No. 610,274. Patented Sept. 6, 1898.

L. O. McPHERSON.

TELAUTOGRAPH.

(Application filed Mar. 13, 1897.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

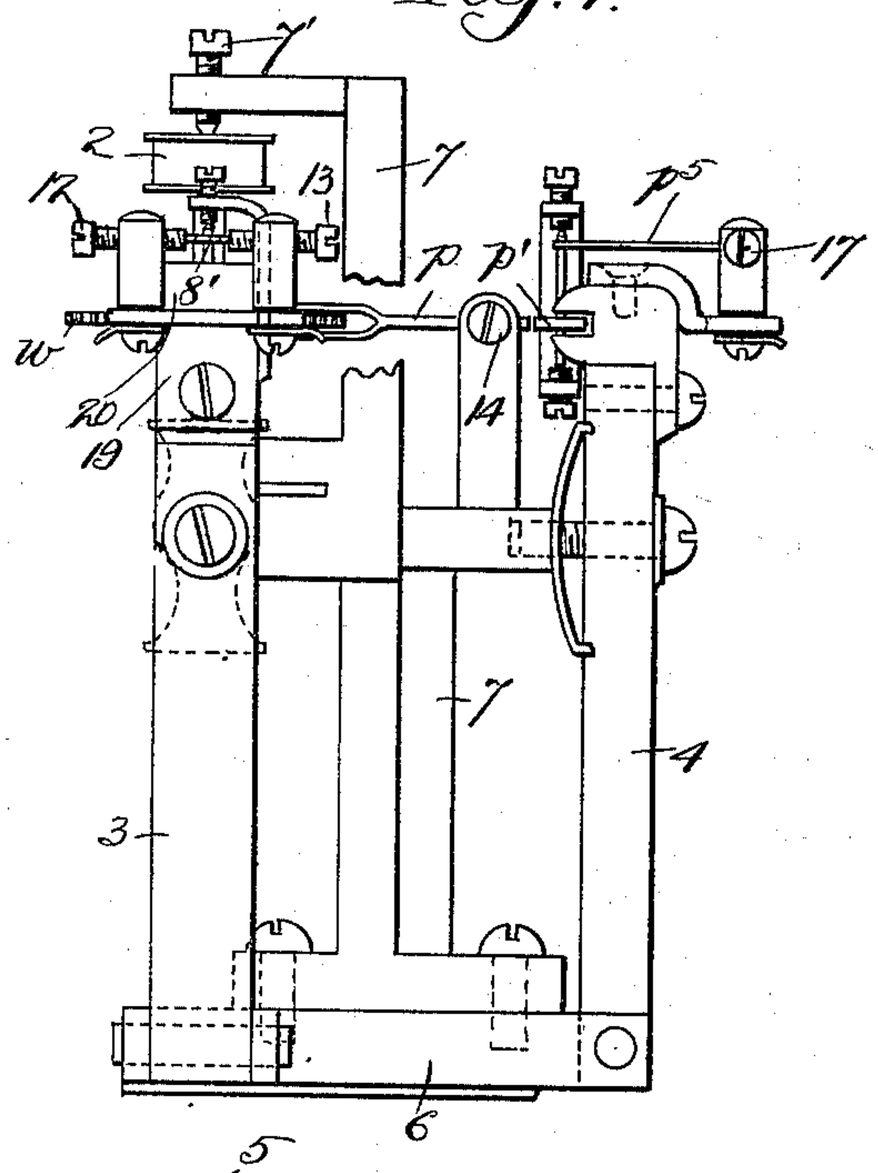


Fig. 2.

Fig. 3.

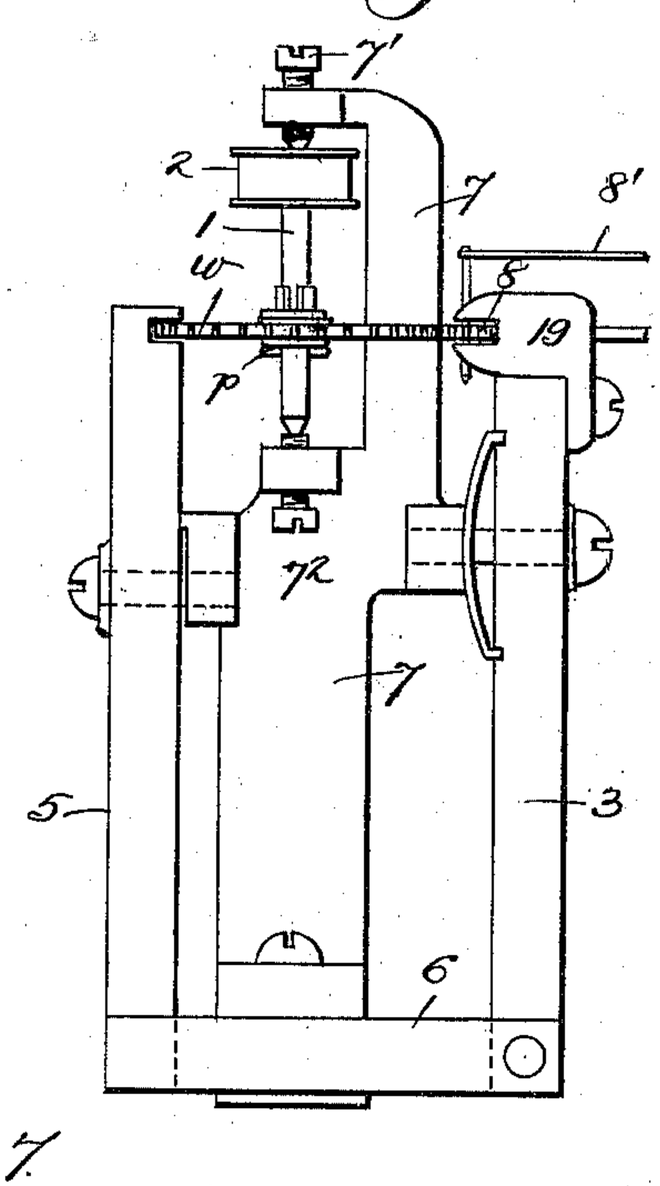
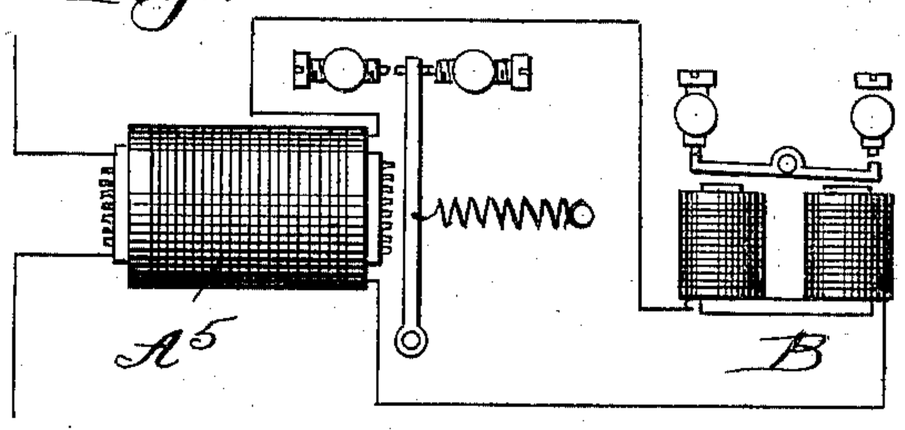


Fig. 7.



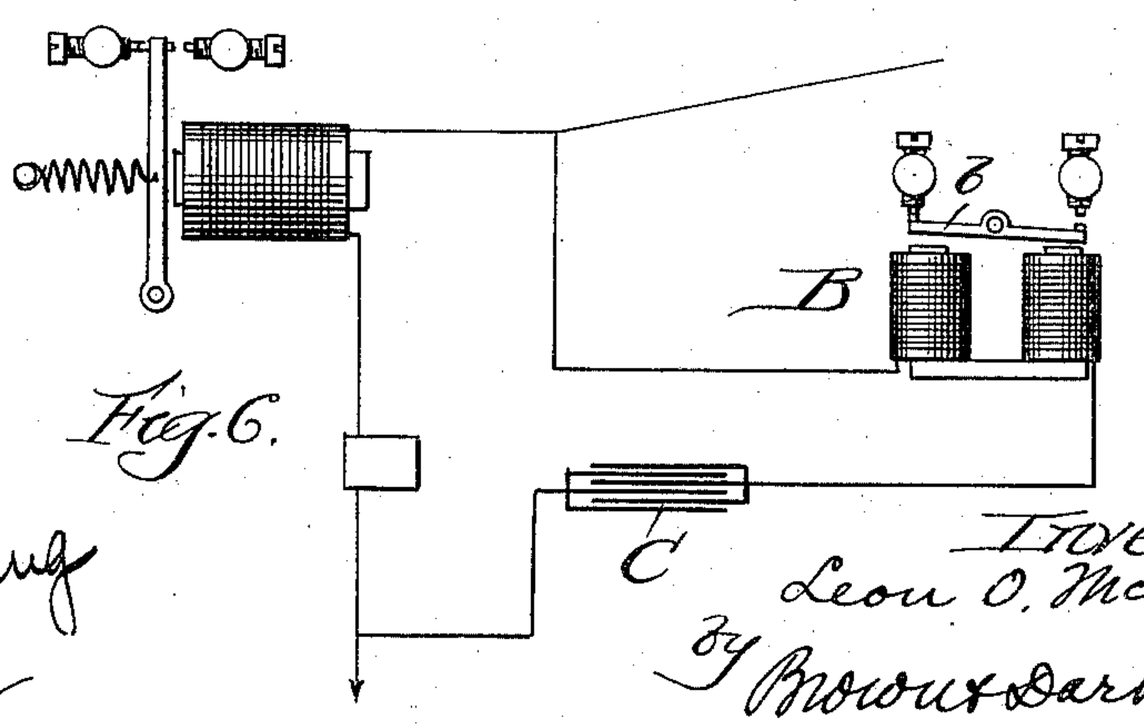


Fig. 6.

Witnesses
Wm. F. Fleming
S. Hutchison

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(No Model.) 4 Sheets—Sheet 2.

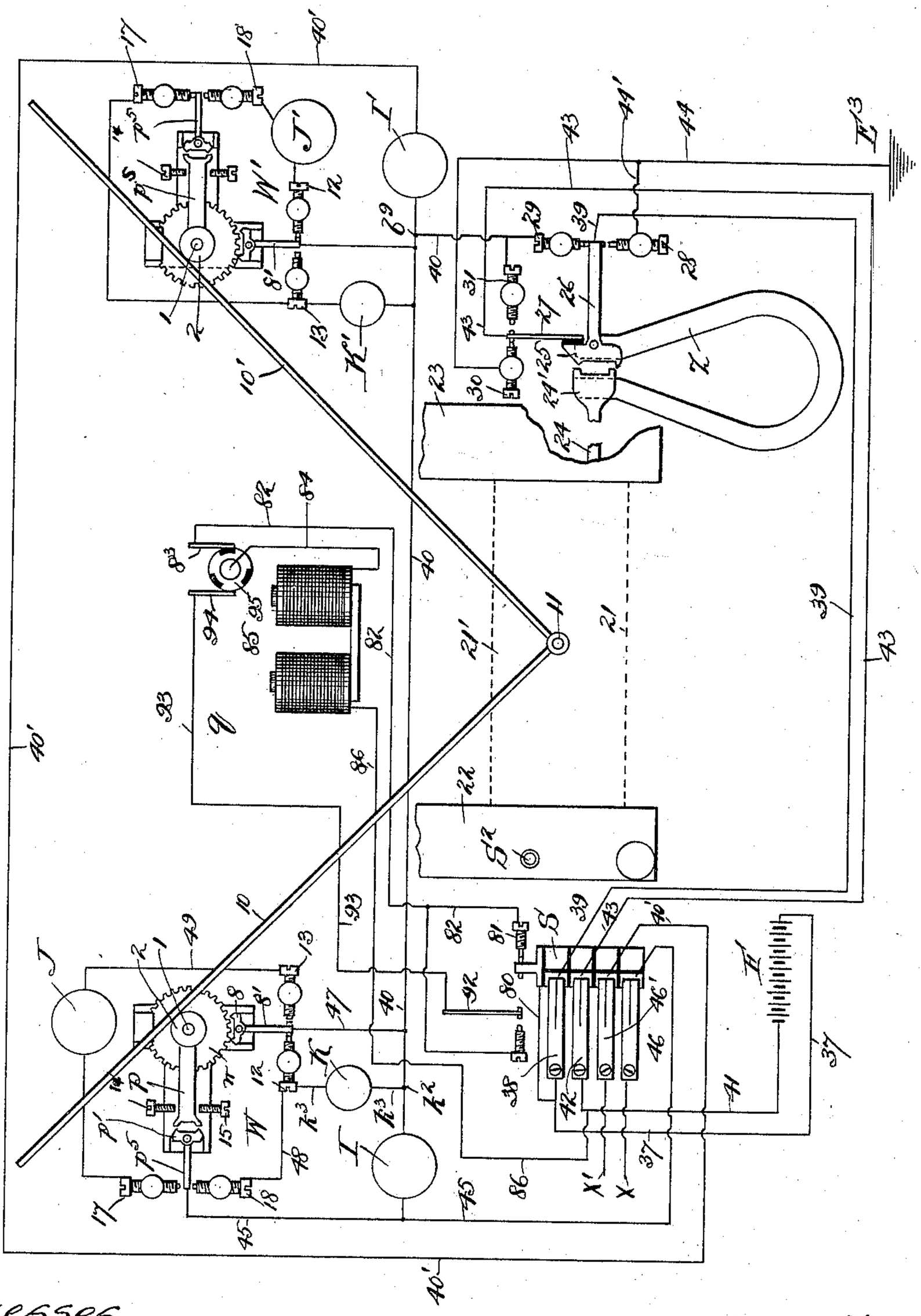

Fig. 4.

Witnesses
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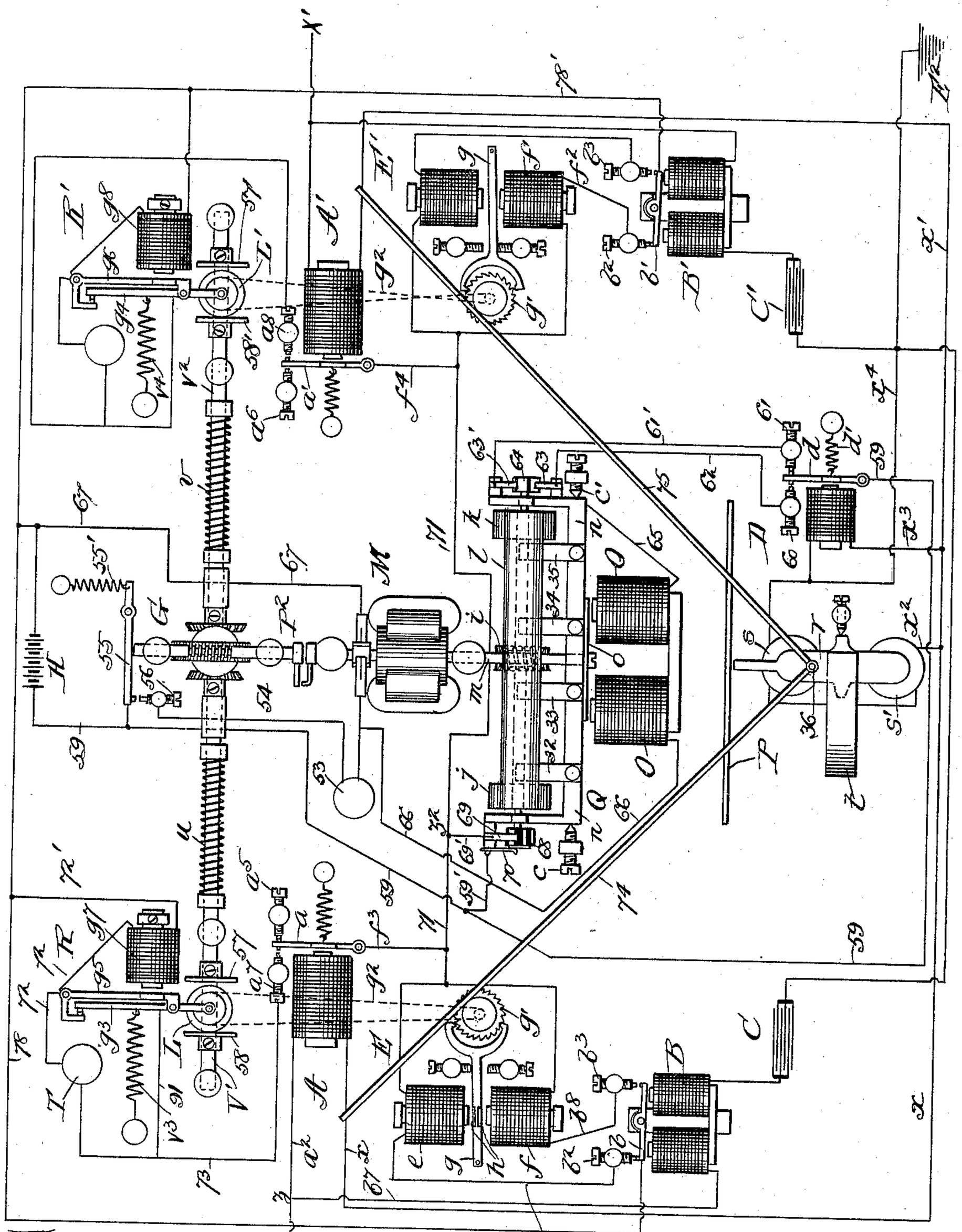
TELAUTOGRAPH.

(Application filed Mar. 13, 1897.)

(No Model.)

4 Sheets—Sheet 3.



Witnesses
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Fig. 5.

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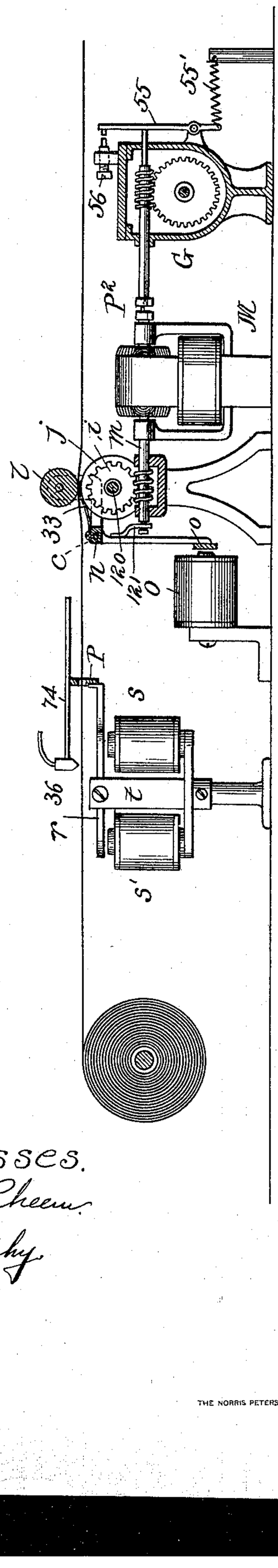
TELAUTOGRAPH.

(Application filed Mar. 13, 1897.)

(No Model.)

4 Sheets—Sheet 4.

Fig. 8.



Witnesses.
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F. W. Murphy.

Inventor
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UNITED STATES PATENT OFFICE.

LEON O. MCPHERSON, OF HIGHLAND PARK, ILLINOIS, ASSIGNOR TO THE GRAY EUROPEAN TELAUTOGRAPH COMPANY, OF CHICAGO, ILLINOIS.

TELAUTOGRAPH.

SPECIFICATION forming part of Letters Patent No. 610,274, dated September 6, 1898.

Application filed March 13, 1897. Serial No. 627,443. (No model.)

To all whom it may concern:

Be it known that I, LEON O. MCPHERSON, a citizen of the United States, residing at Highland Park, in the county of Lake and State of Illinois, have invented a new and useful Improvement in Telautographs, of which the following is a specification.

This invention relates to telautographs, and particularly to that class of autographic sign-telegraphs wherein a recording-pen is caused to trace upon a suitable surface characters in facsimile of and simultaneously with similar characters traced by the hand of the operator at a distant point, wherein the reproducing movement is a resultant of two forces acting at substantially right angles to each other upon a single point, and wherein the progression of the two forces acting upon the single point is regulated in extent by successive electric impulses of varying strength and varying in number according to the distance moved, and is regulated in direction by additional variations of the current strength of the successive impulses which control such progression.

The object of the invention is to simplify and improve the construction and arrangement of devices and apparatus for effecting telautographic communication between two distant points or stations connected by suitable line-wires and to render the same more accurate, more speedy, and more perfect in operation.

The invention consists, substantially, in the construction, combination, location, and relative arrangement, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference signs appearing thereon, Figure 1 is a view in front elevation, showing the disposition and arrangement of the various parts of the interrupter. Fig. 2 is a horizontal sectional view. Fig. 3 is a view in side elevation of the construction shown in Fig. 1. Fig. 4 is a view somewhat diagrammatic, showing the arrangement of transmitter embodying the principles of my invention. Fig. 5 is a view similar to Fig. 4, showing the arrangement of the receiver. Fig. 6 is a view in diagram, illustrating the operation of the polarized relay through which the receiving-pen arm is controlled. Fig. 7 is a similar view showing a slightly-modified arrangement of relay. Fig. 8 is a sectional view taken transversely of the record feed-rollers.

I will first describe the mechanical construction and arrangement of apparatus shown and afterward describe the joint operation of transmitting and receiving.

In my Patent No. 587,013, dated July 27, 1897, I have shown, described, and claimed certain forms and arrangements of apparatus for the purpose of securing autographic reproduction at a receiving instrument distantly located with respect to a transmitting instrument, but connected thereto by means of two line-wires. Certain features of such prior application are also made use of and will be referred to in this application—such, for instance, as the combining of the two instruments—namely, the transmitter and receiver—of each station upon the same base and inclosed by a single case, the overlapping of the two sets of pen-arms, the reversing mechanism, the force-pump attachment for the inking system, the form of pen-rest, and the locking and releasing arrangement connected with the switching system of the transmitter. These several parts, therefore, being fully and completely described as to their construction, function, mode of operation, and coöperative relation in my said prior application, do not require specific illustration and description herein.

By reference to Figs. 4 and 5 of the drawings it will be seen that certain parts of the instrument, and particularly the parts or devices concerned in effecting the movements of the two sets of pen-arms, are duplicated on opposite sides of the instrument—that is to say, certain of the parts or devices connected with and concerned in the operation of one member of each set of the pen-arms are identical with the corresponding parts or devices connected with and concerned in the operation of the other member of the same set of pen-arms on the opposite side of the instrument. In this specification, therefore, I will specifically describe in detail the arrangement of parts and devices only on one side of the instrument, but will point out the

operation and joint function of all the like parts or devices.

In the drawings, Fig. 4, I have shown at W W′ the circuit-controlling apparatus of the transmitter, known technically as the "interrupter," to which are connected the pen-arms 10 10′, said arms being arranged at substantially right angles with respect to each other and which at their junction carry the transmitting style or pencil 11. That portion of the interrupter which effects a transmission of the impulses by which the movements of progression of the pen-arms of the receiver at the distant station are secured is substantially the same as the construction and arrangement set forth in the patent to Elisha Gray, No. 491,347, dated February 7, 1893. In the patent referred to, however, the construction and arrangement are designed for use where four line-wires are employed connecting the transmitter and distant receiver. The portion of the mechanism for controlling the direction of the movements of progression of the pen-arms at the receiving-station, and which mechanism is known technically as the "Prony brake," of the form and arrangement shown in said patent, is sufficient for the purpose and answers the requirements of a four-line system; but when all the movements of the receiving-pen arms are to be secured through a two-wire system, as contemplated in the present invention, such form of Prony brake is insufficient and ineffective. Various expedients have been resorted to and various modifications and changes and alterations in the details of construction and arrangement of the mechanism for controlling the currents which govern the direction of the movements of the receiving-pen arms have been devised and employed with a view to adapting the Prony brake to a two-wire system and to aid and supplement it in the performance of its functions. In my Patent No. 585,319, dated June 29, 1897, I have shown such an expedient in this connection, which admirably answers the purpose; but such arrangement as set forth in my said patent unnecessarily complicates the construction and increases the initial cost, as well as the maintenance, of the apparatus. I have therefore in the present case shown and will now describe some material alterations and improvements in this feature of the apparatus in the adaptation thereof to a two-wire system, particular reference being had to Figs. 1, 2, and 3, wherein reference sign 7 designates a suitable brass framework in which are mounted the oppositely arranged and alined screws $7'$ 7^2, forming screw-point bearings for shaft 1. Mounted upon shaft 1 to revolve therewith is the pen-drum 2, and also mounted on said shaft is a toothed wheel *w*. Suitably supported upon the framework 7 is an iron yoke or heel piece 6, upon which are suitably mounted the permanent magnets 3, 4, and 5.

Reference sign 8 designates a magnetic pallet arranged to operate in connection with toothed wheel *w* and to which is connected pallet-lever 8′, the outer or free end of which is arranged to operate between the adjustable contact-limiting screws 12 13. The magnetic anchor or pallet 8, the pallet-lever 8′, toothed wheel *w*, magnets 3 and 5, yoke 6, and contact-limiters 12 13 constitute that portion of the interrupter which is employed for sending the impulses by which the movements of progression of the receiving-pen arms are secured and are essentially the same as the corresponding parts for the same purpose set forth in the patent to Gray, No. 491,346, dated February 7, 1893. The Prony brake, by which the direction of the movements of progression of the receiving-arms is controlled and which is indicated in the drawings at *p*, Figs. 1, 2, and 3, and which embodies in its construction and arrangement and coöperative relation the principles of modification, alteration, and change constituting my present invention and improvement over the prior art in this feature of the apparatus, consists of a metallic lever of suitable magnetic material, said lever being bifurcated at the inner end thereof and the legs of such bifurcation being arranged to straddle the wheel *w* and to be in close proximity thereto in order to be influenced magnetically thereby for a purpose presently to be more fully explained. At its inner end the Prony brake-lever is provided with the friction clamp-jaws p^2 p^3, by which said lever is frictionally engaged with shaft 1, a screw 16 or other suitable means being employed to adjustably regulate the degree of friction by which such engagement is effected. The outer end of lever *p* is formed with the sharp corners or teeth p^4, similar to the teeth of wheel *w*, and for this purpose said outer end of the lever is made of a suitable width to accommodate said corners or teeth, as clearly indicated in Fig. 2, and said teeth or corners are presented to a magnetic pallet *p*′, identical in its details with the pallet 8, above described. The lever *p* is arranged to vibrate between the adjustable limiting stops or contacts 14 15. The pallet *p*′ is provided with a lever p^5, which is arranged to play between the adjustable limiting stops or contacts 17 18. Magnet 3 carries at its upper end a pole-piece 19, of magnetic material, upon which is supported a non-magnetic frame 20, and upon the latter is carried the shaft of pallet 8 and pallet-lever 8′ and also the insulated adjustable limiting-contacts 12 13. Pallet *p*′ and its lever p^5 are similarly mounted with reference to permanent magnet 4. The upper end of magnet 5 is grooved or slotted across the inner face thereof, as clearly indicated in Fig. 3, and in which slot is adapted to be received a portion of the periphery of wheel *w* without establishing mechanical contact between said wheel and magnet. Magnets 3 and 4 are of the same polar

sign at their upper ends, while magnet 5 at its upper end is of the opposite polar sign with respect thereto.

From the foregoing description of the nature and arrangement of the parts it will be seen that by reason of the relative arrangement of the wheel *w* and magnet 5 the former is magnetized by the latter and an attractive force is set up between said wheel *w* and pallet 8, which latter is magnetized by reason of the proximity thereto of magnet 3 of opposite polarity with respect to magnet 5. It will also be seen that by reason of the close proximity to wheel *w* of the two legs of the bifurcated Prony brake-lever *p* said lever is under the influence of magnet 5 of one polarity and at its outer end magnetic attraction will be exerted between said lever and the magnetic pallet *p'*, which is under the influence of magnet 4 of an opposite polarity. If under these conditions lever *p* be rocked against stop 14, for instance, lever p^5 will be drawn against its contact or stop 17 under stress of the increased magnetic attraction between lever *p* and that limb or portion of pallet *p'* which is nearest stop 14. On the other hand, should lever *p* be moved against its limiting-stop 15, a decrease of the magnetic attraction upon the first-named limb or portion of pallet *p'* results with a corresponding increase of the magnetic attraction on the other limb or portion of said pallet *p'*—namely, that limb or portion nearest stop 15—thereby effecting a rocking of pallet-lever p^5 against its limiting-contact 18. Thus it will be seen that the pallet-lever p^5 never moves except to make a complete excursion from one of its limiting-contacts to the other, and such movements are always at the same speed and occupies the same interval of time in crossing the space between said limiting-contacts. This is a most important advantage over the prior constructions and arrangements for controlling the direction-of-progression currents of the prior art, for the reason that in such prior constructions and arrangements the movement of the Prony brake-lever corresponding to lever p^5 between its limiting-contacts is directly related to the movements of the hand of the operator, and may therefore be slow or rapid or may at certain periods of the operation occupy an intermediate position between its limiting-stops and out of contact with both, thereby seriously deranging the current scheme for effecting the proper operation of the other functions of the apparatus. Such derangement is impossible in my present arrangement, and still the lever *p* follows the movements of the hand of the operator, as will appear more fully hereinafter.

I will now describe the construction and arrangement of parts constituting the transmitter, afterward pointing out and explaining the various electrical operations that take place therein, particular reference being had to Fig. 4.

The platen of the transmitter, over which is moved the paper upon which the operator inscribes the message, is arranged between the brackets 22 23, the upper and lower, or, rather, the rear and front, edges of said platen being indicated by the lines 21' 21, respectively. This platen is of the usual form as employed in telautograph or writing telegraph-machines, and is hinged at its rear edge in the usual or any well-known or convenient manner, and rests at its front edge upon the inner end of a lever 24, pivotally mounted intermediate its ends underneath said platen and its outer end yieldingly held at its lower limit of movement by means of a spring (not shown) in the usual and well-known manner in this art. The bracket 23 is broken away in said Fig. 4 to disclose a view of the outer end of this lever. The outer end of said lever 24 carries a magnetic metal extension or head 24', which when the lever is rocked, as will presently be apparent, has a limited vertical movement. For the sake of clear illustration of this feature of my invention, however, I have shown said head arranged horizontally to operate in a horizontal plane, and therefore said head is shown as broken off from the end of lever 24, it being understood that in use said head moves vertically or at right angles to the plane of movement thereof, as indicated in this figure of the drawings. Arranged in proximity to the magnetic head 24' of lever 24 and in coöperative relation with respect thereto is a magnetic pallet 25, similar in principle, function, and mode of operation to the pallets 8 and *p'* above described with reference to the interrupter W W'. The pallet 25 is provided with a rigid lever or arm 26, having its outer or free end arranged and adapted to play or vibrate between the adjustable limiting-contacts 28 29. The pallet 25 also carries an insulated spring-lever 27, having the free end thereof arranged to play or vibrate between the adjustable limiting-contacts 30 31. A permanent magnet Z has the two poles thereof so relatively arranged with respect to the magnetic head 24' and the magnetic pallet 25 that said head and pallet are magnetically affected by poles of opposite polarity. From this description it will be readily understood that when the operator places the style or pen 11 upon the paper carried by the transmitter-platen in order to inscribe a message or character the spring by which the lever 24 is supported is overcome, thereby causing said lever to be rocked by the pressure on the platen of such style or pen, and hence moving the magnetic head 24' upwardly. This movement varies the magnetic attraction to which the pallet 25 is subjected, the magnetic attraction on the upper corner or limb thereof increasing and that on the lower corner or limb thereof decreasing, thereby rocking said pallet, and hence moving the rigid lever 26 into contact with its limiting-contact stop 29, and also moving the spring-lever 27 into contact with its limiting-stop 30. Similarly when pressure by the operator upon the platen

through the style or pen 11 is removed the spring supporting-lever 24 causes said lever to rock to its opposite limit, thereby reversing the above operation and causing the levers 26 and 27 to respectively contact with their limiting-contact stops 28 31.

In my before-mentioned patents, Nos. 587,013 and 585,319, I show and describe a construction, arrangement, and mode of operation of master-switch through which the shifting of the paper is controlled at both ends of the line and for locking such switch in "receiving" position and for releasing and moving such switch to the "transmitting" position. In the present instance I retain substantially the same features of arrangement, except that I construct the switch of a single movable block carrying the contact-pieces, as clearly shown in Fig. 4, instead of two separate blocks, as in my prior constructions; but I still adhere in the present case to substantially the same locking and releasing arrangement of my prior constructions with such obvious changes or modifications as would be readily apparent to one skilled in the art to adapt such devices to the single-block switch.

The paper-shifter for effecting the proper movements of the paper is indicated somewhat diagrammatically at *q*, Fig. 4, and more in detail of construction and arrangement at Q, Fig. 5, and consists, essentially, of a frame *n*, suitably pivoted at *c c'*. Suitably journaled in this frame is a roller *l*, arranged to extend across the full width of the paper and having its journals arranged to project beyond the frame at both ends thereof, as clearly shown. Upon one of such projecting journals—namely, the one arranged at the right-hand end of such roller, as viewed in Fig. 5—is mounted a circular disk 64, which I shall designate the "shifter-commutator." This commutator, together with the contact brushes or springs 63 63', regulates the distance through which the paper is advanced in a manner presently to be more fully explained. Upon the other or left-hand end or journal of roller *l* is mounted a disk 68, similar to disk 64. The function of this commutator is to control the battery connections of the magnets of the escapements E E' and also to control the battery connections of the magnets of the reversing mechanisms R R' at the proper time for unifying the relative positions of the receiving and transmitting pens, and I therefore designate this commutator as the "unison-commutator." As above stated, this commutator is insulated from roller *l*, and a collector-brush or contact-spring 70 is arranged in continuous contact therewith, and a second collector-brush or contact-spring 69 is arranged to bear alternately upon an insulation-segment or a conducting-segment, of which said commutator is composed, according as it is desired to break or close the battery connections referred to. The paper is held to the roller *l* by means of flat springs 32 33 34 35, between which springs and the under surface of such roller the paper is held and advanced at the proper time. In suitable supports immediately beneath the roller *l* and arranged parallel therewith is journaled a shaft 120, upon which at points adjacent to the respective ends of the roller *l* are mounted suitable paper-feed rollers *j k*. These rollers *j k* are provided with broad peripheral faces, which are roughened or corrugated after the manner of the ordinary paper-feeding rolls of embossing telegraph-registers. The shaft upon which said feed-rolls *j k* are mounted is rotated by motor M through suitable gearing—as, for instance, through constantly-intermeshing gears *i*, respectively mounted on the shaft *m* of the motor and the shaft carrying said feed-rolls *j k*. From this construction and arrangement it will be seen that the feed-rolls *j k* are rotated coincidently with the actuation of motor M and that when such motor is actuated all that is required in order to effect the feeding of the paper forward is to depress the frame in which the roller *l* is mounted and to which the paper is held by the springs 32 33 34 35 until the paper is pressed firmly against the peripheries of rolls *j k*, the direction of rotation of such rolls being predetermined. The roller *l*, carrying the paper, is normally held a sufficient distance above the rotating rolls *j k* to prevent the paper from touching said rolls. This may be accomplished in any suitable manner, as by means of a suitable spring (not shown) suitably attached to an arm projecting downwardly from the frame *n* and which carries the electromagnet-armature *o*. The coils O O, of which the part *o*, attached to the frame *n*, is the armature, are so placed relative to said armature that when energized by the passage of a current therethrough said armature is attracted by a force sufficient to overcome the tension of the retracting-spring, thereby rocking frame *n* in a direction to press the roller *l*, or, rather, the sheet of paper carried thereby, down upon feed-rolls *j k*.

It will be remembered that in a combined transmitter and receiver but one paper-shifter is used, and therefore the foregoing description applies as well to the shifting mechanism of the receiver as for that of the transmitter, for the sake of clearness of description and illustration the transmitting and receiving arrangements being indicated in different views of the drawings.

The pen-arms 74 75 of the receiving instrument, and which arms are arranged similarly to the transmitting-pen arms 10 10, above described, and which carry at their junction the receiving pen or style 36, are supported upon the pen-rest P when it is desired to move the receiving pen or style over the paper without marking. This pen-rest is actuated in a vertical plane by means of an electromagnetic combination consisting of an armature *r*, pivoted centrally above the polar projections of electromagnets *s s'*. A permanent magnet *t*

is arranged to present its upper end in close proximity to the central upper surface of armature *r*, while the lower end of said magnet is attached to the heel-iron or yoke by which the magnets *s s'* are united and supported.

The escapements E E' may be of the same general form and arrangement as have heretofore been commonly employed in this art for the same purpose. The construction and arrangement are identical on both sides of the instrument, and therefore I will only briefly refer to the construction and arrangement of escapement E, the same description applying also to the construction and arrangement of escapement E'. This escapement consists of a toothed wheel and anchor, the engaging portions of which permit of rotation in reverse direction in the usual manner. The anchor is mounted in the end of a lever *g*, which carries or is supplied on opposite sides thereof or in any suitable or convenient location with two light armatures *h*, respectively arranged in front of and in coöperative relation with respect to the poles of electromagnets *e f*. This arm *g* is moved to and fro between its limiting-stops by alternately energizing said magnets *e f*. The alternate energization of these magnets, and hence the movements of the escapement-levers, are controlled through the relay-electromagnets B B', which relays I designate the "escapement-relays." These relays are of substantially the same construction and arrangement. The exact form and arrangement are immaterial, so long as the armature-lever *b b'* of such magnets responds readily to changes in the direction of current through the magnet-windings—that is, I employ in this regard polarized relays, the armature-levers *b b'* being alternately rocked into contact with the limiting-contacts b^2 b^3, according to the direction of the flow of current. Many different arrangements may be devised to secure the desired and proper reversals of the direction of flow of the impulses of current through windings of the magnets of the polarized relays B B', whereby the armature-levers *b b'* are caused to oscillate or vibrate in a suitable manner toward and from the respective limiting-contact stops b^2 b^3 in order to control the circuits of the magnets which regulate the excursions of the escapement-lever *g*, as will appear more fully hereinafter in the description of the electrical action and function of the apparatus. In Fig. 5 I have shown at C C' suitable condensers or Leyden jars of the type commonly used in telegraph-work and suitably arranged in the circuit of the windings of the polarized relays B B' as one form of means adapted to the purpose of suitably reversing the flow of the impulses of current through the windings of the polarized relays B B', as above mentioned. This same object may be accomplished in many other ways. For instance, as indicated in Fig. 7, I may employ in lieu of the Leyden jar C a common Faradic or induction coil A^5. This coil occupies the same relation in this modified arrangement as the relays A A' in the above-described arrangement—that is, the primary windings of such induction-coil are included in circuit with the line-wires, the secondary windings being included in circuit with the windings of polarized relays B B'. From this it will be seen that when a current is flowing through the line-wire and is interrupted or its strength changed induced currents are temporarily produced in the secondary, which flow through windings of relays B B' in reverse directions, according as the primary current is increased or decreased in strength. I have found this form of embodiment of my invention efficient for the purposes desired; but I prefer the condenser arrangement above described because of the influence exerted by said condenser upon the relay D.

The pen-arms 74 75 of the receiver are actuated from the shaft of the escapement-wheel *g'*, and a rotative tension is imparted to said shaft through a belt or other suitable connections (indicated by dotted lines at g^2, Fig. 5) from the shaft of friction disks or wheels L L', presently to be more fully described. The direction of the rotative tension imparted through said belt or other connection g^2 to the shaft of the escapement-wheel *g'* is controlled electrically through the reversing mechanism R R', presently to be described, by means of relays A A', and which by reason of their function I designate the "reversing-relays." These relays comprise ordinary neutral or Morse relays, depending upon the strength of current flowing through the windings of the magnets thereof independent of polarity for the performance of their proper function.

The reversing mechanism R R', by which the direction of application of the rotative tension imparted to the shaft of escapement-wheel *g'* is controlled, is substantially the same in the essential features thereof as that set forth in my Patent No. 587,013 for the same purpose, and therefore in the present application it is necessary to give only a brief description of the construction and arrangement thereof in order to impart a full understanding herein of the operations of such mechanism in conjunction and coöperation with the other parts of the apparatus. The friction-disks L L' are carried in the free ends of supplemental levers g^3 g^4, which are secured to, but insulated from, the pivotal armature-levers g^5 g^6, respectively, of the electromagnets g^7 g^8, so that said friction-disks may vibrate between the disks 57 58 57' 58', mounted on the shafts v' v^2. The disks L L' are normally held pressed against the disks 58 58', respectively, by means of the retractile springs v^3 v^4, which springs normally hold both the supplemental levers g^3 g^4 and also the armature-levers g^5 g^6 away from the electromagnets g^7 g^8, respectively, and the disks L L' with sufficient force against the disks 58 58' to prevent

rotation of said disks 58 58′, except when permitted to be moved by the release of the escapement-wheels g', when the anchors g are actuated, and similarly the levers g^3 g^5 or g^4 g^6 are not moved under the attractive force of the electromagnets g^7 g^8 until the coils of said magnets are energized by a current of sufficient strength to cause the retractiles v^3 v^4 to be overcome, thereby effecting a movement of the disks L L′ against the disks 57 57′ with sufficient force to prevent the rotation of said disks 57 57′, except when permitted by the actuation of the escapement-anchors g. It will be understood that the gearing connecting the disk L with the shaft of escapement-wheel g' on one side of the apparatus is substantially the same as that on the other. A rotative tension is imparted to shafts v' v^2, upon which disks 57 58 57′ 58′ are mounted, through the gearing G, which has been called in this art the "equalizing-gear," and this rotative tension reaches the escapement-wheels g' through the connections above explained. The equalizing-gears G are actuated by suitable gearing from the shaft of the motor M, and a torsion-spring u v connects the equalizing-gear G to shafts v' v^2, respectively, in the usual manner.

In practice I prefer to pivotally connect the supplemental levers g^3 g^4, at points intermediate but adjacent to one of the ends thereof, to the free ends of armature-levers g^5 g^6, thus leaving the ends of said supplemental levers g^3 g^4 disconnected and free. Retractile springs v^3 v^4 are arranged to act upon said supplemental levers g^3 g^4 at points midway the ends of said supplemental levers, said springs normally acting in a direction to press disks L L′, respectively, against disks 58 58′ when magnets g^7 g^8 are deënergized and in a direction to press said disks L L′, respectively, against disks 57 57′ when said magnets are energized to attract the armature-levers.

In order to reduce the magnetism of the cores of the magnets g^7 g^8 to a point such that the attractive force exerted thereby upon the armature-levers and supplemental levers will just retain the armature-lever in proper position and permit the instant movement of said levers under the influence of the retracting-springs v^3 v^4 when such attraction of the magnet ceases, as by a complete cessation of the flow of current through the magnet-windings, I introduce in series with the circuit of said magnet-windings a resistance T an instant before the armature-levers strike the magnet-cores by the separation of such armature-levers from their respective supplemental levers, which separation is caused by the rocking of the supplemental levers about their point of pivotal connection with the armature-levers.

The amount of torsion imparted to the springs u v is regulated electrically through the spring-balanced contact making and breaking lever, which controls the circuit of motor M in the usual manner of the prior art.

In order to prevent excessive winding of the springs u v during the operation of the paper-shifting apparatus, I provide a pin and tooth carrier coupling between the motor-shaft m and the shaft of the worm-gear of equalizing-gear G, whereby an endwise movement of either of said shafts effects a disengagement of such coupling. Such endwise movement of the motor-shaft may be conveniently accomplished by suitably connecting the armature o of the magnets O O to the motor-shaft, as at 121, Fig. 8, whereby the shaft and armature of motor M may be moved by the pull of the magnets O O upon said armature o when the coils of said magnets are sufficiently energized, whereby the rotation of such motor may continue without driving the worm-shaft of gear G.

Reference sign D designates a suitable relay for controlling the circuits of the paper-shifting mechanism Q. The armature d of this relay is normally held away from the pole of such relay by a very slight spring d', the tension of which may be readily overcome, and said armature d plays between the limiting contact-stops 60 61. The coils of the electromagnet D and of the pen-rest magnets s s' are arranged in parallel series with the two line-wires coming from the distant station. Said line-wires X X′, after dropping branches through the coils of the escapement-magnets B B′ to the condensers C C′ and thence through connection x^4 to ground, pass through the coils of relays A A′ and unite in a common wire x x', which is connected through the wires x^2 x^3 to the coils, respectively, of magnets s s' and of magnet D, said connections x^2 x^3 finally uniting and being connected to earth, as at E^2, through connection x^4. The magnets s s' of the pen-rest apparatus are so constructed as to have considerable self-induction, while the relay-magnet D is so constructed as to have as small a self-induction as is possible. From this arrangement it will be seen that the magnets s s' and D are respectively acted upon alike by currents arriving from the distant station over either of the line-wires reaching their respective windings. It will also be seen that the armature d will be attracted by the weakest current arriving from the distant station over either of the line-wires X X′. It will also be seen that when a complete reversal in direction of flow of the arriving current, which would ordinarily cause a gap of neutrality in the cores of relay D sufficient to permit the armature d of such relay to be moved against its limiting back-stop 61, under the influence of the weak retractile d', does not permit the said armature d to fall away from the core of such magnet D, by reason of the counter electromotive force set up by the self-induction of magnets s s' toward such relay D, and which counter electromotive force is sufficient to instantly destroy such neutrality in the core of relay D, or to bridge over the gap formed therein

whenever the direction of current is reversed, the magnets *s s'* being so constructed and arranged that the self-induction thereof sets up a sufficient counter electromotive force to overcome the retractile *d'*, and hence prevent the armature *d* from falling or moving away from the core of magnet D during such reversal in the direction of flow of the current sufficient for such armature to contact with its back limiting-stop 61, said armature being permitted a movement to contact with such back-stop only when there is an entire cessation of flow of current through the line-wires.

I will now describe the conjoint operation of the several mechanisms above referred to, and as the action of the two halves of the apparatus connected, respectively, by the line-wires X X' are essentially identical I will confine my description to the action of the parts on the left-hand side, except where the conjoint action and operation of the parts of the apparatus on both sides is necessary to the attainment of the desired results and functions.

In the drawings, Fig. 4, the master-switch S is shown in the proper position for transmitting a message. A battery F, consisting of a suitable or desirable number of elements for the purposes required of it, supplies the current for throwing into action the several parts. The positive pole of the battery F is connected through wire 37 to contact-spring 38, switch-block S, wire 39, lever 26, contact-limiter 29, wire 40, and with lever 8' contacting with limiting-stop 12 and lever p^5 contacting with limiting-stop 17 the current passes from wire 40 through a resistance I, which in practice should contain a suitable ohmic resistance—say, for illustrating purposes, eight hundred ohms—to wire 45, thence to switch-block S, contact-spring 46, and to line-wire X. Now, supposing the arrangement illustrated in Fig. 5 is the receiving instrument of a distant station, I will proceed to trace the current, which, according to the above explanation, arrives from the transmitting-battery through the various circuits above mentioned and the line-wire X. At the receiving-station, Fig. 5, the current enters through line-wire X, passes through wire a^2, the coils of the relay-magnet A, wire *x*, connections x^2 and x^3, and the coils of magnets *s s'*, and relay-magnet D, in parallel, and connection x^4 to earth at E^2. Referring back to the apparatus and arrangement at the sending-station, as indicated in Fig. 4, it will be seen that the current from battery F, after traversing the path described to the lever 26 and stop 29, passes thence to wire 40. At the point b^9 the current divides, part passing on through the resistance I, and thence, on as above pointed out, the other part tracing a similar circuit on the right-hand side, thence through connection 40' to line-wire X'. This portion of the battery-current enters the receiving instrument at the distant station, as indicated in Fig. 5, through line-wire X' and traverses a path on the right-hand side of the apparatus similar to that above described with respect to the left-hand side of the apparatus, finally finding earth at E^2. From this it will be seen that current from both line-wires X X' simultaneously enters the coils of magnets *s s'* and of relay-magnet D and which is sufficiently strong to cause the armature *d* of relay-magnet D to be attracted by said magnet, thereby breaking circuit between said armature and the limiting-contact 61 and establishing circuit between said armature and the limiting-contact 60. These arriving currents just referred to are also of sufficient strength to sufficiently energize the magnets *s s'* to cause the pen-rest P to be elevated, so that the pen 36 cannot mark upon the paper. This arrangement of circuits is advantageous for the reason that it secures the positive operation of the pen-rest magnets *s s'* through the combining of the weak currents, either of which alone is insufficient.

The local action in the receiver, due to the closing of the circuit between armature *d* and limiting-contact 60, effects a completion of the circuit of a local battery H, Fig. 5, located at the receiving-station, as follows: from the positive pole of such battery through wire 59, armature *d*, limiting-contact 60, wire 62, brush-spring 63, commutator 64, frame *n*, wire 65, the coils of magnets O O, wire 66, the windings of motor M, and thence to the negative pole of battery H. The effect of the completion of this circuit is to cause the magnets O O to attract the armature *o*, thereby rocking frame *n* downwardly, thereby pressing the paper, which is held to roller *l* by springs 32 33 34 35, tightly down upon the peripheries of the feed-rollers *j k*. At the same time the rotation of the armature of motor M thus insured causes the gearing *i* to effect a rotation of the shaft upon which the feed-rollers *j k* are mounted, and hence the paper is advanced and roller *l* is revolved, and with it commutator 64 is also revolved a sufficient distance for the spring-brush 63 to be removed from a conducting-segment and to rest upon an insulation-segment of said commutator, thereby breaking the above-described local-battery circuit after the paper has been advanced a predetermined step, dependent upon the relative size and arrangement of the segments of commutator 64. The breaking of this circuit, as above indicated, causes the armature *o* to be relieved of the magnetic attraction exerted thereon by the electromagnets O O, thereby permitting the frame *n* to again rise under the influence of the spring above referred to and which is not shown in the drawings, and this movement of frame *n* also elevates roller *l* and springs 32 33 34 35, carrying between them the paper, which is thereby carried out of contact with the feed-rolls *j k*, which thereafter may or may not rotate so far as this particular cycle of operation is concerned. If at the begin-

ning of the operation above described the governing-lever 55 is in contact with the limiting-stop 56, then a motor-circuit will be established as follows: from the local battery H, through wire 59, lever 55, contact 56, wire 54, resistance 53, the motor-windings, and thence back to battery H through wire 67. Hence the rotation of the shaft upon which are mounted the paper-feed rolls *j k* may continue after the paper-carrier is elevated out of contact therewith. The motor continues to revolve, thereby adding torsion to the springs *u v*, until finally the increasing pressure of the worm-shaft of gear G upon said lever 55 overcomes the spring 55′, by which said lever is normally held in contact with the limiting-stop 56, thereby breaking the motor-circuit through this lever and contact. The attraction of the armature *o* by the electromagnets O O, as above described, effects a longitudinal movement of the motor armature and shaft, and hence a breaking of the coupling P^2, by which the motor-shaft is coupled to the worm-shaft of gear G, thereby arresting the addition of torsional tension to springs *u v* by arresting the rotation of such worm-shaft. Hence in either case an undue winding of springs *u v* is provided against. In order that the battery-current may not be short-circuited through the lever 55 and the motor-windings back to the battery when said lever 55 is in contact with limiting-stop 56, thereby preventing the energizing of magnets O O from performing their proper functions whenever it may be desired to effect a shifting or advancement of the paper with said lever 55, contacting with said stop 56, I interpose in the said lever-circuit a sufficient resistance 53 to insure the flow of current through the windings of magnets O O whenever the circuits of said magnet-windings are closed.

The movement of the paper-shifter above described constitutes what is known as a "half-shift"—that is, the paper is advanced thereby approximately only one-half the space of a line of writing, and the shifting mechanism remains in this position during the succeeding operation of recording the transmitted message by the receiving-pen and until the operator at the distant station desires to again advance the paper, as will presently be explained. When the paper-shifting roll *l* began its rotation to advance the paper the half-step above explained, the brush 63 of commutator 64 rested upon a conducting-segment of such commutator, while the spring 69 of the commutator 68 at the opposite end of the roller *l* rested upon a non-conducting or insulation segment of such commutator 68; but at the completion of the half-shift rotation of roller *l* above noted the reverse of these conditions exists and the local-battery circuit is broken between the spring 63 and its commutator 64; but current from local battery H finds a path from such battery through wire 59, wire 59′, spring-contact 70, commutator 68, brush 69, wire 69′ to point z^2 of wire 71, where the current divides, the current on the left-hand side of the apparatus passing through the coils of magnet *e* of the escapement E, wire e^2, escape-relay-contact stop b^2, armature *b*, wire 78 to battery H. The other part of the current passes through wire 71 to the apparatus on the right-hand side of the instrument through the coils of escapement-magnet *f′*, connection f^2, escapement-relay-limiting stop b^2, armature *b′*, and returning to battery H through wire 78′. The armature-levers *a a′* of the magnets of relays A A′ are also in electrical connection with wires 71 through wires f^3 f^4; but under the conditions above named said levers are in contact with their back-stops a^5 a^6, the line-current entering the apparatus at the receiving-station at this stage of the operation over the line-wires X X′, and which, as above pointed out, flows through the coils of reversing-relays A A′, being of a strength insufficient to effect an attraction of said armature-levers, so as to move the same into contact with the limiting-stops a^7 a^8, and hence under the conditions above named no current flows through the wires f^3 f^4.

With the parts in the position above described I now return to the transmitter.

The operator at the transmitting-station begins to move the transmitting-pen 11 outwardly, thereby lengthening the distance between pen 11 and the interrupter W. This movement effects a rotation of the pen-drum 2 and shaft 1, thereby rocking lever *p* through the frictional engagement of said lever with said shaft, said lever being rocked against its limiting-stop 14. The lever p^5 responds to the rocking motion imparted to said lever *p* through the magnetic attraction exerted by said lever *p* upon the magnetic pallet *p′*, whereby the lever p^5 is rocked into contact with the limiting-stop 18. This contact establishes a new condition of line-current, as follows: The current from battery F flows to wire 40, as before explained, thence instead of passing through the high resistance I, as above explained, it finds a short path through wire 47, lever 8′, limiting-contact 12, wire 48, limiting-contact 18, lever p^5, wire 45, switch-block S, spring 46, and line-wire X. Thus by shunting around the high resistance I it will be understood that a current of greatly-increased strength is sent over the line-wire. This current of increased strength arriving at the distant receiving-station divides at the point *z*, a part passing on through the coils of the escapement-relay B and to the condenser C, while the other part passes through the coils of relay A and finally finds ground at E^2, as before described. The increased strength of the current flowing through the windings of relay A effects such an energization of said magnet as to cause the magnetic attraction exerted thereby upon the armature-lever *a* to overcome its retractile and move said armature-lever into contact with

its limiting-stop a^7. This operation closes the circuit of the local receiving-station battery H, as follows: from the positive pole of said battery through wire 59, wire 59′, spring 70, commutator 68, brush 69, wire 69′, wire 71, there dividing, a part passing through the coils of escapement-magnet *e* and returning to battery H through wire 78, as above explained. Another part flows from wire 71 through wire f^3, armature-lever *a*, limiting-contact stop a^7, wire 73, wire 91, lever g^3, lever g^5, the coils of reversing-magnet g^7, wire 72′, and thence to the battery. The energizing of the coils of magnet g^7 effects a movement of lever g^5 g^3 against the action of the spring v^3, thereby pressing the disk L into engagement with disk 57, and hence through the gearing g^2 imparting a rotative tension to the shaft of escapement *g′* in a direction to rotate said shaft so as to move the receiving-pen arm 74, actuated thereby, and the pen 36, carried by said arm, an extent and in a direction corresponding to the movement originally imparted to the transmitting-pen arm 10 and pen 11. Simultaneously with the above operation the escapement-relay B is actuated in the following manner: The increased potential of the arriving current due to the removal from the circuit traversed thereby of the resistance I—say of eight hundred ohms—causes a temporary dividing of the current at the point *z* upon entering the receiving instrument, a portion passing on through the coils of relay A and on to ground at E^2, as above explained, and another portion passing through wire b^7, the coils of escapement-relay B, and into the leaves of the condenser C. This energization of the escapement-relay magnets B, which, as above explained, are polarized relays, effects a rocking of the armature-lever *b* out of contact with the limiting-stop b^2 and into contact with limiting-stop b^3, thereby breaking the circuit through the coils of magnet *e* in the local-battery circuit and at the same time completing the local-battery circuit as above traced from wire 71 through the coils of escapement-magnet *f*, wire b^8, contact-stop b^3, armature-lever *b*, and to battery H through wire 78. The breaking of the circuit through the coils of magnet *e* deënergizes said magnet, and the completing of the circuit through the coils of magnet *f* energizes said magnet. Therefore the anchor-lever *g* is relieved of attraction toward the core of magnet *e* and is attracted by the core of magnet *f*. At this instant the friction-disk L is traversing the space between its driving-disks 58 57 and toward said disk 57, and hence the escapement *g′* is relieved of a rotative tension, and hence does not rotate when released by the movement of the anchor above explained. Accordingly the anchor enters the opposite side of the escapement-wheel before the wheel L has completely reëstablished a rotative tension upon the said escapement-wheel, and any movement of the escapement-wheel when such rotative tension is reëstablished is limited to the slack or lost motion between the parts, which is inappreciable. The operator at the transmitting-station continues to move the pen-arm 10 and pen 11 outwardly, thereby continuing the rotation of shaft 1 of the pen-drum 2, and hence also of magnetic toothed wheel *w*. The continued rotation of this toothed wheel effects a rocking of pallet 8 through the magnetic attraction exerted thereon by the teeth of such wheel, which are in proximity to said pallet, thereby rocking the lever 8′ out of contact with the limiting-stop 12 and into contact with the stop 13. This movement breaks the circuit through wire 47, lever 8′, and stop 12, as above explained, and which circuit contained no resistance, and hence the line-circuit from the local battery of the transmitting-station is caused to flow again through the resistance I of, say, eight hundred ohms. At the same time an additional resistance K of, say, two hundred ohms is introduced in parallel with the resistance I (eight hundred ohms) by the current flowing from battery F to wire 40 through the above-described circuit, dividing at the point k^2, a part passing through resistance I to wire 45, and thence to line-wire X, as before described, while the other part passes through wire k^3, resistance K, (two hundred ohms,) stop 12, wire 48, stop 18, lever p^5, and wire 45 to line-wire X. By a well-known electrical law the arranging of the resistances I (eight hundred ohms) and K (two hundred ohms) in parallel in the same circuit effects an introduction of a resulting resistance of, say, one hundred and sixty ohms in the circuit of the line-current, and since this circuit in the immediately preceding step in the operation, as above explained, included no resistance the result is a fall of potential of the current arriving at the distant receiving-station. The only effect of the fall of potential in the arriving current observed at the receiving-station is in the action of the escapement E, the fall being sufficient to cause a temporary flow of current through the coils of this relay from the condenser C, thereby imparting an opposite polarity to said magnets B, and hence rocking the armature *b* to again contact with stop b^2 and out of contact with stop b^3. This action causes magnet *f* of the escapement E to be deënergized and magnet *e* to be again energized, thereby rocking the anchor *g*. At this point the ratchet *g′* is under a rotative tension, and hence the movement just described of anchor *g* permits said ratchet to rotate one-half a step or tooth. The continued movement by the operator at the transmitting-station of pen-arm 10 and pen 11 effects a continued rotation of toothed wheel *w*, the magnetic action of the teeth of which upon pallet 8 restores the lever 8′ to position contacting with stop 12, and hence thereby reëstablishing through the wire 47 lever 8′, stop 12, wire 48, and on, as above explained, the path of no resistance for the line-current, thereby in-

creasing the potential of the current arriving at the receiving-station and again causing a flow of line-current through the windings of polarized relays B, and a consequent vibration of the armature-lever b, back again into contact with stop b^3 and out of contact with b^2, and hence again breaking the local circuit of magnet e and completing the local circuit of magnet f, thus again rocking anchor g, and a consequent rotation of escapement-wheel g' another half step or tooth. The continued movement of the transmitting-pen arm 10 and pen 11 thus effects a vibration of lever 8′, and hence alternately a rise and fall in the potential of the line-current by cutting out and in the resistances I K in parallel, and hence securing a reversal of direction of impulse of current through the polarized relay B, thereby effecting a proper actuation of the anchor g to cause the escapement to perform its function of duplicating in the receiver arm and pen the advancing movement of the transmitting arm and pen. This action continues without other derangement of apparatus or circuits, except as above noted, until the movement of the transmitting-pen arm in the direction noted ceases and a reverse movement—that is, a shortening of the distance between the pen 11 and the interrupter W—occurs. This movement of pen-arm 10 causes the pen-drum 2 and shaft 1 to revolve in a direction opposite to that above described, thereby causing the frictionally-engaged lever p to be rocked into engagement with its limiting-stop 15, where it is held during the continued rotation of shaft 1 in the same direction, the said shaft being permitted a continued rotation in the direction indicated by overcoming the resistance of the frictional engagement of lever p therewith. This movement of lever p through the magnetic attraction exerted by said lever on pallet p' causes lever p^5 to rock against limiting-stop 17. Now with lever 8′ contacting with limiting-stop 13 the line-current condition is as follows: Current from the battery F passes to wire 40, as before explained. Thence it divides, a portion passing through resistance I (eight hundred ohms) to wire 45, and thence to line-wire X, and the other portion passes through wire 47, lever 8′, stop 13, wire 49, resistance J—say of eight hundred ohms—to stop 17, lever p^5, wire 45, and thence to line-wire X, as before explained. According to the electrical law before mentioned the interposition of the two resistances I J, each of, say, eight hundred ohms, in parallel in the line-circuit results in the introduction of a resulting resistance of, say, about four hundred ohms in the line-circuit, which under the precedingly-described condition contained a resistance of only one hundred and sixty ohms. The fall of potential of the line-current resulting from the increased resistance from one hundred and sixty to four hundred ohms through which such line-current is compelled to flow causes the energization of reversing-relay A to fall to such a point as to permit the retractile of armature-lever a to withdraw said lever from contact with limiting-stop a^7 and into contact with its back-stop a^5. This movement breaks the current of the local battery H through the coils of reversing-magnet g^7, and hence permits the friction-disk L, under the influence of spring v^3, acting upon levers g^3 g^5, to be moved from engagement with disk 57 and to be again pressed against the friction-disk 58, whereby a rotative tension in the opposite direction to that above described is imparted to ratchet g' through g^2, which rotative tension is exerted in a direction to remove the receiving-pen arm 74 and pen 36 in a direction to shorten the distance between the escapement E and the pen 36 and corresponding to the similar movement of the transmitting-pen arm 10 and pen 11. The fall in the potential of the line-current last above noted causes a further discharge of current through the coils of relay B to take place from the condenser C; but as the last above-described position of armature-lever b was due to a discharging impulse of current from the condenser C of course a further discharge from the condenser produces no effect upon the polarized relay B, and hence the escapement-anchor g is not disturbed from the position occupied thereby, as determined by the last position of the armature-lever b. A continued movement by the transmitting-operator of the pen 11 toward the interrupter W causes the lever 8′ to break contact with stop 13 and to make contact with stop 12, the lever p^5 remaining in contact with stop 17. The effect of this movement of lever 8′ is to break the parallel circuit, including resistance J, the shunt-circuit of no resistance being maintained open by lever p^5 being out of contact with stop 18, and hence the line-current condition is the same as at the beginning of the operation—namely, the said line-circuit includes the resistance I of eight hundred ohms. The result of this increase in resistance in the line-circuit from four hundred ohms to eight hundred ohms is a fall in potential of the line-current. Since, however, the armature-lever a of reversing-relay A has already been withdrawn by its retractile when the fall in potential of the line-current occurred by the introduction therein of the four hundred ohms' resistance above noted, of course no effect is observed in said reversing-relay by a further fall of potential of the line-current due to increasing the resistance therein from four hundred ohms to eight hundred ohms. For the same reasons no effect is produced in the polarized relay B, as only a further discharge from the condenser takes place; but this does not have any effect, for the reason that the position of armature b is that in which it was left by a discharge from the condenser, and of course a further discharge does not effect it. From this it will be seen that the half step or tooth rotation of the escapement-wheel g' which should have resulted from the

movement of lever 8′ from stop 13 to 12 is lost. However, the conditions are such that a half step or tooth rotation of such escapement-wheel g' is also lost when a reversal of the movement of progression of the pen-arm 10 occurs with lever 8′ contacting with stop 12, as above described, and as the reversals in the direction of movement of progression of the transmitting-pen arms occur indifferently whether said lever 8′ contacts with stop 12 or stop 13 the errors by loss of half-steps of rotation of the escapement-wheels g' occur about equally in both directions, and the result upon the reproduced message is therefore practically neutralized. This result will be more readily comprehended when it is remembered that the distance through which the pen-arm moves by one half step or tooth rotation of the escapement-wheel is in practice and in the size of apparatus employed by me only about one one-hundredth of an inch. The continued movement of progression of the transmitting-pen effects an increase of potential of the line-current by reducing the resistance, as above explained, thereby effecting an actuation of the relay B in the opposite direction, and so on. The movements of the pen 36 in two directions and the function and mode of operation of the several mechanisms whereby such results are accomplished by the corresponding movements of the transmitting-pen arm 10 having now been explained, I will proceed to describe the mode of operation by which the pen 36 at the receiving-station is lowered upon or raised from the paper to effect a recording of the transmitted message. The foregoing description assumes that the pen is resting on the paper. Now suppose the operator at the transmitting-station raises the pen 11 from the paper, thereby relieving the downward pressure thereon, allowing the platen to rise under the influence of the spring acting on arm 24, and thereby allowing the magnetic head 24′ to move downwardly or to the reverse position thereof from that shown in Fig. 4 and occupied by said lever and head during the movements and operations above described. The movement of magnetic head 24′ will effect a movement of pallet 25 in a direction to cause lever 26 to break contact with stop 29 and to make contact with stop 28 and to cause spring-lever 27 to break contact with stop 30 and to make contact with stop 31. The circuit of the battery F will thereupon be made from the positive pole thereof, through wire 37, spring 38, block S, wire 39, lever 26, stop 28, wire 44′, and wire 44, to ground at E^3. From the other pole of battery F the circuit leads through wire 41, spring 42, wire 43, spring-lever 27, stop 31, and wire 40 to the line-wires X X′, as before explained, finally reaching ground at E^2 at the receiving-station, thereby actuating the pen-rest magnets s s' in the proper direction to raise the rest P to allow the receiving-pen 36 to be raised from the paper at the receiving-station. Having completed a line of writing, the next step in the operation is to shift the paper forwardly to present a fresh surface for further signaling. In order to accomplish this result, the operator places the point of pen 11 upon the button or rod S^2 and presses thereon. The operation that takes place and the construction and arrangement whereby such operation is accomplished are fully set forth and described in my patent above mentioned and will therefore be referred to herein only briefly and in order that an understanding may be had of the complete apparatus. The downward pressure on the space-button or push-rod S^2 effects a shifting of the switch-block S in such a manner as to cause the contact-springs 38 42 to rest upon insulation or blank spaces, thereby disconnecting the battery F from the line-circuit. Responding to this cessation of current in the line-wires X X′, the armature d of relay D falls away from its magnet, thereby breaking contact between said armature and stop 60, making contact between said armature and stop 61, whereupon the following local action takes place in the distant receiver: The current passes from the local receiving-station battery H through wire 59, lever d, stop 61, wire 61′, brush 63′, which under the conditions above explained has been left by the last movement of paper-roller l upon a conducting-segment of commutator 64. Therefore the current passes from said brush 63′ to commutator 64, frame n, the coils of magnets O O, wire 66, the windings of motor M, and wire 67 to battery H. The energizing of the magnets O O effects an attraction of armature o, and hence a lowering of the paper-carrying roller upon the peripheries of feed-rolls j k, which are now revolving through the actuation of motor M and the gearing connecting the motor-shaft m with the shaft upon which the feed-rolls j k are mounted. Thus the paper is advanced in the same manner as before explained, thereby effecting a rotation of the paper-carrying roller l. This rotation of said roller through a distance corresponding to one-half the space between the lines of the writing causes the spring-brush 63′ to leave the conducting-segment of the commutator 64 and to rest upon an insulation-segment, with brush 63 contacting with a conducting-segment of such commutator. The parts being now in the relative positions occupied at the beginning of the operations first above described, the break in the local-battery circuit caused by the brush 63′ leaving a conducting-segment of commutator 64 relieves the armature o of the magnetic attraction exerted thereon by magnets O O and permits the frame n to return to its normal position, carrying the paper out of contact with the feed-rolls j k. The same rotation of roller l just described, and which caused the conducting-segment of commutator 64 to leave brush 63′, also causes the conductor-segment of commutator 68, upon which brush 69 has been resting since the initial rotation of said

shaft first above described, to leave said brush 69 and bring an insulating-segment under said brush. The connection of the escapement-magnets *e f* with the local battery H is thereby broken, and as the reversing mechanism R R′ are already at rest, as above mentioned, with the disks L L′ in position to drive pen 36 to the left-hand side of the instrument, the pen 36 is moved quickly to the upper left-hand corner of the writing-field, the anchor *g* being vibrated freely through its engagement with escapement-wheel *g′*, said anchor not being attracted by either of magnets *e f*, the circuits of said magnets being broken, as above explained. The position to which the receiving-pen is thus moved with reference to the receiving writing-field corresponds exactly to the position occupied by the transmitting-pen 11 when resting on space-key S^2, the movement of the pen-arm 74 being finally arrested by suitably or conveniently arranged stops or in any desired manner, as is common in the art. These initial relative positions of the transmitting and receiving pens are called the "unison" positions, because the said pens occupy exactly corresponding positions with reference to their respective writing-fields. Simultaneously with the depression of the shifting button or rod S^2, by which the switch S is actuated to break the line-circuit, a circuit is established from the battery F through wire 37, wire 80, block S, contact-spring 92, wire 93, brush 94, commutator 95, wire 84, the coils of magnets 85, wire 86, and back to battery F through wire 41. Arranged in this circuit are suitable devices adapted to be actuated by current flowing through said circuit for advancing the paper at the transmitting-station. The operator at the transmitting-station finally removes the pen 11 from the space-key or push-rod S^2 and a spring (not shown) or other suitable device returns the switch S to its normal or initial position ready to perform its function upon repeating the cycle of operations above described. This movement of the switch S breaks the local transmitting-station-paper-shifting-device circuit at the contact 92 and also sends current over the line-wires sufficient to cause armature *d* to be attracted by relay-magnet D at the receiving-station, thereby completing the local-battery circuit at the receiving-station through the paper-shifting mechanism, as before explained, and hence completing the shifting of the paper at this station. At the same time switch S closes, through contact 81, a local circuit of battery F which includes the shifting mechanism of the transmitting-station, thereby completing the shifting of the paper at the transmitting-station. The parts are now in position for further communication, and the operation proceeds as above explained.

In the foregoing description I have given the resistances I, J, and K arbitrary values. This has been done for the purpose of clearly conveying an understanding of the various operations which take place. It is to be understood, however, that these values are merely relative and of necessity are dependent upon the conditions of battery, lines, &c., met with in actual practice, as will be readily understood by persons skilled in this art.

Having now set forth the object and nature of my invention and a form of apparatus embodying the same and having described the construction, arrangement, function, and mode of operation of such apparatus, I desire it to be understood that I do not confine myself to the exact details of construction and arrangement specifically shown and described, as many changes therein and variations therefrom would readily suggest themselves to persons skilled in the art and still fall within the spirit and scope of my invention; but

What I do claim as new and useful and of my own invention, and desire to secure by Letters Patent of the United States, is—

1. In a telautographic system, a transmitting-pen, a receiving-pen, a line-circuit and a source of electric current, means for connecting one of the poles of said source of current to the line-wire, a circuit-changer actuated by the movement of the transmitting-pen in the plane of the record-surface for initially varying the resistance in the line-circuit, thereby initially varying the strength of the current sent to line-wire, an additional circuit-changer actuated by the changes in the direction of movement of progression of the transmitting-pen for introducing in such circuit additional resistance variations, thereby additionally varying the strength of the current sent to line, means arranged to be thrown into action by such initial variations in current strength for actuating said receiving-pen, in the movements of progression thereof, and means arranged to be thrown into action by such additional variations in current strength for changing the direction of the movements of progression of the receiving-pen, as and for the purpose set forth.

2. In a telautographic system, a primary circuit, a transmitting-pen, a transformer a derived circuit and a receiving-pen, a circuit-changer arranged to be actuated by the movements of the transmitting-pen in the plane of the record-surface for varying the path of the line-current without varying the polarity thereof, each path including a resistance varying from that in the other path or paths, whereby through such transformer currents of alternate direction are produced in the derived circuit, and means arranged in said derived circuit and adapted to be actuated by the currents of alternate direction induced therein for controlling the movements of the receiving-pen in the plane of its record-surface, as and for the purpose set forth.

3. In a telautographic system, a line-circuit, a transmitting-pen and a receiving-pen, a circuit-changer arranged to be actuated by the movements of progression of the trans-

mitting-pen for initially varying the path of the line-current without varying the polarity thereof, an additional circuit-changer arranged to be actuated by changes in direction of the movements of progression of the transmitting-pen for additionally varying the path of the line-current without varying the polarity thereof, each path including a different resistance, whereby the strength of line-current is initially and additionally varied without varying the polarity thereof, magnets for controlling the direction and extent of the movements of progression of the receiving-pen, circuits for said magnets, and a transformer arranged to generate currents of varying polarity from said initial and additional variations in strength of the line-current of fixed polarity, said currents of varying polarity arranged to traverse the circuit of the magnets which control the extent of movement of progression of the receiving-pen, as and for the purpose set forth.

4. In a telautographic system, a line-circuit, a transmitting-pen, a derived circuit and a receiving-pen, a circuit-changer arranged to be actuated by both the continued movement and also by variations in the direction of movement of progression of the transmitting-pen in the plane of its record-surface, and adapted to vary the path of the line-circuit, each path including a different resistance, whereby on each change of path of the line-circuit the strength of the line-current is varied without varying the polarity thereof, a transformer operated by said changes in current strength for inducing currents of varying polarity in said derived circuit, polarized magnets arranged in said derived circuit and variably actuated by such currents of varying polarity, said magnets arranged to control the extent of the movements of progression of the receiving-pen in the plane of its record-surface, a pole-changer for the line-current arranged to be actuated by the movements of the transmitting-pen toward and from its record-surface, and a magnet arranged in the line-circuit and actuated by such changes in polarity of the line-current, said magnet adapted to control the movements of the receiving-pen toward and from its record-surface, as and for the purpose set forth.

5. In a telautographic system, a line-circuit, a transmitting-pen, a derived circuit and a receiving-pen, means for sending to line a current of fixed polarity, and a path-changing device arranged to be actuated by the movements of progression of the transmitting-pen in the plane of its record-surface and adapted to vary the path of the line-current, a different resistance being arranged in each path whereby the strength of the line-current is varied according to the path it traverses without varying the polarity thereof, and a transformer arranged to be acted upon by said currents of varying strength, in combination with magnets arranged in the derived circuit for controlling the movements of progression of the receiving-pen, said magnets adapted to be actuated by the currents of alternate direction induced in said derived circuit through said transformer by the variations of current strength in the line-circuit, as and for the purpose set forth.

6. In a telautographic system, a line-circuit, a transmitting-pen, a derived circuit and a receiving-pen, a movable switch actuated by the movements of progression of the transmitting-pen for varying the path of the line-current without varying the polarity thereof, each path including a different resistance, thereby varying the strength of the line-current, a transformer arranged to be acted upon by the variations in current strength in the line-circuit and adapted to induce, thereby, currents of varying polarity in the derived circuit, and magnets arranged in the derived circuit and adapted to be actuated by said induced currents of varying polarity for controlling the movements of progression of the receiving-pen, as and for the purpose set forth.

7. In a telautographic system, a transmitting-pen and a receiving-pen, a line-circuit connecting the same, and a derived circuit, a movable contact actuated by changes in direction of the movements of progression of the transmitting-pen for initially varying the path of the current sent to line without varying the polarity thereof, an additional movable contact arranged to be vibrated by the continued movement of the transmitting-pen in the same direction for introducing further variations in the path of the line-current without varying its polarity, a different resistance arranged in each path whereby the strength of the line-current is varied, actuating devices for the receiving-pen, a magnet arranged in the line-circuit and actuated by such initial variations in current strength, said magnet adapted to control the direction of action of said actuating devices, magnets arranged in said derived circuit adapted to control the extent of action of said actuating devices irrespective of the direction in which they operate, and a transformer arranged to be actuated by such additional variations in current strength for inducing currents in said derived circuit, as and for the purpose set forth.

8. In a telautographic system, a transmitting-pen, a receiving-pen, a line-circuit, a path-changing device arranged to be actuated by the movements of progression of the transmitting-pen for varying the path of the line-current, a different resistance arranged in each path whereby the strength, but not the polarity, of the line-current may be varied, a derived circuit at the receiving-station, a transformer arranged and adapted to transform the variations of current strength in the line-circuit into currents of variable direction in the derived circuit, actuating devices for said receiving-pen, circuits therefor, and mag-

nets arranged in said derived circuit and actuated by such currents of variable direction for controlling the circuits of said actuating devices, as and for the purpose set forth.

9. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, means arranged in the line-circuit and actuated by the movements of the transmitting-pen in the plane of its record-surface for varying the resistance contained in the line-circuit, thereby varying the strength of electric pulsations sent to line-wire without varying the polarity thereof, a derived circuit at the receiving-station, a condenser arranged therein, actuating devices for the receiving-pen, circuits therefor, and magnets arranged in the condenser-circuit and actuated by currents of alternate direction produced therein by the variations in strength of the line pulsations for controlling the circuits of said actuating devices of the receiving-pen, as and for the purpose set forth.

10. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, resistances, means arranged in the line-circuit and actuated by variations in the direction of movements of the transmitting-pen in a plane parallel to the record-surface, for initially varying the resistance included in the line-circuit, thereby varying the strength without varying the polarity of electric pulsations sent to line, means also arranged in said line-circuit and actuated by the continual movement of the transmitting-pen in the same direction for successively introducing additional resistance variations in the line-circuit, and means actuated by the movements of the transmitting-pen in a direction at right angles to the record-surface for changing the polarity of the pulsations sent to line, actuating devices for the receiving-pen, circuits therefor, a magnet arranged in the line-circuit and actuated by the initial changes in current strength and adapted to control said circuits for regulating the direction of actuation of the receiving-pen-actuating devices, a derived circuit, magnets arranged therein and adapted to control said circuits for regulating the extent of actuation of the receiving-pen-actuating devices, said magnets actuated by the additional variations in the strength of the line pulsations of fixed polarity, devices for controlling the movements of the receiving-pen in a direction substantially at right angles to its record-surface, said devices arranged in the line-circuit and actuated by the changes in polarity of the line-current, as and for the purpose set forth.

11. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, means actuated by the movements of progression of the transmitting-pen for varying the resistance included in the line-circuit, thereby varying the strength of electrical pulsations sent to line without varying the polarity thereof, a pole-changing device also arranged in said line-circuit and actuated by the movements of the transmitting-pen toward and from its record-surface for varying the polarity of the current sent to line-wire, actuating devices for duplicating in the receiving-pen the movements of progression of the transmitting-pen, circuits therefor, magnets arranged to control said circuits, said circuits being in derived relation with respect to the line, a transformer actuated by the variations in current strength in the line-circuit for inducing currents in said derived circuit, a magnet arranged in the line-circuit and actuated by changes in polarity of the line-current for duplicating in the receiving-pen the movements of the transmitting-pen toward and from its record-surface, as and for the purpose set forth.

12. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, means actuated by the movements of progression of the transmitting-pen for sending to line currents of fixed polarity but of varying strength, a derived circuit at the receiving-station, a transformer arranged in such derived circuit for transforming the variations in strength of the line-currents into currents of varying polarity, and means arranged in said line-circuit and actuated by such currents of varying polarity for controlling the movements of progression of the receiving-pen, as and for the purpose set forth.

13. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, means actuated by movements of progression of the transmitting-pen for varying the resistance in the line-circuit, a local circuit at the receiving-station, electromagnets arranged in such local circuit and adapted to control the movements of progression of the receiving-pen, a circuit in derived relation to the line-circuit, a polarized magnet arranged therein and adapted to control the circuits of said electromagnets, and a transformer also arranged in said derived circuit, adapted to send currents of alternate direction through said polarized magnet by the variations in strength of the line-currents, as and for the purpose set forth.

14. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a local circuit at the receiving-station, means arranged in said local circuit for controlling the movements of progression of the receiving-pen, a circuit in derived relation with the line-circuit, a polarized relay arranged therein, a condenser also arranged in said derived circuit, and means actuated by the movements of progression of the transmitting-pen for varying the strength of the current sent to line, as and for the purpose set forth.

15. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, means actuated by the movements of progression of the transmitting-pen for varying the resistance in the line-circuit, and a magnetic circuit-changing device operated jointly with the resistance-varying means and maintain-

ing a constant position during the extent of movement in a fixed direction of the transmitting-pen, and means actuated by the variations in strength of the line-current for controlling the movements of progression of the receiving-pen, as and for the purpose set forth.

16. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, an initially-acting switch arranged in the line-circuit and adapted to be actuated only in a change of direction of movement of the transmitting-pen, a switch also arranged in the line-circuit for cutting in and out resistances, means for vibrating said last-named switch during the entire extent of movement of progression of the transmitting-pen in any direction, and means actuated by the variations in current strength for controlling the movements of the receiving-pen, as and for the purpose set forth.

17. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a magnetic switch arranged in the line-circuit, means actuated by the movements of progression of the transmitting-pen for actuating said switch, means for retaining said switch in the position to which it is moved until the movement of progression of the transmitting-pen is reversed in direction, a second switch also arranged in the line-circuit, and adapted when actuated to vary the resistance of the line-circuit, means actuated by the movements of progression of the transmitting-pen for vibrating said second switch, and means actuated by variations in strength of the line-current for controlling the movements of progression of the receiving-pen, as and for the purpose set forth.

18. In a telautographic system, a circuit-changing and resistance-varying device comprising a magnet, a movable series of teeth and a switch arranged within the range of magnetic influence of such magnet, and adapted to be vibrated by the making and breaking of the magnetic circuit by the movement of such teeth in either direction, and a second switch arranged within the range of magnetic influence of such magnet and operating only upon reversals of movements of such teeth, and a circuit jointly controlled by said switches, as and for the purpose set forth.

19. In a telautographic system, a circuit-changing and resistance-varying device comprising magnets, a toothed wheel or disk arranged in magnetic influence of such magnets, a vibratory switch arranged to be actuated magnetically by the teeth of such wheel, an auxiliary switch arranged to be actuated only upon reversals of movements of such wheel, and a circuit jointly controlled by said switches, as and for the purpose set forth.

20. In a telautographic system, a circuit-changing and resistance-varying device, permanent magnets, a toothed wheel, forming when in proper position a part of the magnetic circuit of such magnets, an electric circuit-changer adapted to be vibrated magnetically by the movements of said wheel in either direction, an auxiliary circuit-changer arranged to be acted upon magnetically by said wheel and to be moved thereby only upon change in direction of movement of such wheel, as and for the purpose set forth.

21. In a telautographic system, a magnet, a wheel or disk arranged within the range of influence of such magnet, a switch frictionally coupled to move with such wheel and adapted to be acted upon magnetically thereby, and limiting-stops therefor whereby said switch is actuated only upon reversals of movement of said wheel or disk, as and for the purpose set forth.

22. In a telautographic system, a magnet, a wheel arranged within the magnetic influence thereof, a lever of magnetic material having corners or teeth formed thereon, said lever frictionally coupled to move with said wheel, limiting-stops therefor, and a circuit-changing device actuated magnetically by the teeth on said lever, as and for the purpose set forth.

23. In a telautographic system, magnets presenting poles of opposite polarity, a lever having one end thereof arranged within the influence of one of said magnets, a magnetic pallet arranged within the influence of the other of said magnets, the opposite end of said lever being presented to said pallet to complete the magnetic circuit, a circuit-changing device actuated by said pallet and means for rocking said lever to break or close said magnetic circuit, as and for the purpose set forth.

24. In a telautographic system, magnetic poles of opposite polarity, a wheel arranged within the influence of one of said poles, a magnetic pallet arranged within the influence of the other of said poles, and a lever for completing the magnetic circuit between said magnets, said lever adapted to be rocked upon change in direction of movement of the said wheel whereby the said pallet is vibrated and a circuit-changer actuated by said pallet, as and for the purpose set forth.

25. In a telautographic system, magnetic poles of opposite polarity, a lever having one end thereof arranged within the influence of one of said poles, a magnetic pallet arranged within the influence of the other of said poles, said lever having the opposite end thereof presented to said pallet and said pallet and lever being provided with projecting corners or teeth upon their opposed surfaces, a circuit-changing device actuated by said pallet and means for rocking said lever, as and for the purpose set forth.

26. In a telautographic system, a magnet, a wheel within the range of influence of such magnet, a divided lever arranged to straddle said wheel and frictionally engaged to move with said wheel, said lever being acted upon magnetically by said wheel and a circuit-

changing device adapted to be actuated magnetically by the movements of such lever, as and for the purpose set forth.

27. In a telautographic system, a magnet, a wheel within the range of influence of such magnet, a bifurcated lever of magnetic material, having the legs thereof arranged to straddle said wheel and to be magnetized thereby and a magnetic circuit-changing device arranged to be actuated by movements of such lever, as and for the purpose set forth.

28. In a telautographic system, a shaft suitably journaled to rotate freely in either direction, a toothed wheel mounted on to rotate with said shaft, a magnet within the influence of which said wheel is arranged, a magnetic pallet arranged to be vibrated magnetically by the teeth of said wheel, a switch actuated by said vibratory pallet, a magnetic lever frictionally coupled to rotate with said shaft, limiting-stops therefor whereby said lever responds to changes in direction of rotation of said shaft but after being initially moved is not disturbed during a continuation of movement of such shaft in the same direction, and a circuit-changer actuated by said lever, as and for the purpose set forth.

29. In a telautographic system, a shaft, a pen-drum and a toothed wheel mounted thereon, a magnet within the influence of which said wheel is mounted, a second magnet, a magnetic pallet within the influence thereof, the magnetic circuit between said magnet adapted to be made and broken by teeth of said wheel during the rotation thereof, whereby said pallet is vibrated, a switch adapted to be actuated by the vibrations of such pallet, a third magnet, a magnetic pallet within the influence thereof a circuit-changer actuated by said pallet, and a lever frictionally coupled to said shaft and adapted to break or close the magnetic circuit between said wheel and last-mentioned pallet, limiting-stops for said lever, a transmitting-pen arm adapted to actuate said drum and line-circuit controlled jointly by said switch and circuit-changer, as and for the purpose set forth.

30. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, an arm arranged to vary the circuit connections to change the polarity of the line-current, a magnet arranged to be actuated by movements of the transmitting-pen toward and from its record-surface for actuating said arm, a rest for the receiving-pen, a polarized magnet for moving said rest toward and from the record-surface of said receiving-pen, said polarized magnet arranged in the line-circuit and actuated by reversals in polarity of the line-current, as and for the purpose set forth.

31. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a movable contact arranged to vary the circuit connection of the line-circuit to vary the polarity of the line-current, a magnetic head connected with said contact, and a coöperating magnetic head for moving said contact, said coöperating magnetic head arranged to be actuated by movements of said transmitting-pen toward and from its record-surface, a rest for the receiving-pen, an electromagnet for moving said rest toward and from the record-surface of the receiving-pen, said magnet arranged in the line-circuit and actuated by reversals in polarity of the line-current, as and for the purpose set forth.

32. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a movable transmitting-platen arranged to be moved by raising the transmitting-pen therefrom or lowering it thereon, a movable contact for varying the circuit connections of the line-circuit whereby the polarity of the line-current is varied, a magnetic head connected therewith and a coöperating magnetic head for moving said contact, said coöperating head arranged to be moved by the movements of said platen, a rest for the receiving-pen, an electromagnet for raising and lowering the same toward and from the record-surface of said receiving-pen, said electromagnet arranged in the line-circuit and actuated by reversals in the polarity of the line-current, whereby the movements of the transmitting-pen toward and from its record-surface are duplicated in the receiving-pen, as and for the purpose set forth.

33. In a telautographic system, a pole-changer, including magnetic poles of opposite polarity, a magnetic pallet having projecting corners or teeth, a movable magnetic head having coöperating projecting teeth or corners presented to said pallet, means for automatically moving said head whereby the magnetic circuit is disturbed and said pallet is vibrated and a reversing-switch actuated by said pallet, as and for the purpose set forth.

34. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a pole-changer arranged in the line-circuit and comprising a reversing-switch, magnetic poles of opposite polarity, a magnetic pallet arranged within the magnetic circuit of said poles and adapted to operate said reversing-switch, a magnetic head, and means actuated by raising the transmitting-pen from and lowering the same upon the transmitting-platen for moving said head, whereby the magnetic circuit is disturbed and said pallet is actuated, and means actuated by reversals of the line-current for causing the receiving-pen to be correspondingly raised from or lowered upon the receiving-platen, as and for the purpose set forth.

35. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, a movable transmitting-platen, a lever upon which said platen rests, whereby when said platen is moved by imposing thereon or relieving therefrom the pressure of the transmitting-pen said lever is also moved, a magnetic head carried by said lever, a pallet to which said head is presented, magnetic poles of opposite polarity within the influence of

which said head and pallet are arranged, a reversing-switch arranged to be actuated by said pallet, and means actuated by reversals in the line-circuit for causing the receiving-pen to be moved toward or from the receiving-platen, as and for the purpose set forth.

36. In a telautographic system, a transmitting-pen, a receiving-pen, recording-platens therefor, and a line-circuit, a pole-changer for reversing the line-current, a magnetic head connected therewith, a coöperating magnetic head for actuating said head, said coöperating head normally held in one limit of its movement, means actuated by lowering the transmitting-pen upon its record-platen for displacing said coöperating magnetic head, thereby actuating said pole-changer to reverse the line-current, whereby when said transmitting-pen is raised said coöperating magnetic head is returned to its normal position, thereby restoring the normal condition of the line-current, a rest for the receiving-pen, an electromagnet for actuating said rest, said magnet being arranged in the line-circuit and normally operating to maintain the receiving-pen in elevated position, as and for the purpose set forth.

37. In a telautographic system, a receiving-pen, means for actuating the same in directions parallel with the plane of the paper, a local circuit for said pen-actuating means, a commutator arranged to make and break said circuit, a paper-shifting mechanism including a shaft, a motor for actuating the same, said commutator being mounted on and rotating with said shaft, whereby during the operation of the paper-shifter the actuation of the receiving-pen is arrested, as and for the purpose set forth.

38. In a telautographic system, a receiving-pen, a ratchet mechanism for effecting the movements of progression thereof, devices for actuating said ratchet mechanism, a commutator arranged in the circuit of said actuating devices, a paper-shifting mechanism, means for actuating the same, said commutator connected to and moving with said paper-shifting mechanism, as and for the purpose set forth.

39. In a telautographic system, a receiving-pen, a ratchet mechanism for effecting the movements of progression of said pen, electromagnets for actuating said ratchet mechanism, a paper-shifting roll, means for actuating the same, a commutator mounted on said roll and arranged in the circuit of said electromagnets for controlling said circuits, as and for the purpose set forth.

40. In a telautographic system, a receiving-pen, means for actuating the same, a paper-shifting mechanism including a shifting-roller, a commutator mounted thereon, said commutator being arranged in the circuit of the said pen-actuating means and appliances for rotating said paper-shifting roll whereby when said roll is rotated, the circuit of said actuating means is broken, thereby arresting said actuating means during the paper-shifting operation, as and for the purpose set forth.

41. In a telautographic system, a receiving-pen, means for imparting the movements of progression thereto, a paper-shifting roll, a commutator carried thereby, said commutator arranged to control the circuit of said movements-of-progresson imparting means, as and for the purpose set forth.

42. In a telautographic system, a receiving-pen, a ratchet mechanism for imparting the movements of progression thereto, electromagnets for actuating said ratchet mechanism, a paper-shifting roll, means for actuating the same, and a commutator carried thereby, said commutator arranged in the circuit of said electromagnets, as and for the purpose set forth.

43. In a telautographic system, a receiving-pen, a ratchet mechanism for imparting the movements of progression thereto, electromagnets for actuating said ratchet mechanism, a paper-shifting roll, a commutator carried thereby, a brush in constant contact with a conducting portion of said commutator, and a brush adapted to alternately contact with conducting and insulating segments of such commutator, said brushes being included in the circuit of said electromagnets, and means for rotating said roll to shift the paper, as and for the purpose set forth.

44. In a telautographic system, a receiving-pen, electrical means for imparting the movements of progression thereto, a paper-shifting mechanism including a shifting-roller, a commutator mounted on each end thereof, one of said commutators arranged to control the circuit of said paper-shifting mechanism and the other to control the circuit of the means for imparting the movements of progression to said pen, as and for the purpose set forth.

45. In a telautographic system, a receiving-pen, electrically-operated means for controlling the movements of progression of said pen, electrically-operated means for controlling the direction of movements of progression of such pen, a common circuit for said electrically-operated means, a paper-shifting roll, means for actuating the same and a commutator mounted on said roll and arranged in said circuit whereby said circuit is broken during the shifting of the paper, as and for the purpose set forth.

46. In a telautographic system, a receiving-pen, electrically-operated devices for controlling the extent and direction of the movements of progression thereof, a commutator for controlling the circuit of said devices, and means actuated by the shifting of the paper for actuating said commutator, as and for the purpose set forth.

47. In a telautographic system, a receiving-pen, electrically-operated devices for controlling the extent and direction of the movements of progression of said pen, a circuit for said devices, a commutator arranged in said circuit, and means actuated by the shifting

of the paper for closing or breaking said circuit through said commutator, as and for the purpose set forth.

48. In a telautographic system, a receiving-pen, means for controlling the direction and extent of the movements of such pen, electrical devices for actuating said controlling means, a circuit therefor, a paper-shifting mechanism including a roller, a commutator mounted thereon but insulated therefrom, and adapted to be actuated thereby, said commutator arranged to control the said circuit, and means for actuating said paper-shifting devices, as and for the purpose set forth.

49. In a telautographic system, a receiving-pen, means for controlling the direction of movements of progression thereof, electrical devices for actuating said controlling means, a circuit therefor, a paper-shifting roll, means for rotating the same, a commutator mounted on said roll and arranged in said circuit for making or breaking said circuit and a circuit-breaker also arranged in said circuit and means actuated by the variations in strength of the line-current for actuating said circuit-breaker, as and for the purpose set forth.

50. In a telautographic system, a transmitting-pen, a receiving-pen, and a line-circuit, means actuated by changes in the direction of progression of the transmitting-pen for varying the strength of the line-current, electrical devices for controlling the direction of progression of the receiving-pen, a circuit therefor, a relay adapted to be actuated by variations in the strength of the line-current for controlling said circuit, and means also arranged in said circuit for making and breaking the same, a paper-shifting device, and means actuated by the movements thereof for actuating said circuit making and breaking device, as and for the purpose set forth.

51. In a telautographic system, a transmitting-pen, a receiving-pen, and a line-circuit, means actuated by the movements of progression for varying the strength of the line-current, electrical devices for controlling the movements of progression of the receiving-pen, circuits therefor, relays arranged in said circuits and adapted to be actuated by variations in strength of the line-current, an auxiliary circuit-breaker for said circuit, a paper-shifting mechanism, means for acuating the same, and means actuated by the movements of said paper-shifting mechanism for actuating said auxiliary circuit-breaker, as and for the purpose set forth.

52. In a telautographic system, a transmitting-pen, a receiving-pen, and a line-circuit, means actuated by the movements of progression of the transmitting-pen for varying the strength of the line-current, a local circuit at the receiving-station, a reversing mechanism, and an escapement mechanism arranged in parallel with each other in said local circuit, a relay arranged to control said reversing mechanism and a relay arranged to control said escapement, both of said relays adapted to be actuated by variations in the strength of the line-current, as and for the purpose set forth.

53. In a telautographic system, a transmitting-pen, a receiving-pen and a two-wire line-circuit, a rest for the receiving-pen, a polarized electromagnet having the armature thereof directly connected to said pen-rest, the coils of said polarized electromagnet being directly included in the line-circuit of both wires, a vibrating contact-arm arranged to vary the pole connections of the source of line-current, and means actuated by the movements of the transmitting-pen toward and from its record-surface for vibrating said arm, thereby simultaneously reversing the polarity of the line-current in both line-wires, as and for the purpose set forth.

54. In a telautographic system, a transmitting-pen, a receiving-pen and a two-wire line-circuit, a rest for the receiving-pen, a polarized electromagnet, the armature of said magnet forming a part of said rest, the coils of said magnet being directly included in the line-circuit of both wires, a vibrating contact-arm arranged to vary the pole connections of the source of line-current, and means actuated by lowering the transmitting-pen upon or raising it from its record-surface for vibrating said arm, thereby simultaneously reversing the polarity of the line-current in both line-wires, whereby the said magnet is energized directly by the combined current of both line-wires, as and for the purpose set forth.

55. In a telautographic system, a receiving-pen, a transmitting-pen, and a line-circuit, a local circuit at the receiving-station, a magnet of large self-induction and a magnet of relatively small self-induction arranged in parallel series with the line-circuit, and a circuit-controller for the local circuit arranged to be actuated by said magnet of small induction, whereby changes in polarity of the line-current do not affect said controller, as and for the purpose set forth.

56. In a telautographic system, a receiving-pen, a transmitting-pen, and a two-wire line-circuit, means actuated by the movements of the transmitting-pen for sending currents over both wires of the line-circuit, a local circuit at the receiving-station, an electromagnet of small self-induction arranged in series with both line-wires and adapted to control said local circuit, and a magnet of large self-induction, also arranged in series with both line-wires and in parallel with said control-magnet, whereby said control-magnet is actuated by currents arriving over either line-wire but is not affected by changes in polarity of the arriving current, as and for the purpose set forth.

57. In a telautographic system, a transmitting-pen, a receiving-pen and a line-circuit, an interrupter adapted to be actuated by the movements of the transmitting-pen in the plane of its record-surface, resistances arranged to be cut into or out of said line-cir-

cuit by said interrupter, whereby the strength of the current sent to line-wire is varied without varying the polarity thereof, devices for actuating the receiving-pen in the plane of its record-surface, a local circuit therefor, means for closing said circuit, an escapement for said actuating means, a circuit in derived relation with respect to said line-circuit, means arranged in said derived circuit and actuated by the variations in current strength of the line-circuit for controlling said escapement, as and for the purpose set forth.

58. In a telautographic system, a transmitting-pen, a receiving-pen, a line-circuit, resistances arranged to be included in said line-circuit, means actuated by the same movements of progression of the transmitting-pen for varying said resistances, actuating means for said receiving-pen including an escapement, actuating means for said escapement, a local circuit for said actuating means, a circuit in derived relation with respect to said line-circuit, a transformer arranged in said derived circuit for transforming the variations in strength in the line-current into currents of alternate direction, and a polarized relay for controlling the circuit of said escapement-actuating devices, as and for the purpose set forth.

59. In a telautographic system, a transmitting-pen, a receiving-pen, a line-circuit, resistance arranged to be included in said line-circuit, means actuated by the continued movement of the transmitting-pen in the same direction in the plane of its record-surface for varying the resistance in the line-circuit, means actuated by changes in the direction of movement of progression of the transmitting-pen for introducing other successive changes in the resistance of the line-circuit, means for actuating the receiving-pen including an escapement, actuating devices for said escapement, a circuit in derived relation with respect to said line-circuit, a transformer arranged in said derived circuit, a polarized magnet also arranged in said derived circuit and adapted to be actuated by the currents of alternate direction generated therein, and means actuated by said polarized relay for controlling the circuit of said escapement-actuating devices whereby the movements of the transmitting-pen in the plane of its record-surface are duplicated by the receiving-pen, as and for the purpose set forth.

In witness whereof I have hereunto set my hand, this 10th day of March, 1897, in the presence of the subscribing witnesses.

LEON O. McPHERSON.

Attest:
S. E. DARBY,
S. HUTCHISON.