are connected, respectively, with the positive and negative ends of one of the batteries above referred to. The rod 21 and the contacts 22 22 constitute an alternating pulsator. This pulsator is electrically connected with a rod 23, which is frictionally mounted on the axle carrying the disk 16. When the disk is revolved in either direction, the rod is carried against one of the contacts which lie on either side in the metallic shoe 24 and connect the pulsator through the resistance R to the line. Whenever the direction of motion changes, the rod swings from one side of the shoe to the other and momentarily disconnects the pulsator from the line. During this period other currents are being sent, as will be described later.

From the foregoing partial description of the transmitter it will be seen that rotation of the transmitter-disks will cause alternating currents to be sent over the lines *a* and *b*, which currents pass through the resistances R, and are diminished in strength thereby. The circuit of line *a* is as follows: ground-wire 15, switch 14, wire 13, one-half of battery, one of points 22, rod 21, rod 23, shoe 24, resistance R, line *a*, shunt around magnet 10, magnet 4, and shunt around magnet 12 to ground. The currents in line *b* traverse a similar circuit, which includes the other half of the receiver, and can be traced readily in the drawings. Each of these connections from ground to lines *a* and *b* constitutes one of the branches to line herein referred to.

On the outer end of rod 23 is a metallic cap insulated from the rod and connected to line ahead of resistance R. When either of the disks connected with the transmitter-pen is rotated in either direction the frictionally-attached rod 23 is moved to the right or left from the position in which it is shown in the figures. The effect of this is, first, to bring the insulated cap 25 on the end of this rod into contact with one of two springs 26, which lie on either side of rod 23 and are normally in contact with points 27, one of which is connected to one pole and the other to the other pole of the battery. As the disk is still further rotated, the spring with which contact is established is carried out of engagement with the contact-points 27 and the rod 23 is moved on into engagement with the metallic shoe 24, thereby establishing the connection from the pulsator to the resistance R above referred to; but at the first moment of contact of the insulated cap 25 with the spring 26, connection is established between the insulated cap and the contact-point in contact with the spring. This momentarily closes a circuit from the battery through the contact-point along the spring to the insulated cap, and from thence to line, exactly as heretofore traced, except that, as will be seen, the pulsator and resistance R are cut out. The current which is thus forced to line for a moment whenever the insulated cap is brought in contact with either of the springs is of sufficient strength, by reason of the cutting out of the resistance R, to operate the magnet 10. This connection forces one or other of the batteries through one or other of contact-points 27, spring 26, and insulated cap 25, constituting another of the branches to line herein referred to.

So long as the pen is moved in one direction the rod is kept over against the same spring and holds it away from its contact-point. The armature of the armature magnet 4 is vibrated by the current sent through the pulsator, and the armature of magnet 10 remains in position to continue the motion of the receiving-pen in the same direction. So soon as the motion of the transmitter-pen is reversed at either rod 18 connected with the pen the rod 23 is carried back out of contact with the spring with which it has been in contact and into contact with the other of springs 26. This other spring, as will be seen, is connected with the opposite end of the battery and will send a momentary current through the cap and around the resistance of opposite polarity to that sent by contact with the first spring. This current will operate the magnet 10 and reverse the clutch, so that on further operation of the magnet 4 the direction of the motion of the receiving-pen will be reversed. It is of no consequence whether the transmitter-pen or the receiver-pen is resting on the paper or lifted above it. The movements of the transmitter-pen control the movements of the receiver-pen exactly in the same way in both cases.

When the transmitter-pen is lifted, the normal ground of line *b* at the transmitting-station A is broken. One pole of the battery is grounded, and the other pole (always the

positive or always the negative pole) is connected to the line through a pole-changer 29 and around the transmitter, the transmitter-disk being at the same time cut out of line. When this is effected, a sufficiently large current traverses line *b* to operate pen-lifting magnet 11 and lift the receiving-pen.

The change in the circuit above stated is effected by merely lifting the transmitter-pen. One of the rods attached to this pen rests on an arm of the anchor-escapement 28, which, when the pen is lifted, rotates the shaft of the pole-changer 29 and moves the pole-changer far enough to pass one pair of contact-strips 30 under the pair of brushes of the pole-changer. When this movement of the pole-changer has been completely made the conditions of the circuit are re-established, so that the pens can be moved to any desired position; but during the movements of the pole-changer the following changes of circuit are effected: The normal ground connection is broken momentarily at switch 14, and one pole of the battery is grounded and the other connected to line *b*, as stated. This circuit should be maintained a sufficient length of time to fully charge the line and to insure sufficient flow of current to actuate magnet 11 and lift the pen. When the receiver-pen is lowered the pole-changer shaft is again rotated in the same direction as before, and far enough to carry the pole-changer around one more space. During its rotation this sets up exactly the same circuit as before, except that the battery is connected up in the reversed direction, so as to send a current to line of opposite polarity to the current used in lifting the pen, thereby effecting the lowering of the pen. This change of polarity will be clear when it is observed that on the pole-changer each alternate contacting-strip is connected with one pole of the battery and the intermediate strips with the other pole of the battery.

The circuits and construction of the pole-changer can readily be seen from inspection of the drawings. The effect of operating the pole-changer is to double the electromotive force of the current on the line and still further increase its strength by cutting out the resistance R.

To shift the paper a rod 31 at the transmitter is pushed in, thereby mechanically shifting the paper at the transmitter-station, and at the same time so changing the circuits of line *a* as to actuate the magnet 12 at the receiver-station and shift the paper by the escapement mechanism shown. To accomplish this one pole of the battery on this side is connected to ground, and the other pole is connected to line *a*, whereby it reaches the ground at the receiving-station. When the switch 14′ is turned the resistance R is cut out and there is sent through the paper-shifting magnet 12 a current of double the normal electromotive force, and further strengthened by a reduction of resistance in line, whereby a current of sufficient strength to operate the magnet 12 is transmitted along the line. These changes in the circuit are effected as follows: When the rod 31 is pushed in the contact-switch 14 disconnects lines 15 and 13 and grounds one pole of the battery. The other pole of the battery is switched directly onto line *a*, transmitter R being cut out. The line is grounded at the receiving-station.

The connections from the battery through either side of the pole-changer to line *b*, or through the paper-shifter commutator to line *a*, constitute a third branch to line herein mentioned. In the system shown, as already stated, no two of these branches can be closed simultaneously. If, for example, the first-described branch were closed at the contact between rod 23 and shoe 24 and through alternating pulsator—say to the positive end of one of the batteries—at the same time that the second branch is closed—say to the negative end of the battery through insulated cap 25 and one of springs 26 and contact-points 27—there would be established a short circuit, as follows: battery 22 21 23 24 R 25 26 27 battery. It is true that the device will operate if these two branches are simultaneously closed to the same pole of the battery; but at the instant of reversal of direction in the transmitter-pen the rod 24 is as apt to be connected to one side of the battery as to the other, and while at the instant of reversing the direction of movement of the pen the first-named branch may happen to be broken at the alternating pulsator it is just as apt to be closed as broken. Therefore this branch through contacts 23 24 and 22 21 must be broken at contacts 23 24 whenever the direction-reversing current is sent to line, and it is obviously as important that the branch through the contacts 25 26 shall be broken when the alternating pulsator is operating. This is all provided for by the location of the rod 23 and insulated cap 25 relative to spring 26 and shoe 24.

When the paper-shifter commutator or pen-lifter pole-changer is operated, there is danger of short circuits, unless both of the other branches are simultaneously opened, for otherwise the line might be connected through one of these commutators—say to the positive pole of the battery—and through one of the other branches be connected to the negative pole. I avoid this difficulty by attaching to the pole-changer and the paper-shifter a device—*e. g.*, a bell-crank lever 32—which, with each operation of the device to which it is attached, is brought down onto the end of the rod 23 and brings it to its neutral position. This breaks both the other branches to line and leaves only the branch through the commutator. The return of this rod 23 to neutral position also has another advantage. The current which shifts the paper or lifts or lowers the pen may also reverse the armature of the direction-controlling magnet 10. An operator may shift the paper or lift the pen

while the insulated cap 25 is in contact with one of the springs 26 and holds the spring out of contact with its point 27. Under these conditions if the pen at the transmitter is then moved farther in the same direction, so that the contact between cap 25, spring 26, and point 27 is not re-established, the pens will move in opposite directions; but if the rod 23 is brought back to neutral position whenever the pen-lifter or paper-shifter in line therewith is operated the untimely reversal of the magnets 10 by the current through the pen-lifter or paper-shifter does no harm, since no matter in what direction the pen is moved after the operation of these devices the very first movement of it will set right the magnet 10 at the receiver-station.

In Fig. 2 I have shown a modification in which the battery is permanently grounded and a second resistance R is introduced into the line. The currents from the alternating pulsator traverse both resistances R and R′, the currents through the insulated cap traverse the resistance R′ only, and the currents through the commutator traverse neither resistance R or R′. The ground-switch 14 and the ground-brush 30 of the commutator shown in Fig. 1 are here omitted.

In Fig. 3 I use no resistances. The batteries are permanently grounded, as in Fig. 2. In each of the leads *x* and *y* I introduce a battery between the points where the wires are led off to contact-points 22 22 and the points where the wires are led off to the contact-points 27 27. I also introduce a battery in each of the leads *x* and *y* between the points where the wires are led off to the contact-points 27 27 and the points where the leads *x* and *y* contact with the commutator. As in Fig. 2, the ground-switch 14 and the ground-brush 30 of the commutator shown in Fig. 1 are here omitted.

In both Figs. 2 and 3 all of the batteries in lead *x* have the same pole—say the positive pole—grounded, and the same pole—say the negative pole—to line, and all of the batteries in lead *y* have the same pole—say the negative pole—grounded, and the same pole—say the positive pole—to line, as is indicated in the drawings. I show these arrangements of Figs. 2 and 3 as equivalents of the arrangement of Fig. 1.

There is this advantage in using permanent grounds for the batteries and always connecting the same end of any one battery to line, to wit: that each battery or other source of energy may be used to supply current to several machines.

The arrangement of Fig. 2 requires but two batteries, and the arrangement of Fig. 3 requires six batteries; but these batteries when not in use are not being exhausted, and there is always waste in working through resistances, which is avoided in the arrangement of Fig. 3. I have shown in these two detail figures only the line which includes the pen-lifting commutator, and only the transmitter end of this line. The same arrangement is applied to the line which includes the paper-shifting commutator. The changes in neither case involve change in the construction of the receivers.

Without limiting myself to the precise details or to the mechanical arrangements shown, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a writing telegraph system, the combination of a wire joining two stations, a suitable device at the receiver station for controlling the movements of the receiver pen, both in extent and direction, and a pen lifting and lowering device, and at the transmitter station means for transmitting over the line currents which control the movements of the receiver pen in extent, stronger currents that control its movements in direction and still stronger currents which effect the lifting and lowering of the receiver pen, substantially as described.

2. In a two wire writing telegraph system the combination of two wires joining the two stations, a suitable device at the receiver station in the two lines for controlling the movements of the receiver-pen both in extent and direction, a pen lifting and lowering device in one of the lines, and a paper shifting device in the other line, and at the transmitting station means for transmitting over the two lines currents which control the movements of the receiver pen in extent and direction, means for transmitting over one of the lines currents which control the lifting and lowering of the receiver pen, and means for transmitting over the other of the lines currents which control the shifting of the paper at the receiving station, substantially as described.

3. In a two wire writing telegraph system the combination of two wires joining the two stations, a suitable device at the receiver station in the two lines for controlling the movements of the receiver pen both in extent and direction, a pen lifting and lowering device in one of the lines and a paper shifting device in the other line, and at the transmitting station means for transmitting over the two lines currents which control the movements of the receiver pen in extent and direction, means for transmitting over one of the lines currents which control the lifting and lowering of the receiver pen, and means for transmitting over the other of the lines currents which control the shifting of the paper at the receiver station, the said pen-lifting and lowering and paper shifting currents being stronger than the said other currents, substantially as described.

4. In a writing telegraph the combination of a transmitting and receiving pen, two circuits in each of which is a half of a transmitter and a half of a receiver, each half of the transmitter being connected up with the transmitting pen, and each half of the receiver being connected up with the receiving pen; in one of the circuits at the receiver sta-

tion a paper shifting magnetic device and at the transmitter station a switch for controlling it, which when operated, closes the circuit around and cuts out the half transmitter; and in the other circuit at the receiver station a pen lifting and lowering magnetic device and at the transmitter station a switch for controlling it, which, when operated, closes the circuit around and cuts out the half transmitter, substantially as described.

5. In a writing telegraph the combination at a transmitter station of devices for sending to line two sets of currents, and means for returning to its neutral position the device for sending one of the sets of currents upon each operation of the device for sending the other set of currents, substantially as described.

6. In a writing telegraph the combination at a transmitter station of devices for sending to line two sets of currents of different strengths, and means for returning to its neutral position the device for sending the weaker set of currents with each operation of the device for sending the stronger set of currents, and at the receiver station apparatus operated by the weaker set and controlling the direction of movement of the receiver pen, and subject to untimely operation by the stronger set of currents, substantially as described.

7. In a writing telegraph the combination at the transmitter station of a switch which is moved by the transmitter pen to either side of its neutral position, and when so moved sends distinctive currents to line with each reversal of the direction of motion of the transmitter pen, a second switch for sending to line stronger currents, apparatus at the receiver station operated by the weaker currents and controlling the direction of movement of the receiver pen and subject to untimely operation by the stronger currents, and means at the transmitter for returning the switch for sending to line the weaker currents to its neutral position with each closure of the switch for sending the stronger currents, substantially as described.

8. In a writing telegraph a transmitting pen connected to a transmitter attached to which is a switch in a branch line which follows the movements of the pen and is constructed to send to line distinctive currents with each reversal of direction of movement of the pen, a second switch for closing a branch to line around the said transmitter, and means for returning the first named switch to neutral position upon each operation of the second switch, substantially as described.

9. In a writing telegraph a transmitter pen connected to a transmitter attached to which is a switch which follows the movements of the pen to close and then by further movement in the same direction to open a connection to line which when closed sends to line an increased current, such increased current being of opposite polarity with each reversal of direction of the pen, a second switch for closing a branch around the said transmitter, and means for returning the first named switch to neutral position upon each operation of the second switch, substantially as described.

10. In a writing telegraph the combination of a transmitting and receiving pen, two line wires in each of which is a half of a transmitter and a half of a receiver, each half of the transmitter being connected up with the transmitting pen and by it moved in opposite directions, a resistance in the circuit with each of said half transmitters, a switch controlled by each of said half transmitters which closes the line around said resistance and changes the polarity of the current with each reversal of the direction of movement of the transmitting pen, a second switch for closing the line around the said transmitter, and means for returning the first named switch to neutral position upon each operation of the second switch; and each half of the receiver being connected up with the receiving pen and including a magnetic device for moving the pen along a given line operated by the current when the aforesaid resistance is in the circuit, and a second magnetic device for controlling the direction of movement of the pen operated whenever the said transmitter switch is moved in either direction from its neutral position, and a paper shifting magnetic device or a pen lifting magnetic device operated only when the said second switch is operated, substantially as described.

11. In a writing telegraph the combination of a transmitting and a receiving pen, two lines in each of which is a half of a transmitter and a half of a receiver, each half of the transmitter being connected up with the transmitting pen and by it moved in opposite directions, and being so constructed as to send varied currents to line when so operated, a resistance in the circuit with each of said half transmitters, a switch controlled by each of said half transmitters which momentarily closes the line around said resistance and changes the polarity of the current with each reversal of the direction of movement of the transmitting pen, and a second switch constructed to cut out of line the foregoing device and send an increased current to line, and means for returning the first named switch to neutral position upon each operation of the second switch; and each half of the receiver being connected up with the receiving pen and including a magnetic device for moving the pen along a given line operated by the current when the said resistance is in the circuit, and a second magnetic device for controlling the direction of movements of the pen operated only when the said resistance is cut out of the circuit, and a paper shifting or pen lifting magnetic device operated only when the said second switch is operated, substantially as described.

12. In a writing telegraph a transmitter pen constructed to send to line currents of both

polarities and having attached to it a switch in a branch to line which follows the movements of the pen, and through which are sent to line distinctive currents with each reversal of movement of the pen, a second switch for closing a branch to line around the said transmitter, and means for returning the first named switch to neutral position upon each operation of the second switch, substantially as described.

13. In a writing telegraph transmitter constructed to send to line currents of both polarities, a combination of two switches each in a separate branch to line, one switch being in a branch with a pulsator, and connected through the pen with a switch in another branch, the co-operation of the switches when operated by the pen being such that with each operation of the switches the latter switch closes, and again breaks its branch before the former switch is closed, a third switch in a third branch to line and means connected with the third switch whereby when the third switch is closed the other two switches are open, substantially as described.

14. In a writing telegraph transmitter constructed to send to line currents of both polarities, the combination of a transmitter pen, a current pulsator operated thereby through mechanism to which is attached a switch arm having two contact points insulated from each other, two sets of contacts co-operating with these two points on the switch arm, one member of each of these sets of contact points lying on either side of the switch arm, two branches, one through the pulsator and switch arm, and one set of contacts and the other through the switch arm and the other set of contacts, the two sets of contacts being so constructed and adjusted relatively to each other that the second branch is closed, and then broken before the first branch is closed, each time that the switch arm is moved in either direction from its neutral position, a third switch in a third branch to line, and means connected with the third switch whereby when the third switch is closed the switch arm is brought back to its neutral position opening the other two switches, substantially as described.

THOMAS EWING, JR.

In presence of—
SAMUEL W. BALCH,
JAMES HART ROBERTSON.