(No Model.) 3 Sheets—Sheet 1.

S. P. DENISON.

AUTOGRAPHIC TELEGRAPH.

No. 315,391. Patented Apr. 7, 1885.

Fig. 1.

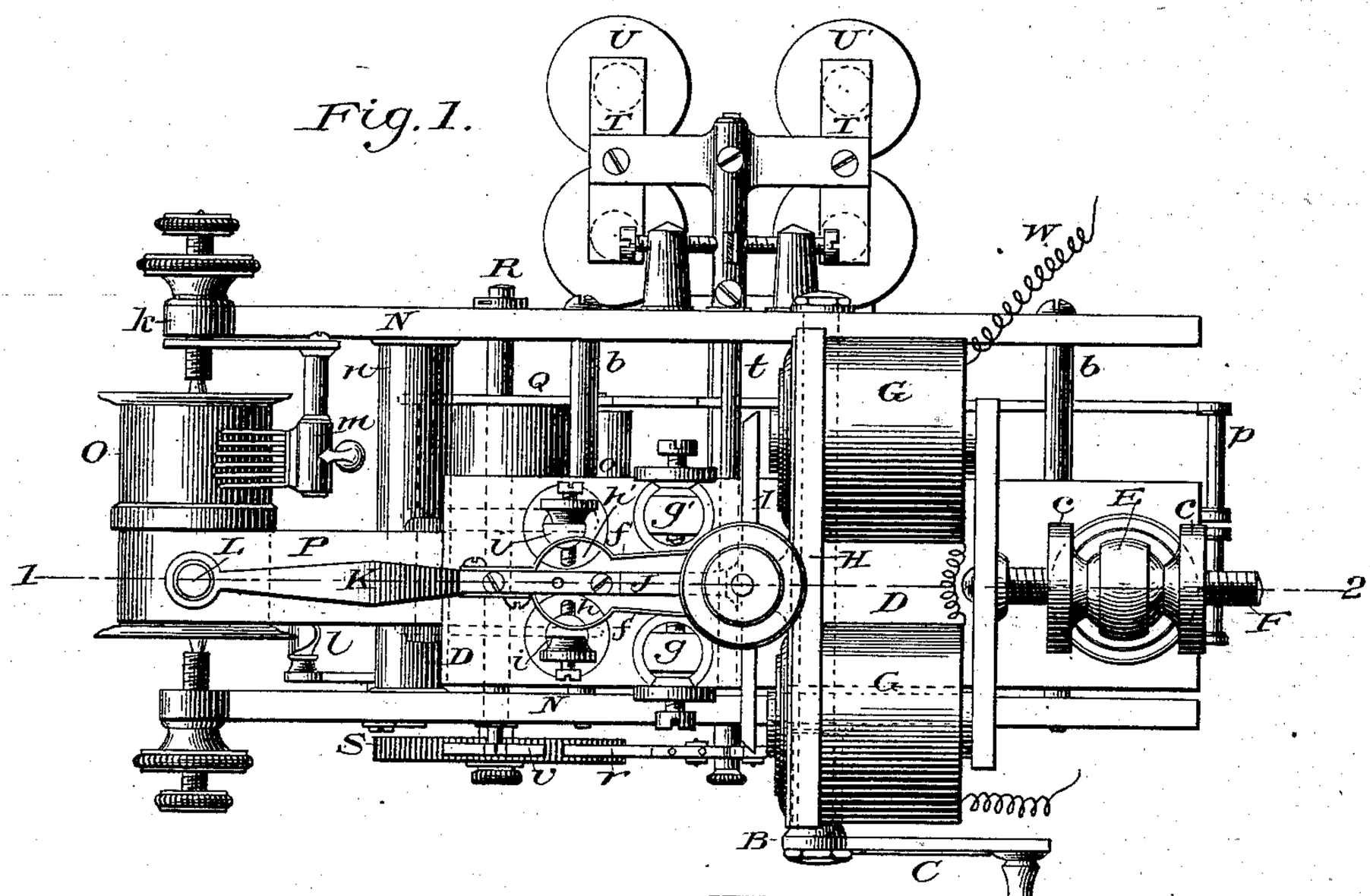
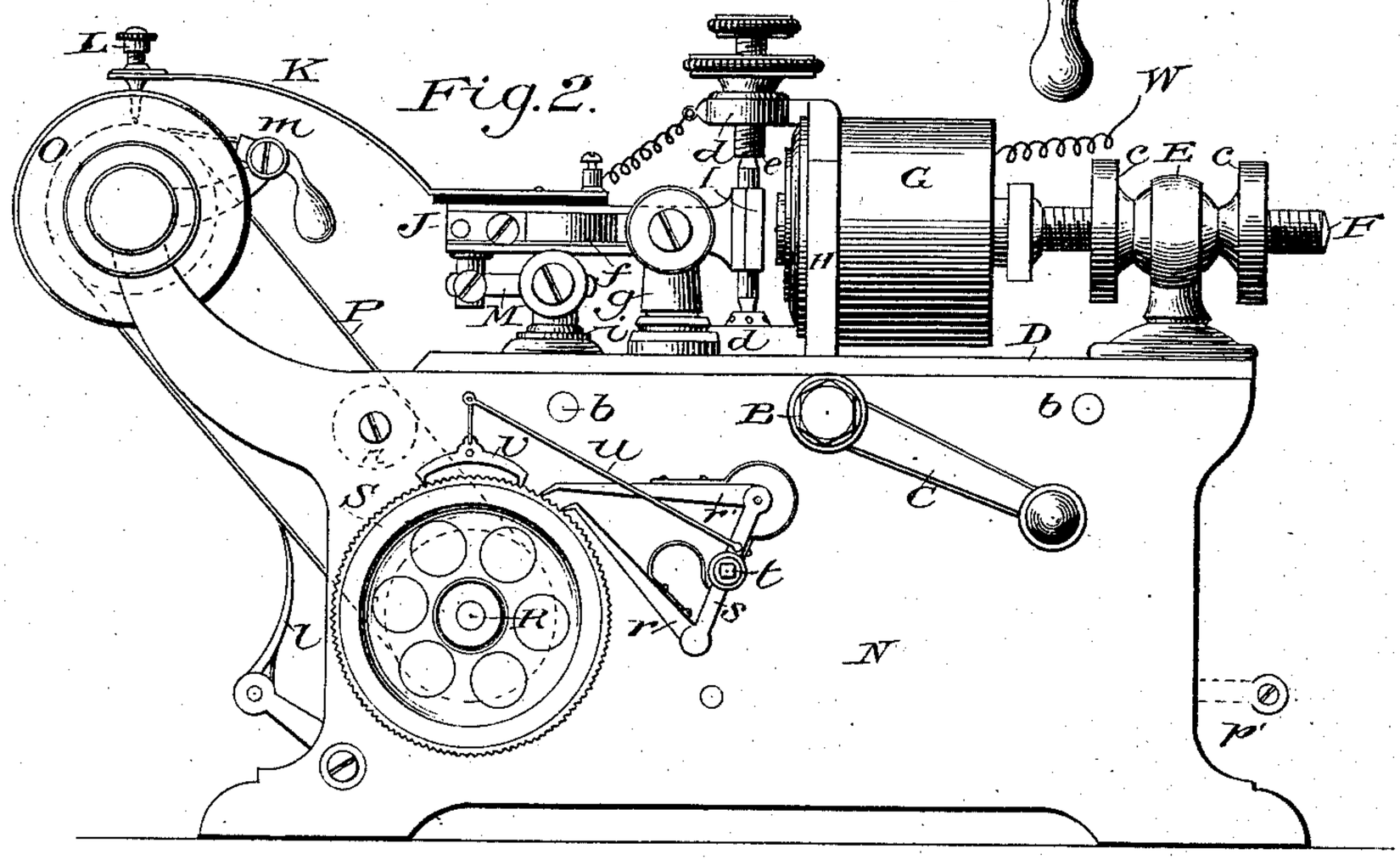


Fig. 2.



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(No Model.)

3 Sheets—Sheet 2.

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AUTOGRAPHIC TELEGRAPH.

No. 315,391. Patented Apr. 7, 1885.

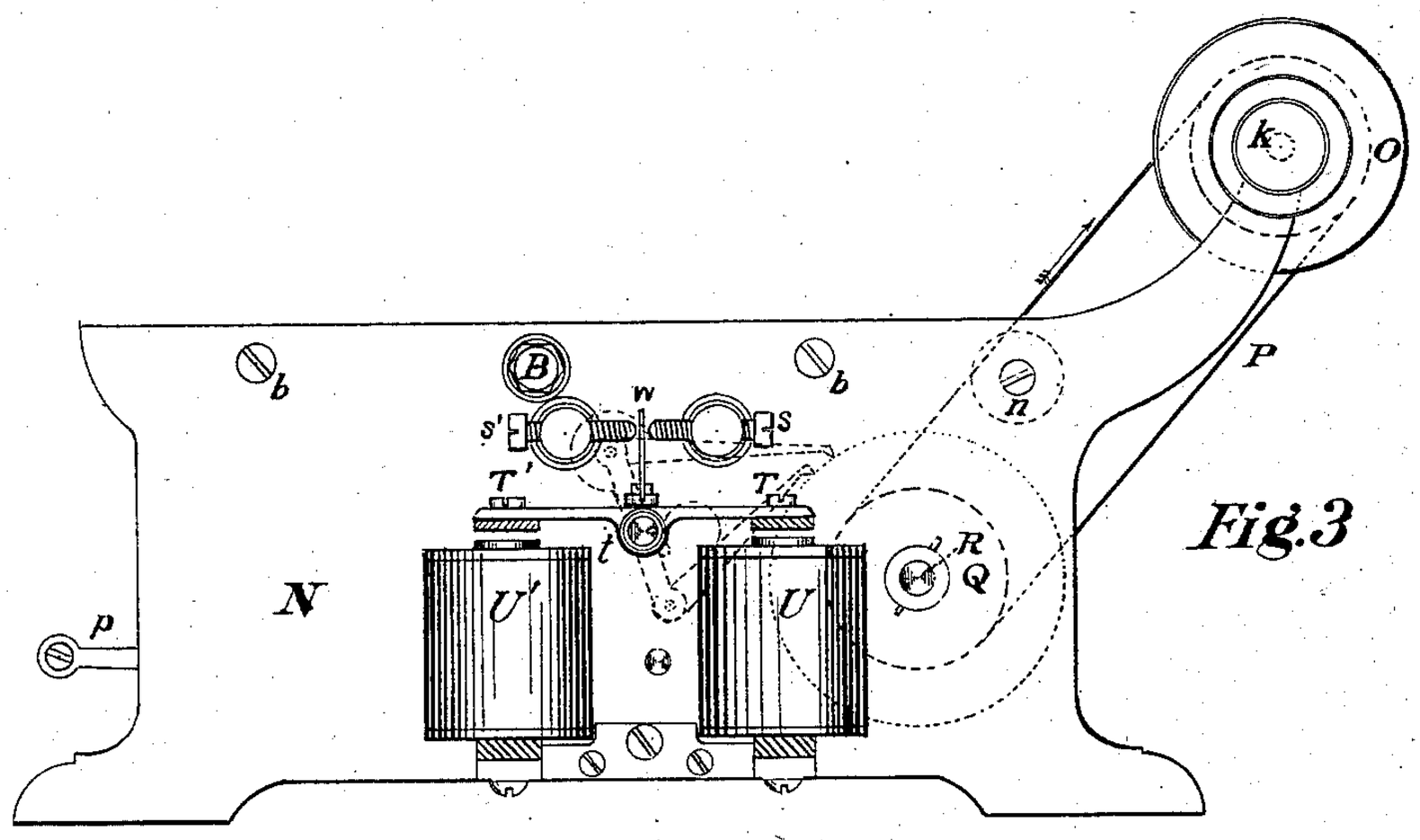

Fig. 3

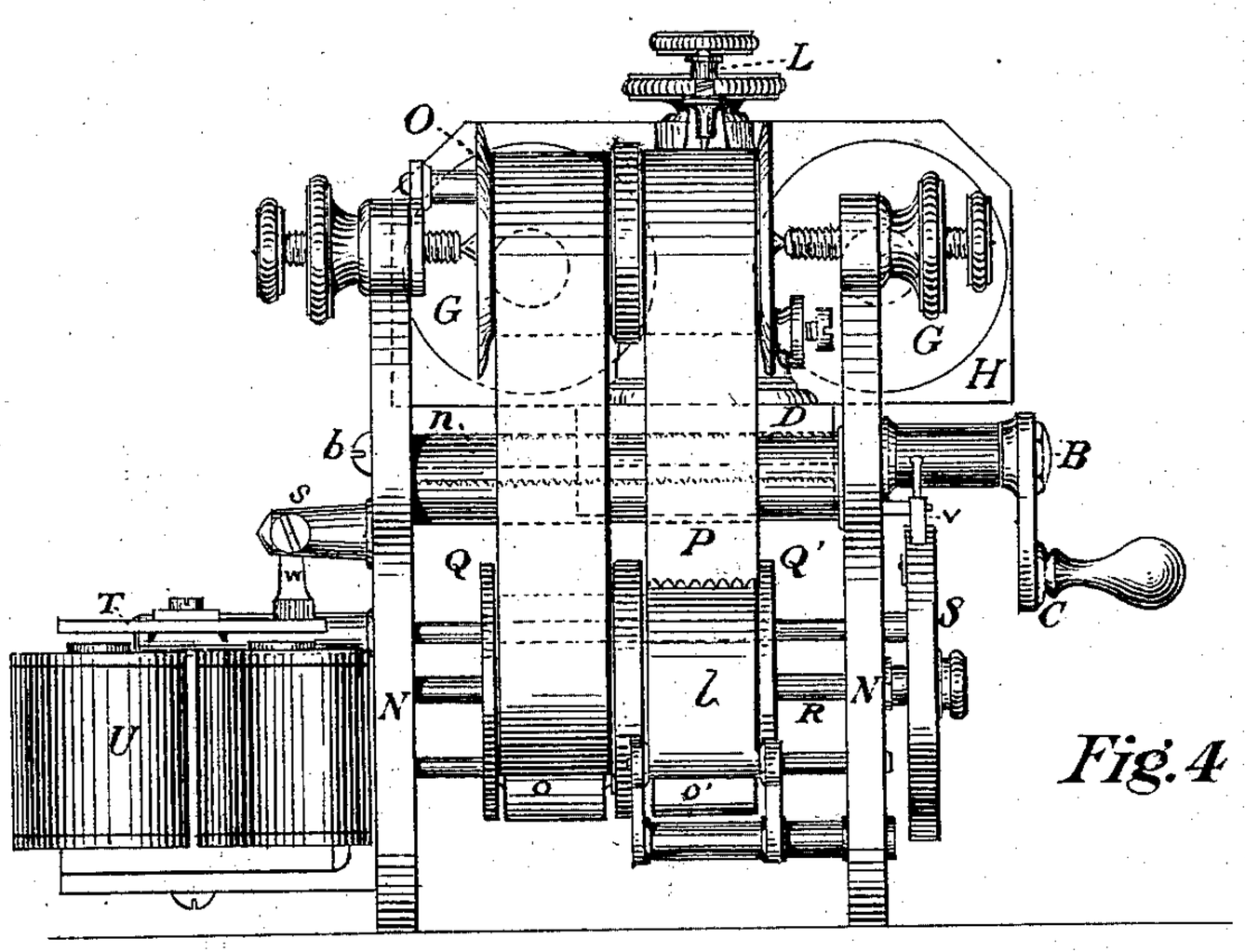

Fig. 4

WITNESSES

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(No Model.) 3 Sheets—Sheet 3.

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AUTOGRAPHIC TELEGRAPH.

No. 315,391. Patented Apr. 7, 1885.

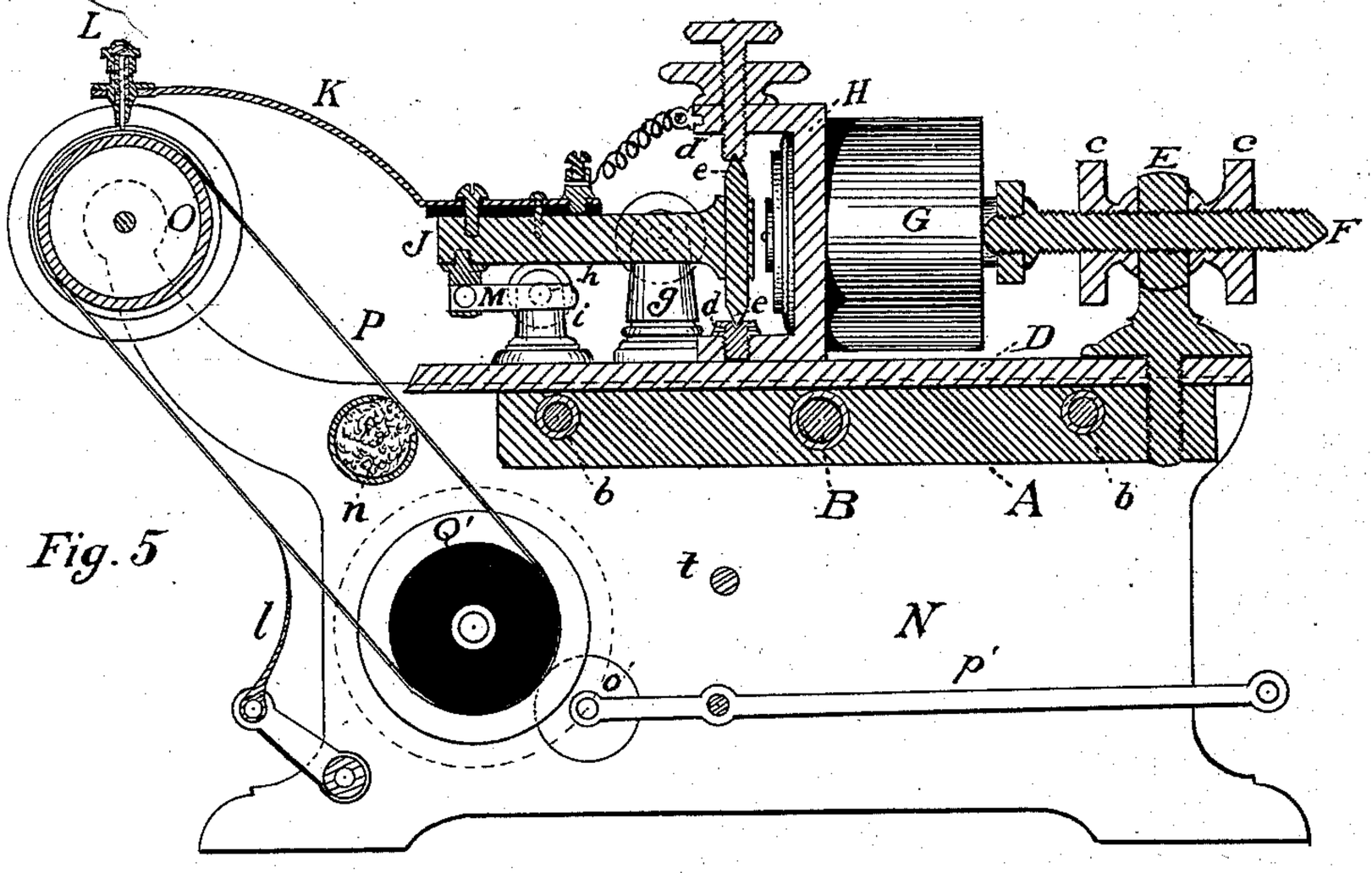

Fig. 5

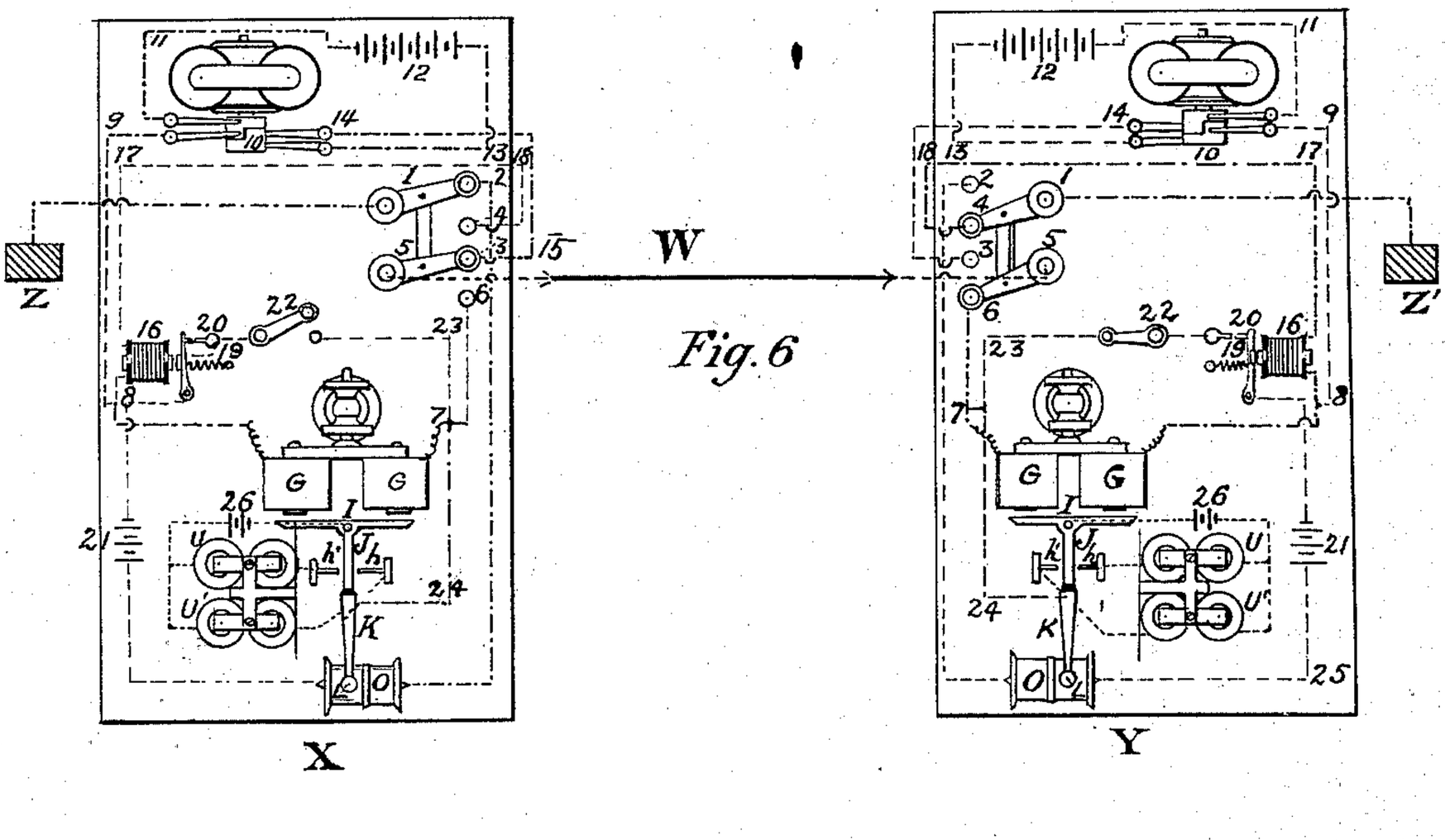

Fig. 6

WITNESSES

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UNITED STATES PATENT OFFICE.

SYLVESTER P. DENISON, OF NEW YORK, N. Y., ASSIGNOR OF ONE-HALF TO ROBERT D. RADCLIFFE, OF SAME PLACE.

AUTOGRAPHIC TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 315,391, dated April 7, 1885.

Application filed June 17, 1884. (No model.)

To all whom it may concern:

Be it known that I, SYLVESTER P. DENISON, a citizen of the United States, residing in the city of New York, in the State of New York, have invented certain new and useful Improvements in Autographic or Copying Telegraph Instruments and Circuits, of which the following is a specification.

My invention relates to a new principle and arrangement of mechanical forms and details which I have discovered, invented, and applied to the construction and use of autograph or fac-simile telegraph instruments and circuits, by which, by using a current into which constant changes of polarity are introduced without causing breaks in the circuit, writings or characters are duplicated at a distant point through one wire only, without the need of the presence of a person at the receiving end, and in which the instruments are run or actuated by electricity alone, without the use of clock-work, springs, or weights.

The objects of my improvements are to render autographic telegraphy practicable to the business and social elements in cities, and make the sending of written messages from one point to another so simple that any person of ordinary intelligence can send them, and to decrease the cost of transmitting messages from one city to another in ordinary telegraph business by the use of simple automatic machines without skilled operators, at the same time securing all the advantages resulting from the reproduction of the handwriting of the original message. I attain these objects by the mechanism and arrangements illustrated in the accompanying drawings, which form a part hereof, and in which—

Figure 1 is a plan view showing the different parts of the machine to be seen from the top. Fig. 2 is a view of one side, showing the parts which operate the electrode at the top and a portion of the mechanism which feeds the paper through the instrument. Fig. 3 is a view of the other side, showing the magnets and armatures which communicate motion to the feed mechanism. Fig. 4 is a view showing the different parts when seen from the front. Fig. 5 is a vertical section of the machine through the line 1 2 in Fig. 1, and Fig. 6 is a diagram showing the different circuits and connections with the several working parts of the machines.

Similar letters refer to similar parts throughout the several views.

In the form herein shown and described the machines are arranged for the use of narrow continuous strips or fillets of paper or its substitute for the transmission and reception of the characters or messages; but the same general devices can be applied to machines arranged for the use of wider and detached sheets of paper.

A (shown only in Fig. 5) is a permanent magnet, which slides on the two bars *b b*, and which, with all the parts fixed to it, can be shifted from one side of the instrument to the other by means of the screw B, which is turned by the handle C. The screw B serves not only to shift the magnet and the parts attached to it, but to hold it securely in position when so shifted.

Fastened to the upper face of the magnet A, and moving with it when it is shifted, is a brass plate, D.

Near the back end of the magnet A, screwed firmly into it, and extending up through the plate D, is a steel post, E, through which passes the steel screw F, which is provided with the two adjusting-screws *c c*.

Attached to the screw F is the electro-magnet G. The magnet G is kept in position at its front end by a brass frame, H, fastened to the plate D. Projections *d d* on the frame H form a pivot-frame, in which is pivoted the armature I on the pivot *e*.

Fixed to the armature I is the arm J, which is extended by the spring K, carrying at its extremity the electrode L. The spring K is insulated from the arm J, as shown in Figs. 2 and 5.

To the sides of the arm J are attached two rebounding springs, *f f'*, which, by the vibrations of the armature I, are brought in contact alternately with the screws in the posts *g g'*, which are set in the plate D. The screws in the posts *g g'* are adjustable, so as to make the contact with the springs *f f'* light or hard, as may be required, and regulate the distance of the sweep of arm J. The object of the springs *f f'* is also to assist in the vibrations of the armature I by helping it at the instant

of starting from either side and prevent sticking at the poles. On the under side of the arm J is attached a platinum contact-spring, M, acting as a relay for the feed-magnets U U', and which at each vibration is brought alternately in contact with the two contact-points *h h'*, which are set in two posts, *i i'*, also set in the plate D, but insulated from it and arranged on the under side for connection with the wires of a local battery.

All of the parts above described are attached to the magnet A and move with it when shifted from side to side of the machine.

N N are the side plates of the machine.

Pivoted between the two arms *k k* is the cylinder O, having two grooves near each end, which serve to guide the strips of paper as they are fed through the machine.

m is a wire brush, which maintains a metallic connection continually on the transmitting-strip, and which is placed as close as possible without touching the electrode L.

P is a band or belt of suitable material extending from the cylinder O to the feed-drum Q', for supporting and carrying the receiving-strip and preventing its being broken by undue tension.

l is a scraper to separate the receiving-strip from the belt P.

n is a tube containing a sponge or other material saturated with the chemical solution with which the receiving-slip is moistened before it passes under the electrode L. The solution is conveyed to the paper by an opening suitably located for the purpose.

R is a shaft extending through the machine, on which is fixed the ratchet-wheel S and the two drums Q Q'. Pressing against the drum Q is the friction-roller *o*, the pressure being established and released by the lever *p*. By the revolution of the drums Q Q' and the roller *o* and the belt P the paper strips are fed steadily through the machine from reels on which they are kept wound.

Engaging in the ratchet-wheel S are the pawls *r r'*, which are operated by the rocking lever *s*, to which a rocking motion is communicated by the shaft *t* and the tilting connected armatures T T', when actuated alternately by the two electro-magnets U U'. As the pawls *r r'* are thus moved by the rocking lever *s* they engage alternately in the teeth of the wheel S and cause it and the drums Q Q' to revolve step by step.

Connected by the arm *u* to an intermediate point on the rocking lever *s* is an escapement, *v*, which by the motion imparted by the arm allows only one tooth of the ratchet to pass at each movement, and thus prevents irregularity in the feed. The rock-shaft *t* is also provided with a stout spring, *w*, which, playing between the set-screws *s s'*, admits of exact adjustment in the extent of the motion imparted.

The magnets U U' are connected by wires through a local battery to the points *h h'*, so that at each vibration of the armature *l* and the arm J alternate contacts are made by the spring M, sending currents through the said magnets and causing corresponding vibrations in the connected armatures T T'.

W is the line-wire which connects the instrument with the main battery, and with one or more similar instruments at distant points.

At the transmitting-machine the current starts from the battery and passes through a suitable pole-changer, which so operates as to throw rapid changes of polarity into the line without breaking the circuit or disturbing it otherwise than by the said rapid changes or pulsations. From the pole-changer the current passes through the electro-magnet G, thence to the electrode L, thence through the transmitting-paper to the brush *m*, and from thence to the line W. At the receiving-machine the current enters and passes through the magnet G, thence to a relay, and from there to ground, unless there are more than two instruments in circuit, in which case the current is taken through the relay-magnet to the next instrument and then to ground.

Having thus described the different parts of my machine, its operation is as follows, and for the purpose of making this explanation more easily understood the case of only two machines being placed in circuit will be taken: Two machines, being constructed exactly similar to each other, and with all the parts as above described, care being taken to have the similar poles of the permanent magnet A similarly located in each, are set up at distant points and connected by the line W, which in its course passes through the main battery and through a suitable pole-changer, as described. At the instrument from which the message is to be transmitted the magnet A, with all the parts as above described, is shifted along the bars *b b* by means of the screw B and the handle C until the electrode L rests over the transmitting-strip and the electrode L is adjusted to a light contact upon its upper surface. At the receiving-instrument the electrode is adjusted in a similar manner over the receiving-strip. The characters or message to be transmitted are written upon the transmitting-strip previous to its being placed in the machine. If a strip is used with a non-conductive surface, the writing must be with a conductive ink, or, if the strip has a conductive surface, non-conductive ink must be used. The receiving-strip is moistened, either before being placed in the machine or during its passage through it, by means of the sponge in the tube *n;* or the sponge may be preferably used to regulate the moisture to a proper degree with any solutions easily decomposed by electrolysis. The lever *p* in the transmitting-instrument is then pressed downward, bringing the roller *o* up to the drum Q, gripping the strip firmly, so that it will be fed through the machine as the drum is made to revolve. When the machines have thus been adjusted and the strips prepared, the circuit on the line W is closed, and at the same time the pole-changer is set in motion by closing a key suit-

ably arranged for the purpose, but not necessary to be shown here. Then at each vibration of the current in the line W the armatures I of both machines will oscillate on the pivots *e*, carrying the arms J, the spring-extensions K, and the electrodes L, causing the latter to vibrate over the surface of the strip with which it is in contact in exact accordance with the vibrations in the line caused by the pole-changer; and it is evident that as the same vibrations govern both machines, the oscillations of the armatures and electrodes must be synchronous. At each vibration of the arm J in both machines the contact-spring M is brought alternately in contact with the points *h* and *h'*, and successively close and open the current from a local battery through the electro-magnets U and U', causing the tilting connected armatures T T' to move in exact unison with the arm J. At each movement of T T' a corresponding rocking motion is conveyed to the rocking lever *s*, and from it to the pawls *r r'* and the escapement-lever *v*. The pawls engaging in the ratchet-wheel S cause it to revolve one tooth or step at a time, and by the shaft R this revolving motion is conveyed to the drums Q Q', and by their revolutions the strips in the two machines are fed. The movement of the paper is a step-by-step one, each movement taking place exactly at the instant the electrode has reached the farthest points on each side of the center of the respective strips. By this means the motion of the paper in each machine is made exactly synchronous, and as the power necessary to drive the feed mechanism is supplied by a local battery the line-current is not thereby taxed.

In practice it will be found that a very light current will serve to operate the machines; but if from an extreme length of the line or leakage on the wire it is deemed too great a tax on the line-current to move the spring-arm K and the electrode L across the entire width of the paper, another local battery can be introduced for that purpose, and the machines provided with an additional vibrating apparatus similar to the parts above described as connected with the permanent magnet A, without the extension-spring K and electrode L, which, set to vibrate very lightly, can be used to relay the vibrations into the main machine, driven by a local battery of sufficient power necessary to obtain the results desired.

As in all operations of the machines thus far described nothing but the pulsations in the line have been utilized to secure such operation, and the line has remained closed, it can be seen that any makes and breaks caused by the electrode of the transmitting-instrument coming in contact with the ink on the strip passing under it will travel along the line and be recorded at the receiving end by electrolysis and identically located. It will be observed that the impulses created by the contact of the electrode with the ink all occur between the changes of polarity, so that but very few are sent along the line before it is cleared by the next vibration, and owing to this cause great perfection in the work is attained.

To secure good work at the recording-instrument, I prefer, instead of carrying the line directly to the receiving electrode, to introduce a relay and use, for the purpose of recording, another local battery adapted in strength and tension to the solution used on the receiving-paper. This can be done with excellent effect; but as it is not necessary, and as the use of relays is common in telegraphy, it does not need full description.

When a message has thus been sent and recorded from one machine to the other, by shifting the magnets A and the parts attached to them along the bars *b b*, the operation of the instruments will be reversed, and the receiver will be ready to transmit, and that which formerly transmitted will be ready to receive, messages in the direction opposite to the first.

The following is an explanation of the operation of the different circuits through the transmitting and receiving instruments and the line, as shown in Fig. 6:

X is the sending-instrument, Y the receiver, and W the line. Starting at the transmitter, Z is the ground. The current from there follows the dash-and-dot line to the arm of the switch marked 1, thence through the button 2, thence to the drum O, through the paper to the electrode L and spring K, thence along the same line to the point 7, from whence it passes through the electro-magnet G, from thence to 8, thence to 9, thence to two contact-points of the pole-changer 10, thence to the main battery 12, thence to 13, thence through the remaining contact-points of the pole-changer to 14, thence to 15, then to button 3 and switch-arm 5, to the line W. At the receiving-instrument the current enters at switch-arm 5, runs through it to button 6, thence to 7, thence through the electro-magnet G, thence to 8, thence through the helix of the relay 16, thence to 17, thence to 18, thence to button 4, to the switch-arm 1, and thence to the ground Z'. In its passage through the helix of the relay 16 the breaks in the line caused by the contact of the electrode with the writing in the transmitter operate the armature 19 and close the contact-points 20 in the circuit of the local battery 21. The course of the current in this local circuit is as follows: from the proper pole of the battery 21 to the armature 19, thence through the contact-points 20 to the switch 22, (which at the receiver is closed,) thence to 23, thence to 24, thence to the insulated arm K, thence through the electrode L and the receiving-paper to the cylinder O, thence to 25, and thence back to the other pole of the battery.

26 is a second local battery used for operating the feed movement. One pole is connected to the arm J of the vibrating armature I. The other pole is connected to and passes through the helices of the two magnets U U', a connec-

tion being made from the magnet U to the contact-point *h*, and from U′ to the contact-point *h′*, so that as the arm J vibrates the current is alternately closed through each of the magnets U U′, as has been already explained.

At the transmitting-station, when the instrument is operated, the local battery 21 and its circuit are not used, the switch 22 being opened while sending; nor at the receiving-station is the pole-changer used, as one pole-changer is sufficient to regulate both instruments. Owing to these facts, it is designed to use the battery 21 at the transmitting-station to operate the pole-changer 10 by means of a light electro-motor, thus utilizing the said battery when it would otherwise be unnecessary. This is done by another switch; but as the pole-changer forms no part of the machine itself, and may be operated by any other motor or current, it is not shown here.

When the instruments are reversed, and Y is used as the transmitter and X as the receiver, the operation of the current from the main battery is the same as already described, except that the positions of the switch-arms 1 and 5 are reversed in regard to the buttons 2, 4, 3, and 6, and the switch 22 is opened at Y and closed at X.

I am aware that prior to my invention autograph telegraph-instruments have been invented in which the electrodes are made to vibrate across the surface of strips or fillets of paper on which the message or characters have been written, or on which they are to be recorded; but in such cases the movement in one direction only is produced by electro-magnetic action, and that in the other by a retracting-spring, while in my own the action in both directions is magnetic and positive. I am also aware that other inventions have been made in which a pole-changer has been used to secure synchronism between the parts of two distant machines; but in such cases the changes of polarity are not effected in a closed circuit, and the resulting movements have only been applied to the regulating of clock-work, by which the main portion of the instruments are operated, and two line-wires are required—one for securing synchronous action and one to carry the transmitting-impulses. Therefore I do not claim such combinations, broadly; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. An automatic autographic telegraph-instrument having the operating stylus or electrode attached to the armature of an electro-magnet fixed to one pole of a permanent magnet, and vibrating over the surface of the substance on which the message is written or is to be recorded, said electro-magnet placed in the main line and actuated by certain changes of polarity introduced into the current on said line, substantially as set forth.

2. The operating stylus or electrode L, its arm K, the armature I of an electro-magnet in the main line, said magnet being fixed to one pole of a permanent magnet, in combination with means for reversing the polarity of the current, substantially as set forth.

3. The vibrating stylus or electrode attached to the armature of an electro-magnet fixed to one pole of the permanent magnet, both the stylus and electro-magnet being in the main-line circuit, in combination with means for reversing the polarity of the current, whereby the changes of polarity actuate the magnet and the circuit is preserved for the transmission of the message-impulses, substantially as set forth.

4. The combination of the following parts: means for reversing the polarity of the current of the main line, an electro-magnet fixed to one pole of a permanent magnet, an armature, I, with its arm J and contact-spring M, and the relay-points *h h′*, by which the feed mechanism is actuated and brought into exact unison with the changes of polarity on the line and the vibrations of the operating electrode or stylus, substantially as described.

5. The combination of the electro-magnets U U′ with the contact-points *h h′* and the contact-spring M on the arm J, operated independently of said electro-magnets, by which the said magnets are alternately energized and a tilting motion given to the connected armatures T T′, substantially as described.

6. The combination of the mechanism for feeding the paper under the electrode, consisting of the electro-magnets U U′, the tilting connected armatures T T′, the shaft *t*, the rocking lever *s*, the pawls *r r′*, the connecting-rod *u*, the escapement *v*, the ratchet-wheel S, the drums Q Q′, the friction-roller *o*, and the belt P, substantially as set forth.

7. The combination of means for reversing the polarity of the main-line current, the feed mechanism, the relay-points *h h′*, the contact-spring M, the armature I, and the electro-magnet fixed to one pole of a permanent magnet, with the operating stylus or electrode, both the said stylus and electro-magnet being in the main-line circuit, whereby the operation and synchronism of all parts are produced and maintained, and at the same time the circuit of the line is preserved for the transmission of the impulses caused by the contact of the transmitting-electrode with the ink of the written message, substantially as herein set forth.

8. The combination of the parts operating the stylus or electrode and the feed mechanism with the cylinder O, the slide-bars *b b′*, and the screw B, by means of which the electrode may be shifted from opposite the center of the transmitting-strip to that of the receiving-strip, and the machine thus converted into either a transmitter or receiver, as desired, substantially as set forth.

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