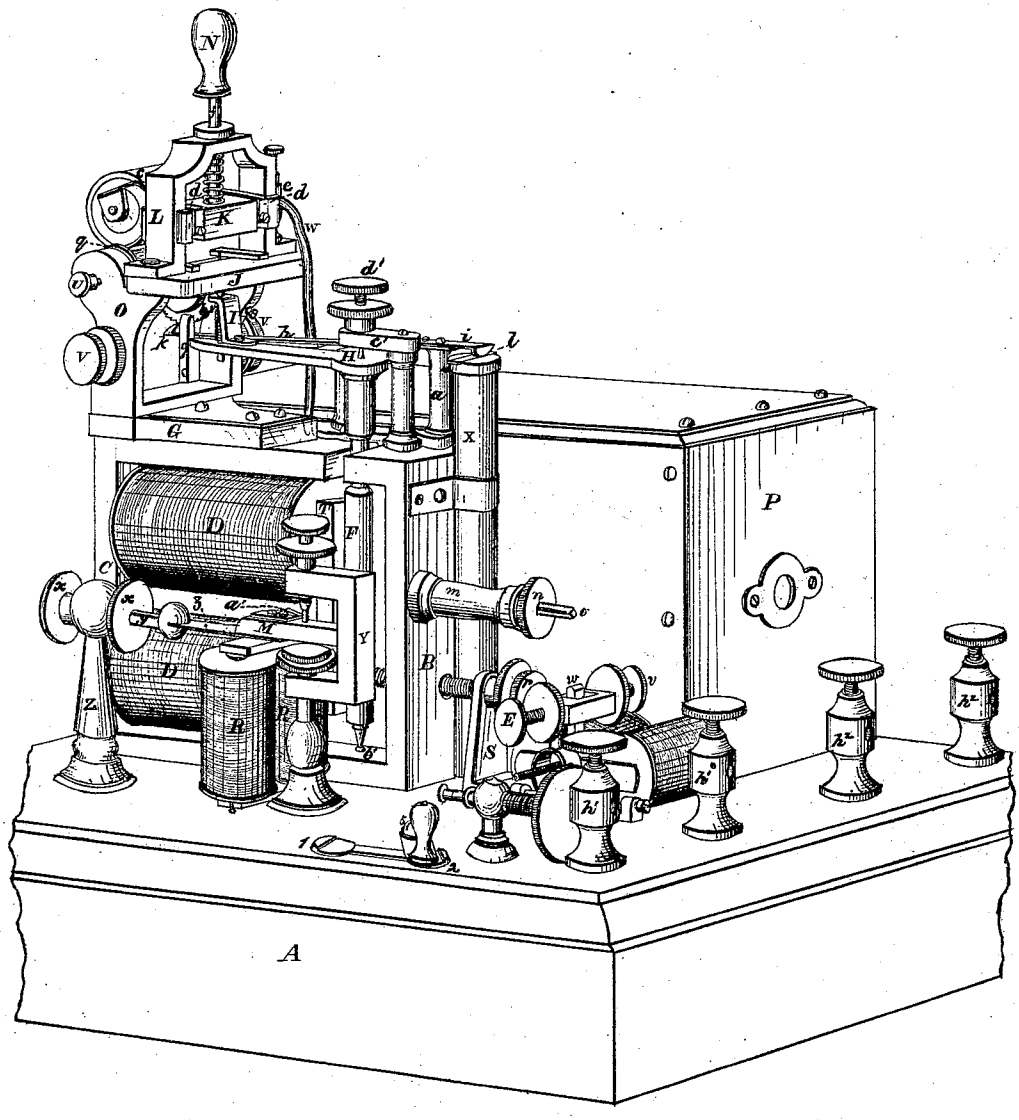
3 Sheets—Sheet 1.

J. C. LUDWIG.

FAC-SIMILE TELEGRAPHS.

No. 170,385. Patented Nov. 23, 1875.



Witnesses;

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Inventor;

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3 Sheets—Sheet 2.

J. C. LUDWIG.

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Fig. 1.

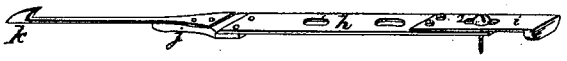

Fig. 3.

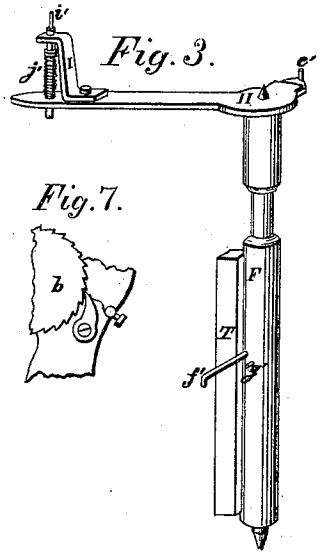

Fig. 2.

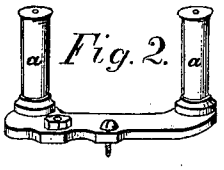

Fig. 4.

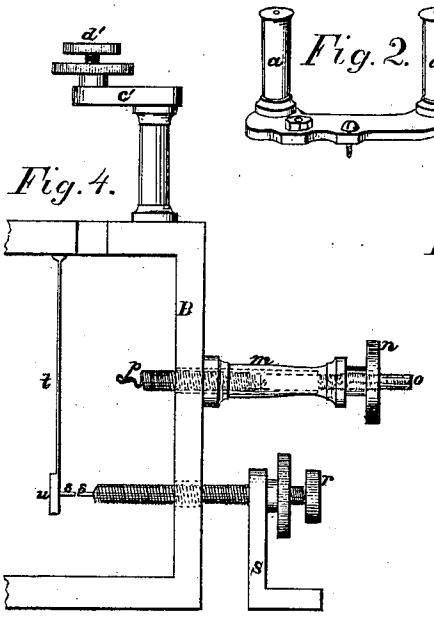

Fig. 7.

Fig. 5.

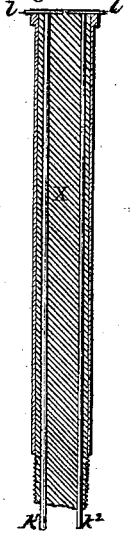

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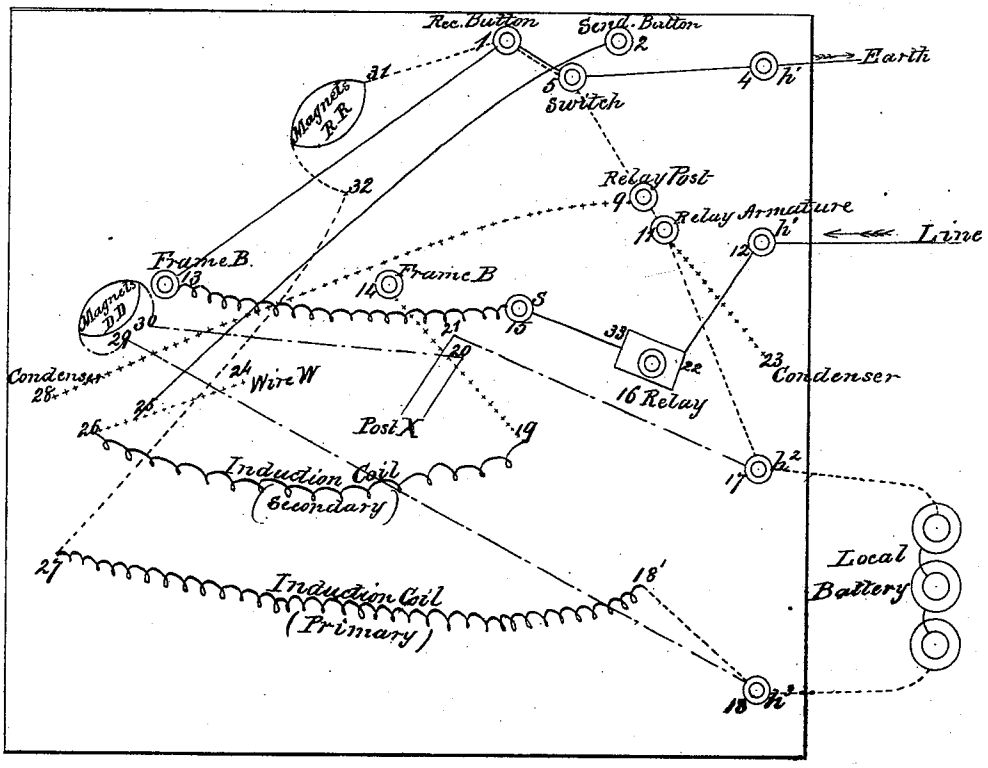
Fig. 6.



Line Current

First Local

Second Local

WITNESSES:

Edward Halsey

W. J. Shinore

INVENTOR:

John C. Ludwig

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

JOHN C. LUDWIG, OF SAN FRANCISCO, ASSIGNOR OF PART OF HIS RIGHT TO WILLIAM H. HALL, MARTIN CORCORAN, B. D. MURPHY, JAMES V. TISDAL, CHARLES WASHEIM, AND DAVID B. MOODY, OF SAN JOSÉ, CAL.

IMPROVEMENT IN FAC-SIMILE TELEGRAPHS.

Specification forming part of Letters Patent No. **170,385**, dated November 23, 1875; application filed November 27, 1874.

To all whom it may concern:

Be it known that I, JOHN CAROLUS LUDWIG, of the city and county of San Francisco and State of California, have invented certain Improvements in Electro-Magnetic Telegraphic Instruments, of which the following is a specification:

My invention consists in a novel combination of devices to form an automatic autographic electro-magnetic telegraphic instrument, as will be hereinafter explained.

In the drawings, Plate 1 is a perspective view of an apparatus embodying my invention. In Plate 2, Figure 1 is the slide which cuts off the current and works roller *c*. Fig. 2 is the rest, which supports the slide. Fig. 3 is the oscillating traverser. Fig. 4 is a section of frame B, showing the springs operating on the traverser. Fig. 5 is a sectional view of post X of Plate 1. Fig. 6, Plate 3, is a diagram, showing the different circuits and connections with the several working parts of the instrument. Fig. 7, Plate 2, is a detail fragmental view of O of Plate 1, with ratchet *b* and pawl.

A is the base, which may be constructed of wood or other suitable non-conducting material, with room or space in the under or bottom side for a condenser. B is the frame, which is secured to the base, and which supports the several working parts of the instrument. C and D D is an electro-magnet secured to B by means of screws. G is an insulator, made of wood or other non-conducting material, placed between B and O, and secured to B and O by screws. J is an insulator made of hard rubber or other suitable non-conducting material, and is secured to O by means of screws in such a manner that it insulates O and L. *q* is a roller, provided with a ratchet-wheel, *b*, and spring-pawl, as in Fig. 7, Plate 2, and is fluted with small grooves. The roller revolves on the rod U, which is secured to O by means of the screw-thread on one end. L is the frame, in which the slide K operates, and is secured to J by means of screws. K is a slide, operating vertically in frame L, which may be made of brass or other suitable material, and armed with a plate of platina on the under side, where it comes in contact with *i'*, as shown in Fig. 3 in Plate 2. It is provided with a rod, *f*, around which is coiled a spiral spring, which tends to keep K pressed downward and in contact with *i'*. On the upper end of rod *f* there is a hard-rubber button, N. These are also connected with K by means of screws or springs *d d*, which are provided with proper perforations to form bearings for the axle of roller *c*. *c* is a roller, covered with hard rubber or other insulating substance, for the purpose of aiding roller *q* in feeding the paper to the instrument. By lifting the button N the slide K and roller *c* are raised sufficiently to admit the paper on which the message is written to pass freely between J and K.

The slide, as shown in Fig. 1, Plate 2, is composed of four parts, *h*, *i*, *j*, and *k*, and is secured to posts *a a*, as shown in Fig. 2, by means of screws passing through the slots 1 and 2, in such a manner that the slide may move backward and forward. *k* is a spring-hook, which operates on ratchet-wheel *b*, and insulated from *h* by a piece of hard rubber, *j*, or other non-conducting material, riveted to *h* and *k*. *i* is a spring, secured to *h* by means of screws, and is armed with platina where it comes in contact with X, as shown in Plate 1.

Fig. 2, in Plate 2, is the rest for the slide, and is secured to frame B by means of screws, as shown in Plate 1. X is a post made of hard rubber or other non-conducting material, having a thread cut on the lower end, that it may be screwed into and secured to base A. It is also secured to the frame B by means of a strap passing around it, one end of which is screwed to the frame B. It is perforated longitudinally, in which perforations two small wires are placed, as shown at k^1 k^2, in Fig. 5, Plate 2, which pass through base A, and around the electro-magnet D D, and connected with binding-screws h^2 h^2 in Plate 1, as will be more fully explained hereafter. The upper ends of the wires are armed with platina where they come in contact with *i*, as shown at *l l* in Fig. 5. The traverser, as shown in Fig. 3, Plate 2, is composed of several parts, the upright rod F, which oscillates on the

points, having bearings in the socket b', and also in the socket in binding-screw d', shown in Plate 1. T is an armature of soft iron, fastened or secured to F by means of solder or screws, in such manner that when D D is magnetized, it, T, will be drawn toward D D, and move arm H toward the slide h. The arm H carries the pin j', which moves vertically through perforations in the arm H and the brace I. A spiral spring is coiled around the pin j', and tends to press it upward so that the point i^1 may, at all times, act on the paper placed between it and the plate or slide K. H is also provided with a short arm, which carries the pin e'. The pin e operates in a slot, shown in Fig. 1, between slots 1 and 2, so that when the armature T is drawn on by the electro-magnet D D, the slide is drawn backward, the hook k moves, and causes the ratchet-wheel b to revolve, and when D D ceases to be a magnet T is drawn back by a spring, p, which is hooked to pin q'. The spring p may be weakened or strengthened by means of a set-screw, n. R R of Plate 1 is an electro-magnet. Z is a post having a square perforation, through which stem y passes, and is thereby kept from turning. y is provided with adjusting-screws x x. z is a spring connected in such a manner with y and M that, when the armature M is drawn on, it will bend and release f', and allow the spring p to operate on the oscillating rod F, and when magnetism ceases in R R the spring z will return to proper position to receive and hold the arm f. a' is a small wedge or hook secured to M, which secures and retains the hook of arm f' until released, as before mentioned. f' is a small arm with a hook projecting from the rod F, as shown in Fig. 3, Plate 2, in such position that when the magnet D D draws on the armature T the hook of the arm f' will move toward and press down the spring z until the hook on f' passes over the wedge a', when it is retained by the wedge a' until M is drawn on again by electro-magnet R R. P is a box containing intensity-coil.

The principle of the operation of the instrument, as thus described, whereby the handwriting of the message is reproduced at the receiving-station in a fac-simile record, is dependent upon the synchronous vibration of the two traversers at the sending and receiving instruments, respectively, which said traversers oscillate across the slips of paper with great rapidity, describing lateral lines across the paper, an infinitesimal distance apart. The paper for this purpose is specially prepared, and the unison in the movements of the traversers is effected by the currents operating as hereinafter described.

In order to send a message with this instrument the paper must be chemically prepared in the following manner: One fluid half-ounce of tincture of ferro-cyanide of potash is put into one gallon of coal-oil, into which the paper is put until saturated, when it is taken out and partially dried by passing it through a common clothes-wringer, or by means of a dry cloth, when it is ready for use. This paper, when thus prepared, must be written upon with a soft common lead-pencil, whereupon the message is ready for transmission.

For receiving a message well-glazed common paper should be used.

h^1 h^1 are the binding-screws for the main circuit. h^2 h^2 are binding-screws for the local circuit. 5—2 shows the position of the switch for sending a message; 5—1 the position of the same for receiving.

The following is an explanation of the instrument, and the manner in which the different circuits are changed by it, and with the switch: For sending, the induction-coil and the parts of the instrument exclusively related thereto are not employed. The main battery or line current passes through one of the binding-screws h^1 to 12, as shown in Fig. 6, Plate 3, from thence to 22, from 22 through the relay, and from thence to 33, from 33 to 15, thence through the base A to S, thence to s s, thence to t, thence to frame B, thence to F and H, thence to platina point i', thence through pencil-mark in the prepared paper to K, thence to binding-screw e, thence down wire W through base A to 24, thence to 25, thence to sending-button 2 of switch, thence to 5, thence to 4, thence through base to the other binding-screw h^1, thence to the line. When the platina-point i' passes over a pencil-mark at the sending-station a current of electricity passes through the pencil-mark, and through the wire to the the receiving-station, as long as i' is connected with K by means of a pencil-mark, which must be made in such a manner that the pencil-mark will form the connection between i' and K. When the moving point i' does not come in contact with a pencil-mark on the paper, no current will flow through the line, and none will be received at the receiving-station, where a similar instrument must be used.

For receiving, the handle of the switch must rest on button 1. When a current passes from i' through a pencil-mark or writing at the sending-station, a current will be transmitted through the line to one of the binding-screws h^1 of the relay to 12, thence through base to 22, thence through the relay to 33, thence to 15, thence to S in Fig. 4, Plate 2, thence to t, thence to B, thence through base A to 13, thence to switch-button 1, thence to 5, thence to 4, thence to the other binding-screw h^1, thence to the earth.

The main-line circuit being thus completed through the relay-magnets, the armature of the latter is drawn on and the circuit of the local battery is completed through 9 and 11 of the diagram, (w v of perspective.) Before the closing of the said local circuit, the magnets are all demagnetized, the traverser moved over toward the hook and slide h k, and held there by arm f', which has passed over the catch a' of magnets R R, the slide moved back so that i is not in contact with l l, and

does not connect k^1 k^2. Now, when an impulse from the main line passes through the relay and closes the local circuit, the course of the latter is as follows, reference being had to the diagram: From the local battery to 18, thence to 18′ into the primary wire of the induction-coil, out from the coil at 27, thence to 32 into the magnets R R, out at 31 to the receiving-button 1, thence to 5, thence to the relay-post 9, thence to the relay-armature 11, thence to 17 and the opposite pole of the local battery. The effects of this circuit upon the working parts of the instrument are as follows: The charging of the induction-coil; the attraction of the armature of magnets R R; the release of arm *f′*; the action of spring *p* to draw back the armature T and move traverser H, and the passage of the spark from the secondary wire of the induction-coil from 19 to 14 into frame B, thence through the traverser H and point *i′* through the paper to slide K, down wire W to 24, and from thence to 26, the other electrode of the secondary wire of the induction-coil. At the same time that the traverser moves away from the slide *h* by reason of the release of its armature by magnets R R, an arm, *e′*, of the traverser advances the slide and brings the point *i* upon *l l*, connecting the wires k^1 k^2. (20 21.) The effect of this is to form a new circuit for the local battery, and it passes from 17 to 21, (k^1,) thence to 20, (k^2,) thence to 30 into the magnets D D, magnetizing the same, out at 29, and from thence to 18 and the opposite pole of local battery.

The action of the new local circuit is to charge magnets D D, draw on armature T, lock arm *f′* over catch *a′*, move back the traverser toward the slide, move back the slide *h* by arm *e′*, and shut off the local current by moving *i* from *l l* and breaking the connection between k^1 k^2. (21 20.) The instrument is now at rest, and in the same condition that it was before receiving the main-line impulse, and can only be operated again as a receiving-instrument by the closing of the local-battery circuit through the relay by an impulse from the main line produced by the closing of the circuit at the sending-stations, through a pencil-mark on the paper.

Thus it will be seen that, as the above action is repeated for each impulse received from the main line, the vibration of the traverser at the receiving-station is dependent wholly upon the main-line impulse, and is locked when there is no current over the main line by the magnets R R.

In the sending-instrument, however, the vibration of the traverser is continuous and independent of the main-line current, the said vibration being effected by the local battery to produce the feeding of the paper.

The function of the armature *u* is that of a contact-breaker for the main-line current, whereby is insured the unison of movement of the traversers, which is explained as follows: Whenever the magnets D D are magnetized the armature *u* is drawn away, so that the contact of the points *s s* is broken, whereby the main-line current can only be complete when magnets D D are demagnetized. The main-line current can, therefore, only pass through the paper when the magnets D D are demagnetized, and the traversers are moving from the action of the springs *p*. Now, the strength of the springs being made to correspond in both receiving and transmitting instrument, it will be seen that the traversers are made to vibrate, so far as the main-line current is concerned, in unison.

In the receiving-instrument the parts *v w* of the relay act as a spring and hammer of the intensity-coil, and the glazed paper in said instrument receives the fac-simile record, which is registered in the shape of perforations formed by the sparks.

I would have it understood, however, that although I have shown my method of recording by an intensity-coil, I do not confine my invention to the same, for it is obvious that certain features of my invention are equally applicable to recording by electrolysis or chemical discoloration.

Having thus described my invention, what I claim is—

1. In an autographic telegraphic instrument, the combination, with a suitable conducting-surface, of an oscillating traverser, arranged to move back and forth over the paper passing between the said traverser and conducting-surface, substantially as described.

2. The method of preparing the message-paper by saturating it with a mixture of ferrocyanide of potassium and coal-oil, for the purpose of rendering the same capable of conducting the current through a lead-pencil mark, substantially as described.

3. The combination, with the pivoted oscillating traverser, having an armature upon its axis, and a retracting-spring for the same, of the electro-magnets and a suitable contact-breaker, substantially as described.

4. The traverser H, having a spring-seated contact-point, *i′*, in combination with a spring-seated conducting-plate, K, and suitable feed-rollers, substantially as described.

5. The combination of a slide, operated by an arm of the traverser, with the feed-roller, having a ratchet-wheel, and the contact-points, through which the circuit is formed that operates the traverser, substantially as described.

6. The combination, with the traverser H and armature T, having arm *f′*, of the releasing-magnets R R and the spring-mounted armature M, having a catch, substantially as described.

7. The combination, with the magnets D D and the main-line circuit, of the spring-mounted armature *u* and the contact-points *s s*, to insure the passage of the main-line current through the paper while the traverser is being moved by spring-power, substantially as described.

8. The combination of the relay-magnets,

the induction-coil, the magnets D D, the releasing-magnets R R, the traverser H, and armature T, having arm f', the spring p, and the slide for feeding the paper and breaking the second local circuit, substantially as described.

9. The combination of the hook or pawl k with the fluted or channeled feed-roller q, having a ratchet-wheel, b, and the roller c, journaled in springs d d, substantially as described.

10. The combination, with the second local circuit, of the non-conducting post X, wires k^1 k^2, contact-plates l l, and the circuit closing plate i, substantially as described.

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