(No Model.)

4 Sheets—Sheet 1.

# E. A. COWPER.

## ELECTRIC TELEGRAPH.

No. 353,541. Patented Nov. 30, 1886.

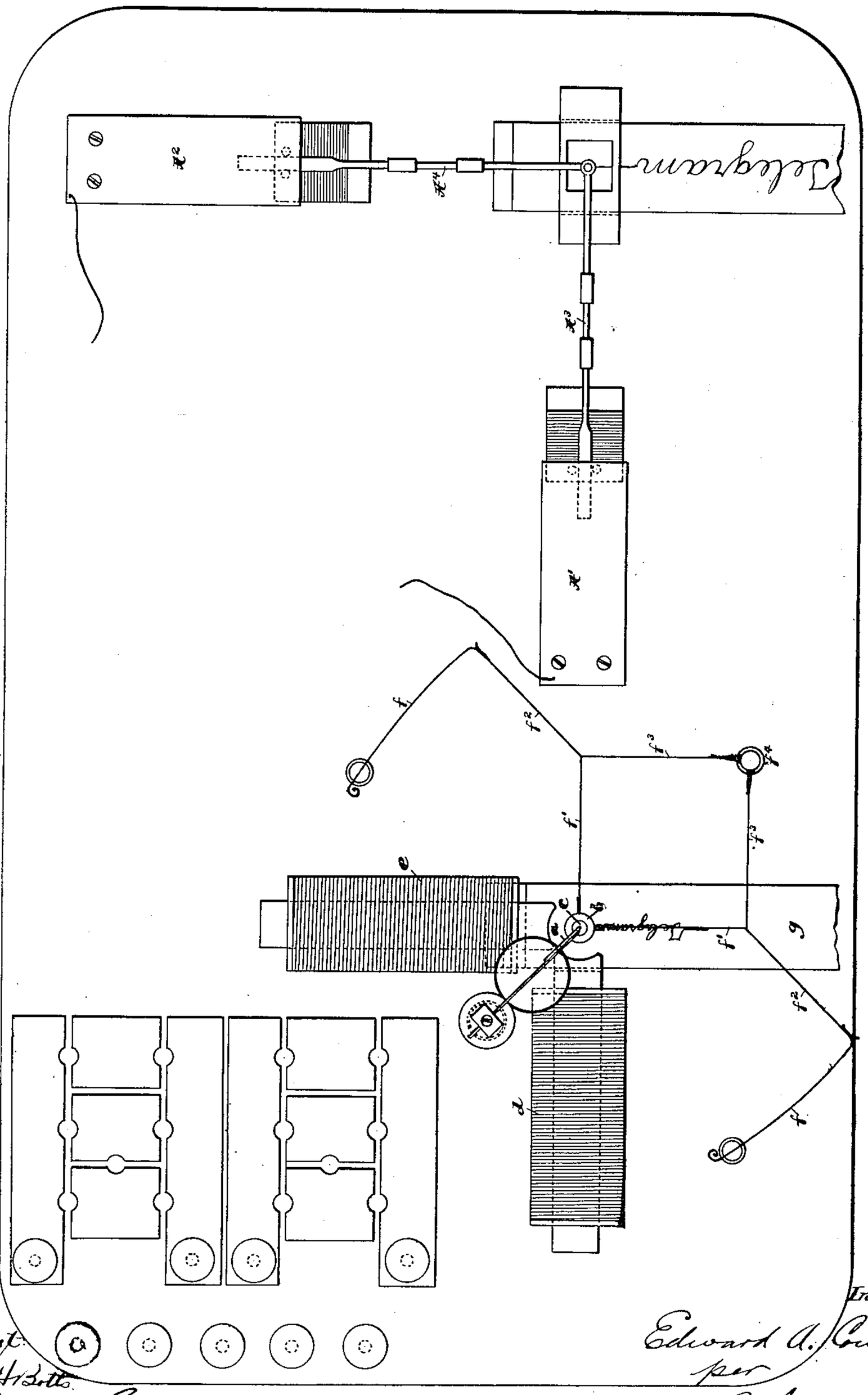


Fig. 1.

Attest:
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L. P. Storm

Inventor.
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per
Behrend & Cady,
Attys.

(No Model.)

4 Sheets—Sheet 2.

# E. A. COWPER.

## ELECTRIC TELEGRAPH.

No. 353,541. Patented Nov. 30, 1886.

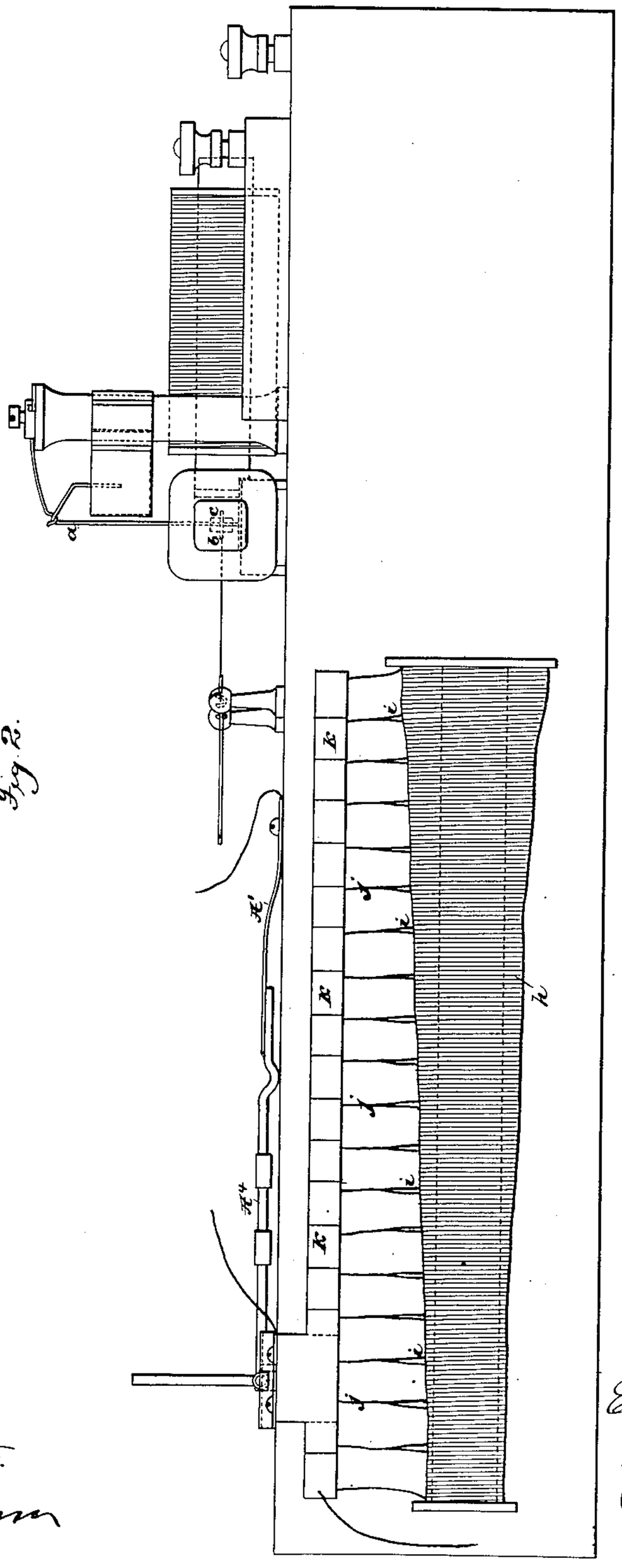

Fig. 2.

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(No Model.)

4 Sheets—Sheet 3.

# E. A. COWPER.

## ELECTRIC TELEGRAPH.

No. 353,541. Patented Nov. 30, 1886.

Fig. 10.

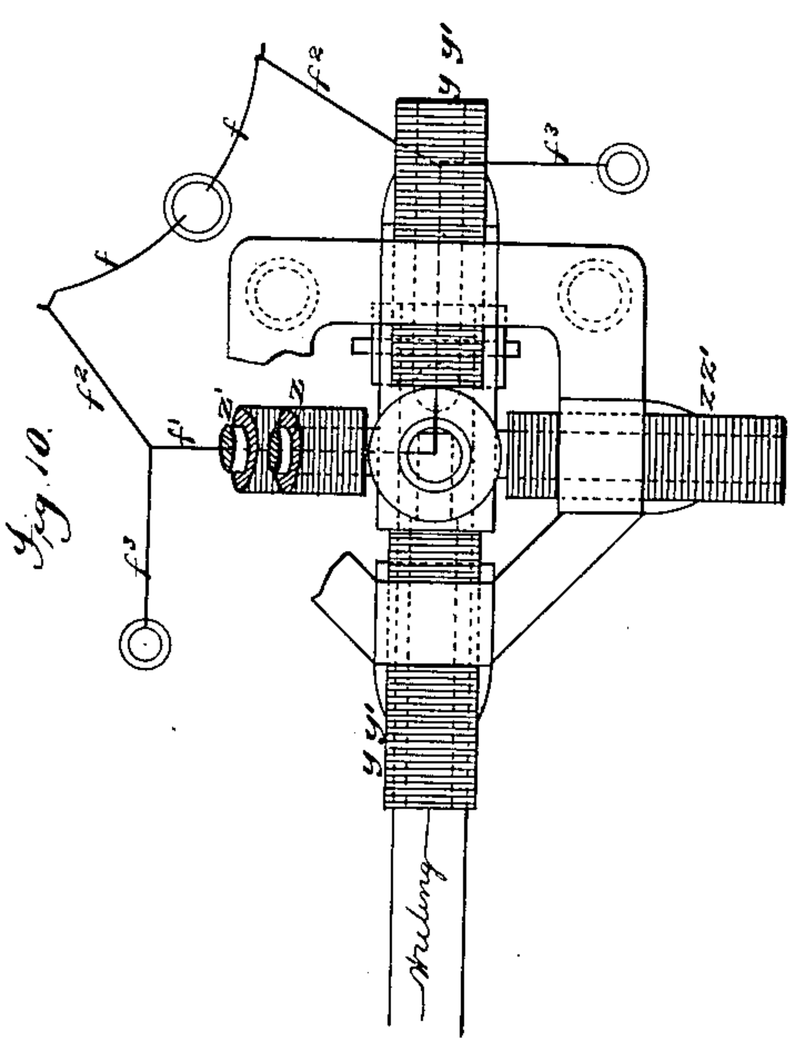



Fig. 7.

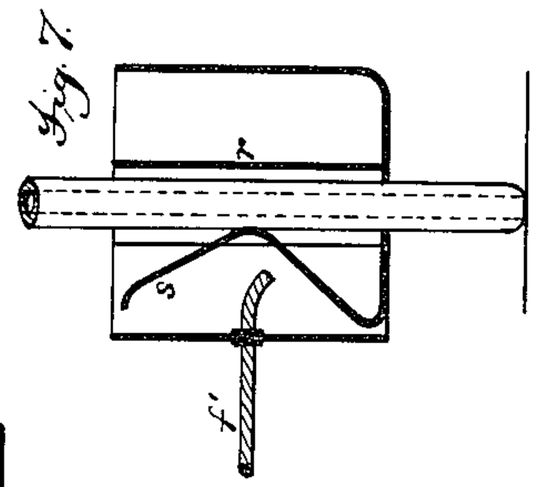



Fig. 8.

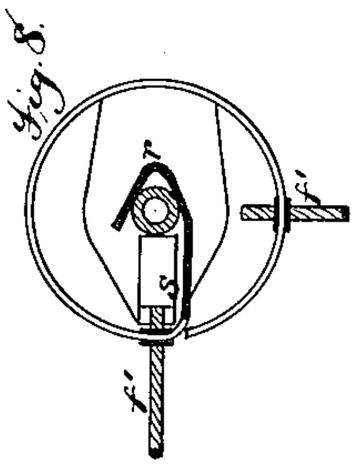



Fig. 6.

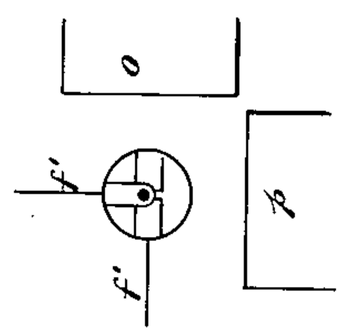



Fig. 9.

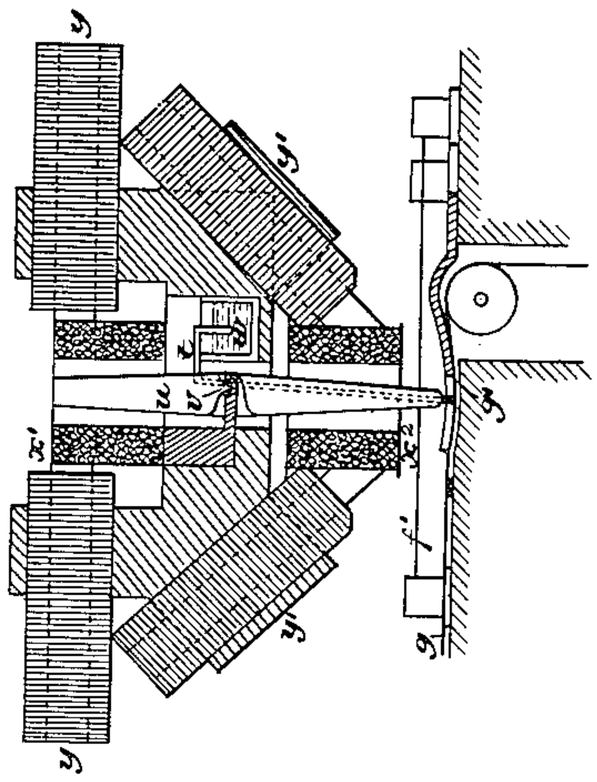



Fig. 5.

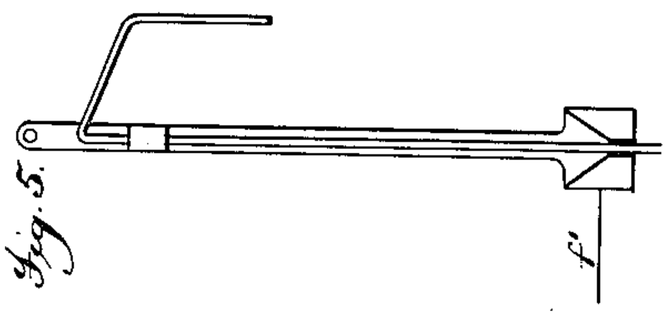



Fig. 4.

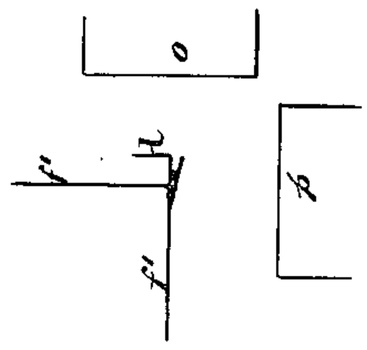
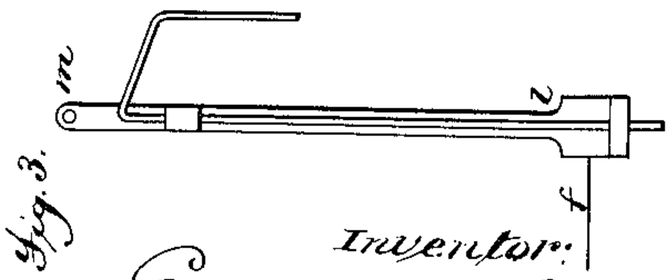



Fig. 3.

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(No Model.)

4 Sheets—Sheet 4.

# E. A. COWPER.

## ELECTRIC TELEGRAPH.

No. 353,541. Patented Nov. 30, 1886.

Fig. 13.

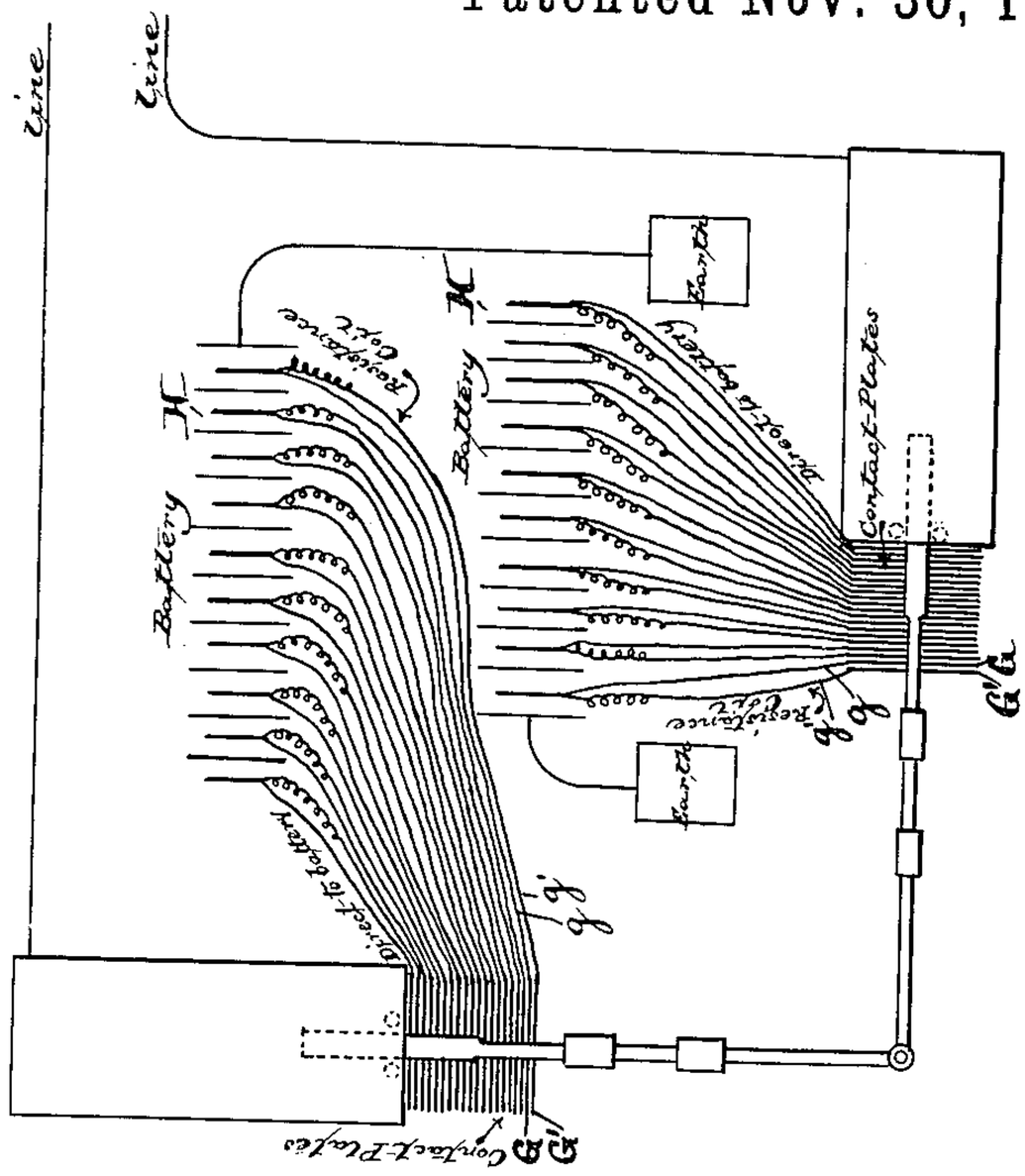



Fig. 11.

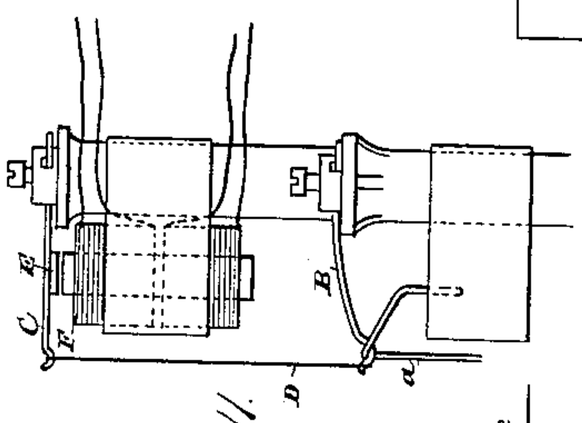
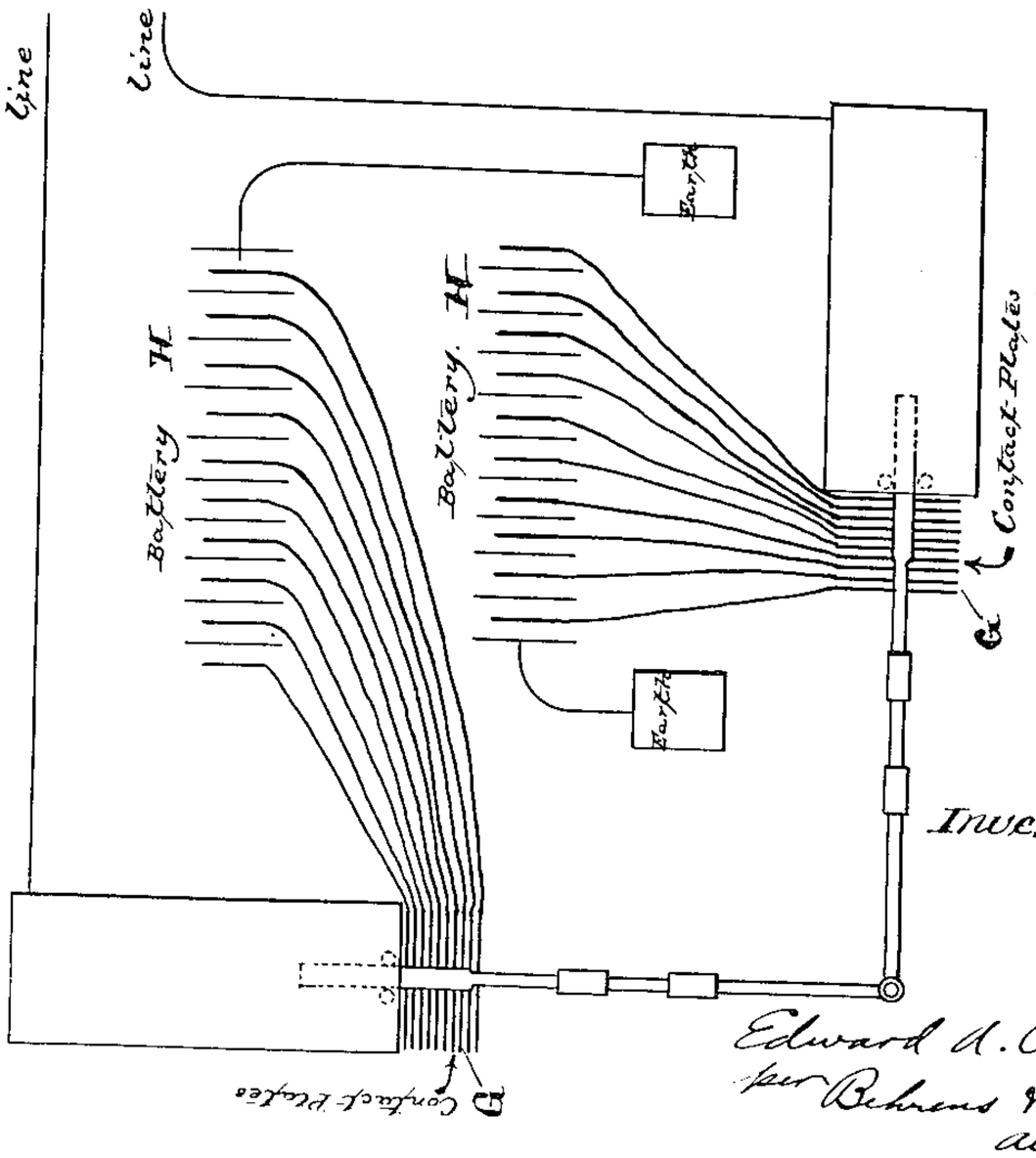



Fig. 12.




Attest:
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Inventor:
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# UNITED STATES PATENT OFFICE.

EDWARD ALFRED COWPER, OF WESTMINSTER, COUNTY OF MIDDLESEX ENGLAND, ASSIGNOR TO BRENT GOOD, OF NEW YORK, N. Y.

## ELECTRIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 353,541, dated November 30, 1886.

Application filed August 7, 1886. Serial No. 210,467. (No model.) Patented in England March 28, 1879, No. 1,242.

*To all whom it may concern:*

Be it known that I, EDWARD ALFRED COWPER, a subject of the Queen of Great Britain, residing at Westminster, in the county of Middlesex, England, have invented a new and useful Improvement in Electric Telegraphs, (for which I have received Letters Patent in England, No. 1,242, dated March 28, 1879;) and I do hereby declare that the following is a full description of the same.

My invention relates to the method of transmitting telegraphic signals for which Letters Patent for Great Britain were granted to me on the 15th of June, 1878, No. 2,385. According to this method the movements of a pen or style at the sending-station were caused to introduce varying resistances into two electric circuits connected with the receiving-station, so that the varying currents in acting upon two electro-magnets at the latter station caused these to impart movements in two directions at an angle to each other to the receiving pen or style, whereby this was made to reproduce the writing or characters produced by the sending-pen.

According to my present invention, instead of making the movements of the style or pen introduce varying resistances into the line-circuit, I cause them to produce greater or less strength of current by bringing into the circuit a greater or less number of battery-cells or parts thereof, as illustrated in Fig. 12; or, instead of employing the direct currents from the batteries or other sources of electricity, I employ for the line-circuit induced currents varied in strength by the movements of the style or pen, for which purpose it may be connected to iron cores sliding longitudinally within solenoids, or to solenoids sliding over fixed cores. The variation in the strength of currents sent into the line-circuit may also be effected by combining various numbers of battery cells with various resistances in the following manner: The contact-bars worked by the sending pen or style, besides passing over successive plates connected through various resistances to the line-wire, as described in the specification referred to, also pass over successive plates respectively connected to various numbers of battery-cells, these two sets of plates being so arranged that at the one extreme of its stroke the contact-bar makes connection from the smallest number of cells to the greatest resistance, and conversely, as illustrated in Fig. 13. Each contact-bar may be made to slide in guides and have two projections on its under side, one sliding over a set of contact-plates connected to the resistance-coils and the other projection sliding over a set of contact-plates connected to the battery-cells, and the pencil being connected to each by a connecting-rod, so that as the operator writes battery-cells are added and resistance-coils left out of the circuit when greater power is wanted, or battery-cells are left out and resistance-coils are taken into the circuit when less power is wanted. In the arrangement described in the specification referred to the receiving-pen was connected by a system of threads or wires to two horizontal soft-iron cores or bars mounted on axes within fixed coils, through which the varying currents were passed, and situated between the poles of fixed magnets; or the varying currents were passed through the coils of fixed electro-magnets, so that the varying movements of the said cores or bars were imparted through the threads to the pen.

According to one of my present improvements I employ, in place of this arrangement, a single movable soft-iron bar, tube, or needle, which is connected directly to and is in line with or parallel to the pen or style, being suspended between two fixed electro-magnets, or two sets of such magnets, situated at a right or other angle to each other, through the coils of which electro-magnets the varying currents of the two circuits are made to pass. The needle being connected to two springs acting upon it in opposite directions to those in which the two sets of magnets act upon it, it will be seen that varying currents passing through the one magnet or set of magnets will produce varying movements in the one direction in the needle, while the varying currents passed through the other magnet or set of magnets will produce varying motions in the other direction at a right or other angle to the first, and these mo-

tions being imparted directly to the pen or style will cause this to reproduce the characters written by the sending-pen.

The suspension of the needle, so as to enable it to move in every direction, may either be effected by resting it on a point or on a universal joint at any part of its length, or it may be suspended from a spring or from a flexible thread or wire. It may be either rigidly fixed to the pen or style, or the latter may be supported independently of the needle, and be so connected thereto that the pen is caused to reproduce the motions of the needle in a more or less magnified manner.

In order to render the cores of the fixed electro-magnets as sensitive as possible to slight variations in the current, I make them of bundles of fine wires or thin plates in a manner well known. Instead of employing a separate needle or separate needles to which the pen is connected, the pen itself may be pivoted or suspended vertically over the paper and have fixed on it a piece of iron exposed to the varying attraction of electro-magnets in the two directions, acting in opposition to springs pulling it in the opposite directions. The elasticity of the pen itself or the needle which carries it may serve instead of such springs.

In order that the pen when it is pivoted may more easily traverse the surface of the paper, it is of advantage to give the paper at the place where the pen moves over it a concave form coinciding nearly with the circular path in which the pen moves round its pivot. For this purpose I pass the paper under a bent plate with a hole through it of sufficient size to allow of the largest excursions of the pen, the bend of the plate giving the paper a certain amount of concave curvature at the place where the pen moves over it.

In order to secure the pen to the rods, strings, needle, or bar which gives it motion, I insert its lower end in a light spring-clip, so that it can be readily withdrawn therefrom when required, but is firmly held thereby when in use. This clip may be made as a hole or slot in a light spring admitting of a small amount of vertical motion, so as to allow the pen to give to inequalities of the paper.

According to another improvement which has for its object to raise the pen from the paper when it ceases to write, and which is applicable either to the above-described arrangement or to that described in the specification of my previous patent, I apply to the pen or style a spring acted on by an electro magnet or magnets, through the coils of which the currents of the two circuits are made to pass, so that on the passing of such currents the pen is allowed to descend by the action of the electro-magnets in opposition to the spring, so as to come in contact with the paper strip, while when the currents are caused to cease, by raising the sending-pen on the completion of the word or character transmitted, the spring raises the pen out of contact with the paper, thereby causing each word or character transmitted to be written separate from the other or others adjoining it, as in ordinary writing.

I have described my method of transmitting telegraphic signals as being worked by two separate electrical circuits; but it will be evident that by the application of the well-known "duplex" system a single circuit may be used for the purpose; also, that instead of using the currents from the line wire or wires direct, these may be made to operate relays at the receiving-instrument in a well-known manner. For example, by rapid alternations of current, a single line-wire may be arranged to convey only positive impulses from one of the contact-rods of the sending-pen to excite one of the electro-magnets of the receiving-pen, the same wire being arranged to convey only negative impulses from the other contact-rod of the sending-pen to the other electro-magnet of the receiving-pen; or, according to a known method, depending on the correspondence of vibrations of tuning forks or springs, each of the two electro-magnets may be made to receive the impulses only from one of the bars of the sending-pen.

Although in the above description I have referred to batteries as the source of electricity employed in the apparatus, it is to be understood that electricity from other sources—such as that produced by magneto-electric or dynamo-electric machines—may be applied to operate, as set forth.

Referring to the drawings, Figure 1 is a plan, and Fig. 2 an elevation, of an instrument constructed according to my present invention. *a* is the glass siphon receiving-pen suspended by a spring. *b* is a thin disk of soft iron having a central hole, into which is inserted a plug of cork or other suitable material, *c*. The pen *a* fits into a central hole in the plug *c*, and its lower end projects a short distance below the said plug. The pen may fit the hole in the cork plug with sufficient friction to support the weight of the plug and disk and retain them in their proper position on the pen; or the pen may be a loose fit in the hole and be retained in position by wax or any suitable cement. *d e* are electro-magnets placed at right angles to each other, each capable of moving the pen by attracting the disk *b*, which acts as an armature to both. Each of these magnets is connected with one of the line-wires. *f f* are the fine springs, which supply the necessary resistance to the pen against the pull of the magnets, the pen being connected to those springs by the threads $f' f' f^2 f^2 f^3 f^3$, the last two of which are attached to the post $f^4$. *g* is the traveling slip of paper upon which the message is written by the siphon-pen. It is driven by clock-work or other suitable mechanical means at a uniform relative speed to the paper in the sending-instrument. The sending apparatus shown is similar in its construction to that described in my former specification, above referred to. The currents from the two batteries, instead of being conveyed through wires fixed to the connecting-rods at-

tached to the pencil, are conveyed to the springs A′ A², which bear upon the ends of the said connecting-rods, respectively. A³ A⁴ are small portions of insulating material—such as wood or vulcanite. The resistance-coils are formed of long continuous wires wound on long bobbins *h*, Fig. 2. Connections are made by other short wires, *j*, from the long ends or tails *k* of the contact-plates to loops *t*, formed on the said continuous wires and projecting at the suitable intervals.

Fig. 3 is an elevation, and Fig. 4 a plan, of another form of the armature attached to the pen. *l* is a piece of thin soft sheet-iron the lower end of which is bent to the form of a right angle, and presents one of two flat faces to each of the magnets *o p*. Above the flat faces is a shank, *m*, of a trough-like section, in the hollow of which the pen can be placed. At the top of the shank *m* is a hole, into which is inserted the end of the fine spring, which supports the whole. At the bottom is a spring-clip, to hold the pen in position, and near the top the pen is steadied in the trough-like shank by a ring of wire or string or by cement.

Fig. 5 is an elevation, and Fig. 6 a plan, of another modification of the armature, the material and the form of the shank being the same as in that last described. The lower end is in this case formed into a cylinder, from the upper edge of which two narrow strips or tongues project inward and downward, forming together a pair of clips to hold the pen in the axis of the cylinder. The shank is bent or cranked just above the cylinder into the line of the pen.

Fig. 7 is an elevation, and Fig. 8 a plan drawn to an enlarged scale of another form of armature, differing from those above described in having no shank, being supported solely by its attachment to the pen. This consists of a strip of sheet-iron bent into a cylinder, one end of the strip being extended inward toward the axis of the cylinder, where it is bent to form a trough-like recess, *r*, into which recess the pen is pressed by a spring tongue or clip, *s*, projecting upward from the lower edge of the cylinder. In this case the pen itself is hung to the suspending-spring above, and the pressure of the clip is sufficient to sustain the weight of the light armature. In each of the cases above described threads and springs similar to those shown in Figs. 1 and 2, or other convenient means, are employed to resist the pull of the magnets.

Another method of carrying out my invention is shown in Figs. 9 and 10. In this arrangement the siphon-pen *t* is held by a bar of soft iron, *u*, of a tubular section, which I call the "needle." *v* is a fixed bracket projecting into the interior of the needle through a hole in the side thereof, and having a small hollow at its extremity to receive a steel point fixed in the axis of the needle. The needle thus supported is free to vibrate in any direction, and to move with it the pen *t*, which has its longer leg passed in through a hole in the side of the needle and projects out through another hole a little the lower extremity of the same. The shorter leg of the siphon dips into the ink-reservoir *w*. *x′ x²* are stationary coils of wire surrounding the needle *u*, of sufficient internal diameter to permit the required amount of motion of the needle. A current passing through these coils magnetizes the needles. *y y y′ y′* are a set of stationary bar electro-magnets, which, being in one circuit, always act together. Their poles are so arranged that when the needle is polarized they all unite to deflect the needle to an inclined position in the plane in which they are placed. *z z z′ z′* are a set of magnets precisely similar in their arrangement and action, placed in a plane at right angles to the plane of the first set, and producing a deflection of the needle in their own plane. *f f* are springs. *f′ f′ f² f² f³ f³* are threads to give the necessary resistance to the needle, against the pull of the magnets, as in Figs. 1 and 2. The one set of stationary magnets, *y y y′ y′*, are connected to one line-wire, and the other set, *z z z′ z′*, to the other, while a local battery is connected to the needle-coils *x′ x²* to keep the needle constantly magnetized, as in one method of working the two-needle instrument constructed according to the specification above referred to. As will be seen in Fig. 9, the paper *g* is made to pass under a curved plate, *g′*, so as to present to the pen a surface approximately corresponding to the arc in which the point of the pen moves. Another modification of the arrangement last described consists of a permanently-magnetized steel needle in place of that of soft iron, in which case the coils and the local battery are not required; or the magnetism may be induced in the needle by strong permanent magnets in close proximity to it.

Fig. 11 is an elevation of the mechanism for raising the pen from the paper, and is described as follows: B is a light spring which partly supports the weight of the pen *a*, allowing it to bear upon the paper with the requisite amount of pressure for writing. C is a stronger spring, capable of lifting the spring B and the whole weight of the pen by means of the connecting-thread D. E is an armature attached to the spring C, and capable of being attracted by the electro-magnet F when a current is passing around either of the two coils with which the latter is wound. The ends of the said two coils are so connected that each is in the circuit of one of the two currents which flow through the line wire or wires when the pen is writing. It will be seen that as long as the pen is moving in the act of writing the electro-magnet F will hold down the armature E and the spring C, causing the thread D to hang slack and inoperative; but as soon as the currents cease to flow through the line-wires, and consequently through the coils of the electro-magnet F, the latter will release the armature E and the spring C, which latter will rise, and by the tension of the thread D will lift the pen off the paper. The

discontinuance of the currents and consequent lifting of the pen may be effected by the lifting of the pencil by the operator, lifting the contact-rods off the contact-plates and so stopping all currents; or it may be done by a switch or other contact-breaker.

In Fig. 12, G indicates a number of contact-plates, over which the contact-pieces, pressed thereon by a spring, move, and the contact-plates G are connected, as shown, to a series of battery-cells, H.

It will be seen that as the contact-pieces are moved by the action of the stylus to and fro over the contact-plates the strength of the current will be varied by bringing into the circuit a less or greater number of the battery-cells H.

In Fig. 13 the contact-plates are indicated by G G′; the plates G being connected to the batteries H by wires *g*, and the plates G′ by wires *g′* having resistance-coils. When the contact-piece has moved onto the first plate G, all the battery-cells are then in circuit without any resistance-coils. When the contact-piece has moved onto the next contact-plate G′, the same number of cells are still in circuit with one resistance coil. Moved onto the next contact-plate G all the battery-cells but the first one will be in circuit. Moved onto the next contact-plate G′, (the fourth plate,) the same number of cells as the last will be in circuit, but through a resistance-coil, the first cell and resistance-coil being cut out entirely, and so on down to one cell of battery with the resistance-coil in.

I am aware of Patent No. 80,452, and what is therein shown and described is hereby disclaimed.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The combination, with two electro-magnets placed at an angle to each other, of a laterally-movable armature-carrier pivoted or supported between said electro-magnets, substantially as described.

2. The combination, with two electro-magnets placed at an angle to each other, of an armature-carrier pivoted or supported between said electro-magnets, and a pen or stylus connected with said carrier, substantially as described.

3. The combination, with two electro-magnets placed at an angle to each other, of a laterally-movable armature-carrier pivoted or supported between said electro-magnets and provided with an armature common to both, substantially as described.

4. The combination, with two electro-magnets placed at an angle to each other, of an armature-carrier pivoted or supported between said electro-magnets and provided on its lower end with a pen or stylus, substantially as described.

5. The combination, with two electro-magnets placed at an angle to each other, of an armature-carrier supported by a spring and provided at its lower end with a pen or stylus, substantially as described.

6. The combination, with a siphon receiving-pen suspended by a spring, of an armature carried by said pen, substantially as described.

7. The combination, with contact-plates, of a sending-stylus, contact-makers, and springs connected with the circuit and arranged to bear on said contact-makers, substantially as described.

8. The combination, with the receiving-stylus, of a curved perforated plate under which the paper is arranged to pass, whereby a surface approximately corresponding to the arc in which the point of the pen moves is presented to the pen, substantially as described.

9. The combination, with the receiving-stylus laterally movable in any direction, of means for lifting the same from the paper when the circuit is broken, substantially as described.

10. The combination, with the receiving-stylus laterally movable in any direction, of an armature connected thereto, and an electro-magnet in circuit with the sending apparatus, substantially as described.

11. The combination, with the receiving-stylus laterally movable in any direction, of a spring-armature connected to said stylus and arranged to normally lift the latter, of an electro-magnet in circuit with the sending apparatus, and arranged, when energized to depress the armature, so as to allow the stylus to come into contact with the paper, substantially as described.

12. The combination, with a movable sending style or tracer, of contact-pieces connected thereto and to the circuit, and a series of contact-plates connected to a series of battery-cells, whereby varying numbers of battery-cells may be included in and excluded from the circuit, substantially as described.

13. The combination, with the movable sending style or tracer, of contact-pieces connected thereto and to the circuit, and a series of contact-plates connected to a series of battery-cells and to a series of resistances, whereby varying numbers of battery-cells and also varying resistances are included in or excluded from the circuit, substantially as described.

In testimony whereof I have hereunto subscribed my name.

EDWARD ALFRED COWPER.

Witnesses:

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THOMAS LAKE,

*Both of* 17 *Gracechurch St., London, E. C.*