

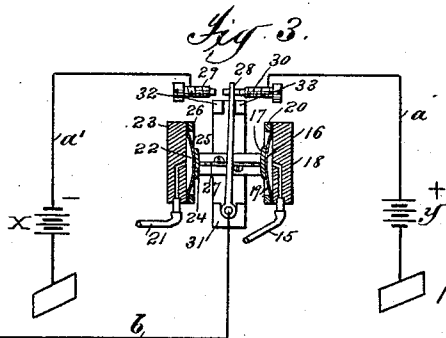
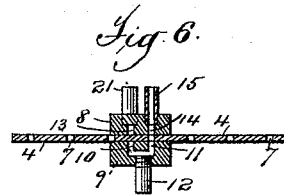
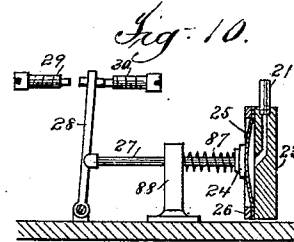
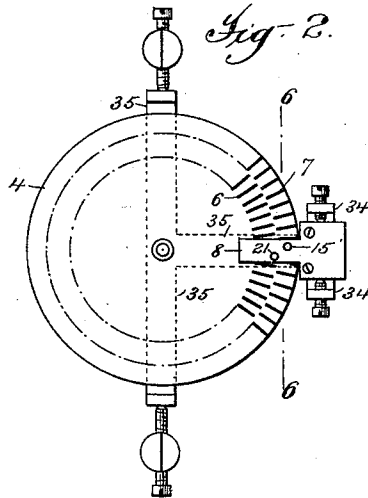
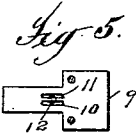
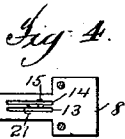
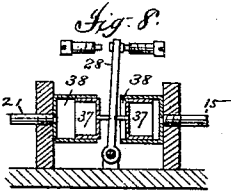
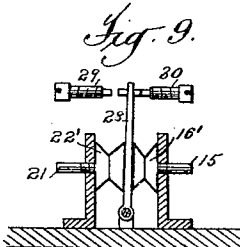
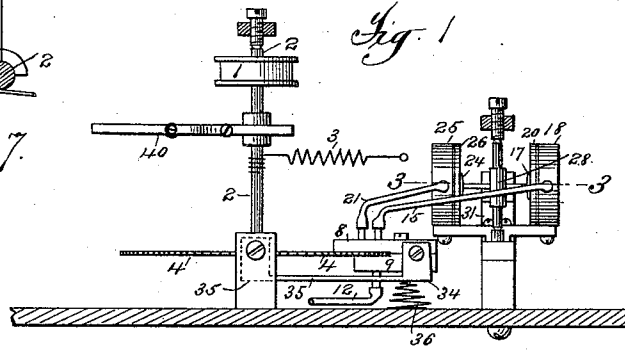
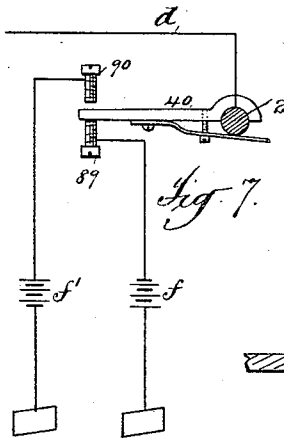
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3 Sheets—Sheet 1.

E. GRAY.
TELAUTOGRAPH.

No. 461,474.

Patented Oct. 20, 1891.



Attest
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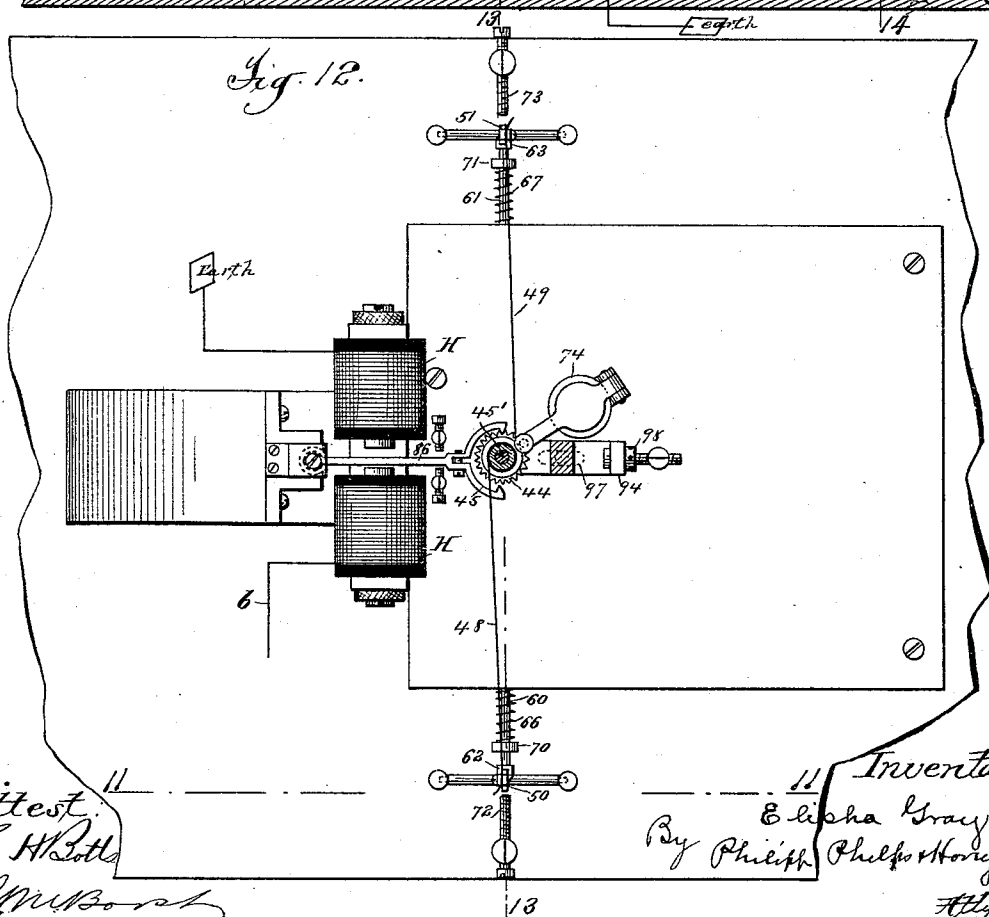
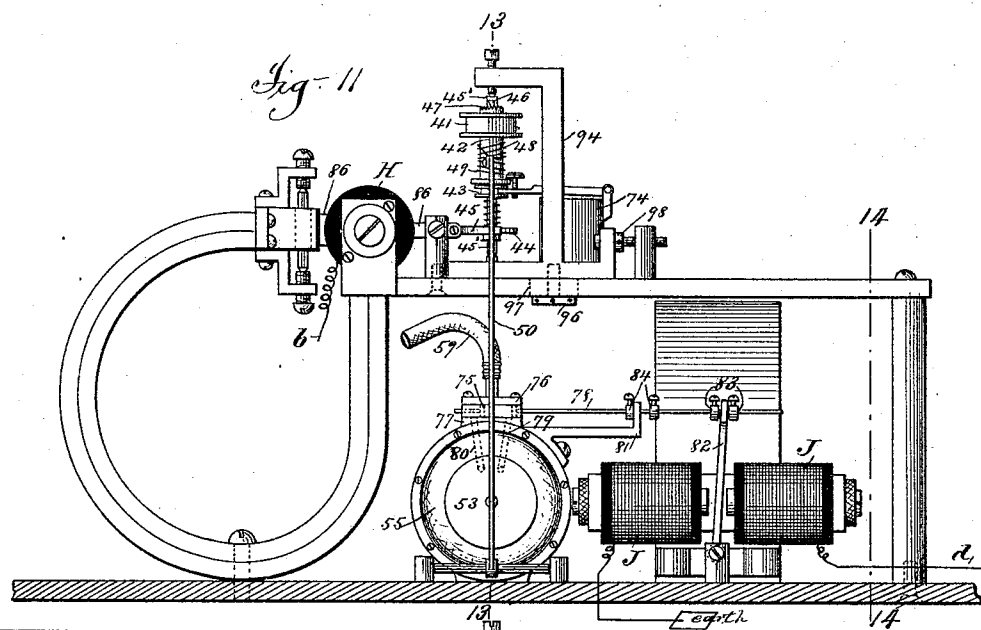
(No Model.)

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TELAUTOGRAPH.

No. 461,474.

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3 Sheets—Sheet 3.

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TELAUTOGRAPH.

No. 461,474.

Patented Oct. 20, 1891.

Fig. 13.

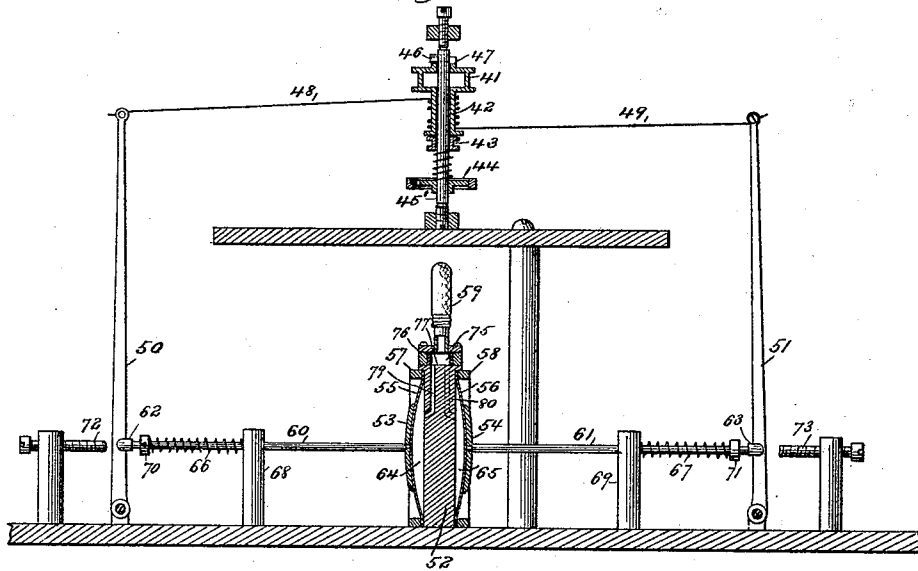


Fig. 15.

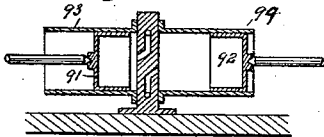


Fig. 14.

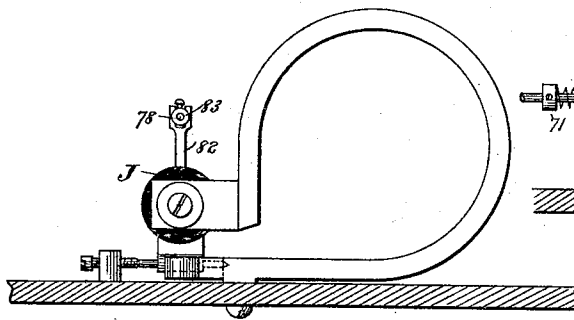
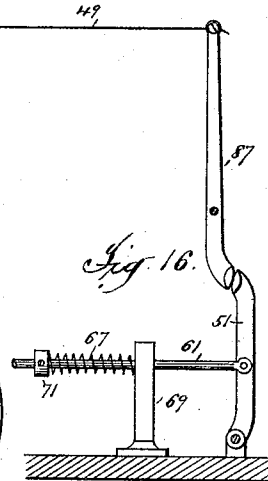


Fig. 16.



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UNITED STATES PATENT OFFICE.

ELISHA GRAY, OF HIGHLAND PARK, ILLINOIS.

TELAUTOGRAPH.

SPECIFICATION forming part of Letters Patent No. 461,474, dated October 20, 1891.

Application filed September 22, 1890. Serial No. 365,705. (No model.)

To all whom it may concern:

Be it known that I, ELISHA GRAY, a citizen of the United States, residing at Highland Park, county of Lake, and State of Illinois, have invented certain new and useful Improvements in Telautographs, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

My invention relates to a writing-telautograph of that class in which the act of writing the message at the sending-station operates to reproduce it at the receiving-station, and is in the main an improvement upon the apparatus and organization described in an application filed by me on or about the 17th day of September, 1889, and serially numbered 324,232.

I have found that while instruments made in accordance with said application may be successfully used, a difficulty is likely to arise because of the fact that the trailer in moving over the sunflower-segments at a rapid rate causes a wear of the surface of the segments, which interferes with the accurate operation of the instrument and also is liable to attach to itself a collection of dust and metal wearings, which may cause variations in the length of the pulsations, and possibly false movements of the receiving-instrument. Furthermore the accumulations of dust upon the sunflower-surface are liable to prevent perfect contact.

My present invention has for one of its objects the overcoming of these difficulties; and to this end I propose to use a supply of fluid under pressure and to apply the pressure of this fluid, controlled by the movement of the transmitting-pen, to the operation of the circuit-interrupter, which latter shall be so placed with reference to the parts in connection with which it operates that the difficulties referred to may be obviated. Thus I may, as herein illustrated, cause the transmitting-pen to give movement to a perforated plate or disk, which shall release at successive intervals the fluid-pressure, the impulses thus obtained being applied to give vibratory movement to a circuit making and breaking lever moving between two stops. This form of interrupter is not liable to any of the objections due to the wear or accumulation of dust above mentioned, and as the positive movement which is given to it causes it to strike its stops with

considerable force the accumulation of dirt is prevented and certainty of contact secured.

My invention further relates to the receiving-instrument, and has for its object to obtain increased simplicity of parts and certainty of action. To these ends, also, I provide a fluid-pressure mechanism for producing the tension under the influence of which, according to its direction, and which is reversed in correspondence with reversals in direction of motion of the transmitting-pen, the receiving-pen is driven.

My present invention further consists in certain arrangements and combinations hereinafter fully described and shown, and specified in the claims.

In the drawings, Figure 1 is a side elevation of a portion of my air-transmitting device. Fig. 2 is a plan view of the same, certain parts having been removed. Fig. 3 is a sectional view on the line 3 3 of Fig. 1, showing the circuit connections. Figs. 4 and 5 are detached views of the diaphragm-blocks. Fig. 6 is a sectional view on the line 6 6 of Fig. 2 on an enlarged scale. Fig. 7 is a diagram showing the connections of the reversing-circuit. Figs. 8, 9, and 10 represent modifications. Fig. 11 is a side elevation, and Fig. 12 a plan view, of a part of an instrument embodying my improvement and receiving apparatus. Fig. 13 is a sectional view on the line 13 13 of Fig. 11. Fig. 14 is a side view of the reversing-magnet shown in front view in Fig. 11, and Figs. 15 and 16 represent modifications.

The general organization of the system is the same as that described in my application, Serial No. 324,232, above referred to. As the circuits and the parts of the instruments not immediately concerned with my present invention are the same as those shown in the said application, they are not described and shown herein, only those parts of the instrument being incorporated into this application which are requisite to show the relation of my present invention to the machine as a whole and its mode of operation.

The fluid-pressure-transmitting device will first be described. The pen-drum 1, of which there are two in the transmitting portion of the machine, about which is wound one of the cords connected to the transmitting-pen, is mounted, as in the machine of the application referred to, upon a vertical shaft 2, and

is provided with the reversely-acting spring 3. Instead, however, of a trailer, this shaft has fixed to it a thin disk 4, preferably of sheet-steel, provided at its circumference with two concentric rows 6 7 of slots, so placed with reference to each other that each slot of each row is midway between two slots of the adjoining row. Each of the rows has consequently a like number of slots, the number being preferably eighty-five. This disk moves between two blocks 8 and 9, screwed together and termed, for convenience, "valve-blocks." The lower valve-block 9 (shown in plan view in Fig. 5) has two slots 10 11, both of which communicate with a tube 12, connecting with any suitable reservoir containing a fluid under pressure. The preferable form of fluid is air or an aeriform gas; but I do not confine myself to these, as a liquid may be employed. These slots 10 and 11 are so placed in the block 9 that they are immediately below the outer row of slots 7. The upper block 8 is provided with two slots 13 and 14 of a length equal to the combined width of the two rows of slots 6 and 7, and so placed in the block 8 as to be immediately above these two rows of slots, and also respectively immediately over the two slots 10 and 11. The slots 13 and 14 are placed far enough apart, so that when the outer end of one of them, as 14, is immediately above one of the slots of the row 7 its inner end will be midway between two of the slots of the row 6, and at the same time the inner end of the other slot 13 will be immediately above one of the slots of the row 6, while the outer end of the same slot 13 will be midway between two of the slots of the row 7. The slots 13 and 14 do not pass entirely through the block 8. One of them 14 connects with a tube 15, which leads to a chamber 16, formed between a movable plate 17 and a block 18. The plate 17 is preferably mounted upon a flexible disk 19, which may be made of soft rubber, and is held against the block 18 by a ring 20. The tube 15 connects through a passage-way formed in the block 18 with the chamber 16. The other slot 13 connects by a tube 21 with a second chamber 22, formed between a similar block 23 and movable plate 24, carried upon a diaphragm 25, held in place by a ring 26. The plates 24 and 17 are connected by a cross-piece 27 with a lever 28, pivoted at one end and carrying at the other contact-points which play between stops 29 and 30.

The base-piece upon which the lever 28 is pivoted consists of a permanent magnet 31, the free end of the lever playing between two lips 32 and 33, and thus completing the magnetic circuit when in contact with either of these lips, the lever 28 itself being of soft iron. The lever 28, together with the stops 29 and 30, constitutes a circuit-interrupter, the circuit connections in the present case being as follows: A wire *a* leads from the positive pole of the battery *y*, the negative pole of which is grounded to one of the stops 30. Another wire *a'* leads from the negative plate of an-

other battery *x* of equal strength, the positive pole of which is grounded to the other stop 29. The lever 28 is connected with the main-line wire *b*, which operates the escapement-magnet *H* of the receiving-instrument.

The valve-blocks 8 and 9 are, as has been stated, screwed together, and are therefore rigid with each other. They lie longitudinally in one of the diameters of the disk 4, and are trunnioned in the plane of the disk in a block 34, attached to a frame-piece 35, which in turn is trunnioned in the plane of the disk 4 and in the diameter of the disk perpendicular to the diameter in which the blocks 8 9 lie. This is for the purpose of preventing friction between the disk 4 and the valve-blocks, due to any irregularity in the rotary movement of the disk 4. Further, to reduce the friction between the valve-blocks and the disk 4 a supporting-spring 36 is placed between the block 34 and the table.

The operation of the apparatus is as follows: The transmitting-pen being moved in one direction or the other, the drum 1 is rotated by the pull of the string connected to the pen or by the reverse pull of the spring 3 and rotates the disk 4 with it. When the disk 4 is in such a position that one of the slots of the row 7 registers with one of the slots 10 11 in the block 9, as 11, and also with one of the slots, as 14, in the block 8, the fluid under pressure passes from the tube 12, through the disk and tube 15 to the chamber 16, forcing out the movable plate 17 and carrying with it the lever 28 against the stop 29. In this position of the instrument there is a passage-way open from the chamber 22 through the tube 21, slot 13, and one of the slots of the row 6 in the disk 4 to the outer atmosphere, whereby the chamber 22 is permitted to exhaust and the plate 24 to move inward. As the disk continues to rotate a solid portion of the disk comes between the slots 10 11 and 13 14, cutting off both the inlet and outlet passages to the chambers 16 and 22. Presently, however, the slot 10 registers with one of the slots of the row 7, opening a communication from the pipe 12 through the disk and the outer end of slot 13 and the pipe 21 to the chamber 22, while at the same time the inner end of the slot 14 registers with one of the slots in the row 6 and opens a passage-way through the disk 4, the slot 14, and the pipe 15, between the chamber 16 and the outer atmosphere, through which the said chamber may exhaust. The movable plate 24 is now forced outward, while the movable plate 17 is at the same time free to move inward, because of the opening of the exhaust-passage, and the lever 28 is carried to the right. This operation will be repeated as often as the disk 4 is revolved through the arc represented by the space between two of the slots in the row 6 or the row 7, and results in sending a series of electric pulsations of successively opposite polarity over the main line *b*.

The magnet 31 causes the lever 28 to always assume a position against one or the other of the stops 29 30, preventing it from standing at any time between these two stops. There is thus insured at all times a full current upon line, except at the moments when the lever 28 is passing from one stop to the other.

It is evident that the circuit connections made and broken by the lever 28 might be varied. Thus they might be such as to send pulsations of successively the same polarity instead of pulsations of successively opposite polarity, or the changes effected in the current might be of a different character.

Instead of having a movable portion in the form of a plate, the chambers 16 22 might be provided with movable pistons. Such a construction is shown in Fig. 8, in which the pressure is caused to move the pistons 37, fitting closely in the piston-chambers 38. It is obvious that an equivalent construction would be a single movable portion or a single piston moved in opposite directions by pressure alternately on each side, as illustrated in Fig. 9, where the lever 28 is placed between the two flexible chambers 16' and 22', and is operated by pressure acting in them alternately, or the lever 28 may be moved in one direction by a movable portion of a chamber and in the other direction by a spring, as illustrated in Fig. 10, where the spring 87, held between plate 24 and fixed abutment 88, is substituted for one of the chambers.

It is also obvious that equivalent results may be obtained by using a vacuum-reservoir in communication with the pipe 12, instead of a reservoir containing fluid under pressure, thereby utilizing as a supply of fluid under pressure the atmosphere at its normal pressure, the movable portions of the chambers then being alternately drawn inward by connecting the chambers with the vacuum-space and permitted to return to their normal positions by re-establishing the connection of the chambers with the air under normal pressure and the interrupter being thus operated.

The shaft 2 is provided with the usual circuit-changing arm 40, which serves to operate the reversing-circuit d upon reversal of the direction of movement of the transmitting-pen. Those circuit connections are shown in Fig. 7. The arm 40, being frictionally mounted upon the shaft 2, rests against one or the other of stops 89 90, according to the direction of movement of the transmitting-pen and consequent rotation of shaft 2, and accordingly makes circuit for one or the other of the batteries ff' , placed with opposite poles to line, all as described in my said former application.

The receiving-instrument will now be described so far as it is concerned with the present invention. This consists of the usual pen-drum 41, about which is wound the cord connected to one of the arms of the receiving-pen. This drum 41 is carried upon the usual

sleeve 42, which in turn rests upon a freely-moving collar 43, supported by a spring resting upon ratchet-wheel 44, fast upon the shaft 45', trunnioned vertically and carrying at its upper end a pin 46, adapted to engage with a circle of crown-teeth 47, formed upon the top of the pen-drum, all as described in my said former application. The shaft 45' is trunnioned in a movable frame-piece 94, clamped to the table by screw 96, which is capable of a slight lateral motion, when loosened, in a slot 97 in the table, and an adjusting-screw 98 is provided, bearing upon the frame-piece 94. The frame-piece 94 is placed in line with the armature 86, and may, by means of the adjusting-screws above mentioned, be moved slightly to and fro in order to delicately adjust the teeth of the wheel 44 to the pallets 45. The opposite faces of the teeth of the escape-wheel and the pallets are made of substantially like shape, so that the escapement will operate in either direction, as stated in my said former application. About the sleeve 42 are wound in opposite directions the cords 48 49, connected, respectively, to the levers 50 51, pivoted at their lower ends to the table. Midway between these levers is placed a fluid-pressure device consisting of a stationary plate 52, having on either side a movable plate 53 54, preferably mounted upon soft-rubber diaphragms 55 56, held to the plate 52 by rings 57 58. There are thus formed two chambers 64 65 between the stationary plate 52 and the movable plates 53 54, respectively, which are connected by passage-ways through the plate 52, and a valve mechanism about to be described, with the tube 59, leading to a suitable supply of fluid under pressure. The movable plates 53 54 are connected, respectively, with the levers 50 51 by means of the rods 60 61; each rod being attached at one end to one of the movable plates 53 54, its free end being pointed and received in one of the two sockets 62 63, attached to the levers 50 51. The rods 60 61 are preferably made of hardened steel and are pressed outward by springs 66 67, each having a bearing at one end in the posts 68 69, respectively, through which the rods freely pass, and at the other end upon the collars 70 71. The springs 66 67 serve to prevent either of the cords 48 49 from becoming slack. The screws 72 73 serve as unison-stops, the use of which in connection with the magnet 74 is described in my said former application.

The valve mechanism for controlling the application of the fluid-pressure may be of any suitable construction. That shown consists of a slide-valve 75, moving in a casing 76 upon a valve-seat 77, the valve being in the form of a hollow square, the interior cavity of which is always in communication above with the tube 59. In the valve-seat 77 are provided two ports 79 80, communicating the one with chamber 64 and the other with the chamber 65, and so placed in the valve-seat that one of them, as 80, is included within the cavity of

the slide-valve 75 when in one of its extreme positions, as shown in Fig. 13, the other port 79 being in such position of the valve in communication with the external air. When the valve is shifted to its other extreme position, the port 79 is in communication with the interior cavity of the valve and the port 80 is in communication with the external air. The valve 75 is attached to a valve-rod 78, which moves in a rest-piece 81, and is reciprocated to and fro by the armature 82 of the reversing-magnet J, playing upon stops 83, attached to the valve-rod. The play of the valve-rod is limited by other stops 84, which are adapted to come into contact with the rest-piece 81 in either direction of movement of the valve-rod. The magnet J is of any suitable construction, that shown in this case being the same as that of the reversing-magnet in my said former application—to wit, an ordinary Siemens polarized magnet. It is in circuit with suitable electrical connections (as shown herein, the reversing line wire *d*) with the circuit-reversing device at the transmitting-station. (Shown in Figs. 1 and 7.) The magnet H is also an ordinary Siemens polarized magnet, and to its armature are attached the pallets 45, which engage with the toothed wheel 44, forming with it the escapement which holds the receiving-pen in restraint as against the tension produced by the fluid-pressure tending to move it, as described in the said former application. This magnet H is in circuit with the main-line wire *b*, proceeding from the transmitter. (Shown in Fig. 3.)

The operation of this part of my improved apparatus is as follows: Fluid under pressure is always provided during the operation of the instrument in a suitable reservoir communicating with the tube 59, and consequently is in communication with one or the other of the chambers 64 65, pushing outward one or the other of the plates 53 54, and causing a corresponding tension upon the pen-drum through one or the other of the cords 48 49. This tension causes a tendency of the pen-drum 41 to revolve; but the drum is held in restraint against this tension by the escapement-pallets engaging with the escape-wheel 44, the pallets being controlled by the armature 86, to which they are attached, this armature being normally held in one or the other of its extreme positions by the attraction of one or the other of the poles of the magnet H. As pulsations of successively opposite polarity are received over line *b* through the coils of the magnet H, the armature 86 is successively attracted from one of the poles of the magnet H to the other, and the pen-drum is therefore permitted to move step by step under the tension of the fluid-pressure as long as the transmitting-pen continues to move in one direction. Assuming now that the instrument is in the position shown in the drawings, and that there is a reversal in movement of the transmitting-pen, the circuit-changing arm 40, Fig. 1, has its position reversed, so as to change the polarity

of the current upon the reversing-circuit *d*, causing the magnet J to shift its armature, and thereby throw the valve 75, opening the inlet-port from the tube 59, through the valve and inlet 80 to the chamber 65, and at the same time opening the passage-way from the chamber 64, through the inlet-port 79, to the outer air, permitting the chamber to exhaust. The fluid under pressure is now thrown into the chamber 65, the chamber 64 simultaneously collapsing, and the plate 54 is forced outward, reversing the direction of the tension upon the pen-drum. The pen-drum, and with it the receiving-pen, now moves in the reverse direction step by step, as permitted by the escapement and its governing-magnet H until the transmitting-pen again reverses its direction of motion.

It will be obvious that the various modifications in the construction of the fluid-pressure devices suggested with reference to the transmitting-instrument are equally applicable with reference to the receiving-instrument. Thus, instead of having a movable portion in the form of a plate or diaphragm the chambers may be provided with movable pistons, as shown in Fig. 15, where the fluid-pressure is caused to move the pistons 91 92, fitting in the piston-chambers 93 99. An equivalent construction to those shown would be a single movable portion or piston moved in opposite directions by pressure acting alternately on the two sides, as illustrated in Fig. 9 and described above with reference to the transmitter, the arm 28 serving, through proper connections, to give the two reversely-acting tensions to the pen-drum. So, too, the tension may be effected in one direction by fluid-pressure and in the other by a spring or a weight, as shown in Fig. 10 with reference to the transmitter, and numerous other modifications of construction will readily occur to a skilled person. In this case, as in the case of the transmitting-instrument, the supply of fluid under pressure may be obtained by providing a vacuum instead of a body of fluid under greater than normal pressure, the atmosphere under normal pressure then serving as the supply of fluid under pressure. The only change requisite for adopting this mode of operation is in the connection between the chamber and the pen-drum. Proper connections for this adaptation are shown in Fig. 16, the rods 60 61 at their outer ends being pivotally attached to their levers 50 51, so that they may operate upon those levers by a pulling instead of a pushing action, as before, and additional pivoted levers 87 being supplied intermediate between the levers 50 51 and the cords 48 49, respectively. When operated in this manner, the chambers will be alternately connected with the vacuum-space and the movable portions thus forced inward by the pressure of the outer air and caused to return to their normal positions by re-establishing the connection of the chambers with the air under normal pressure. As each movable portion

of the chamber is drawn in by the suction produced by the vacuum, its rod, as 61, is carried inward, moving with it its lever, as 51, which in turn acts upon the lever 87 and produces the required tension upon the cord 49.

As with the transmitting-instrument, the fluid used may be a liquid; but I prefer an aeriform fluid, and believe that the atmosphere is the most suitable for the purpose.

I do not confine myself to using the novel features shown in this application solely in connection with the particular form of the other parts of the apparatus herein described and shown. Thus it will be understood that the pulsations through which the receiving-instrument is controlled might be pulsations successively of the same polarity, instead of successively opposite polarity. The restraining mechanism shown in this application as an escapement might be any other suitable form of mechanism for the purpose without departing from my invention, as the same is concerned with the fluid-pressure devices. So, too, the pulsations may be sent over line by an ordinary sunflower arrangement instead of by a fluid-pressure transmitter without affecting the operation of the improvements relating to the receiving-instrument. So, too, the part of the invention relating to the transmitter may be used with a receiving-instrument of any other suitable construction as well as with that herein described and shown. Reversal of the tension of the fluid under pressure upon the receiving-pen may be effected by any other suitable means as well as by the use of the separate line-wire with reverse currents, as shown.

It will of course be understood that I have shown and described herein the devices constituting one-half of the instrument only—viz., that relating to the movement of the pens in one of their two crosswise directions. Another transmitting and receiving apparatus, a second main-line wire corresponding to the wire *b*, and a second reversing-wire corresponding to the wire *d* are required to complete the organization hereof and provide for the movement of the transmitting and receiving pens in the other of their two crosswise directions of movement, as described in my said former application.

Under the term "interrupter" as used in this application I intend to include every device by means of which electrical pulsations, whether successively of the same or opposite polarity, may be produced in a circuit.

By the term "transmitting-pen" as used in this specification I mean to indicate, as in my said former application, any device which may be used by the transmitting-operator to form the characters or other matter to be transmitted. This pen may be either a writing-instrument of any sort or a simple handle of convenient form to be grasped by the operator and moved to describe the outline of the characters, and the term "transmitting-pen" is therefore to be understood as includ-

ing any writing-instrument or a simple handle capable of being moved by the operator to follow the outline of the characters, figures, hieroglyphics, maps, &c., to be transmitted. So, too, under the term "receiving-pen" I intend to include not only a pen acting to make a record by the use of a writing-fluid, but a pencil or any other instrument capable of recording a character or other matter received.

As stated in my patents, Nos. 386,814 and 386,815, the movements necessary to reproduce the message, instead of being imparted to the receiving-pen, may be wholly or in part imparted to the paper, and it is therefore to be understood that a recording-surface movable for the purpose of forming characters is for the purposes of this application the equivalent of a movable pen.

What I claim is—

1. The combination of a vibrating circuit-closer, a supply of fluid under pressure for giving movement to the circuit-closer, and a magnet, as 31, operating upon the circuit-closer to prevent it from stopping except at one or the other of its contact positions, substantially as set forth.

2. The combination of a transmitting-pen, circuit connections with a receiving-station, a circuit-interrupter, and a supply of fluid under pressure controlled through the movements of the transmitting-pen and caused thereby to operate the interrupter, substantially as described.

3. The combination of a transmitting-pen, circuit connections with a receiving-station, a circuit-interrupter, a supply of fluid under pressure, and a valve mechanism operated through the movements of the transmitting-pen and controlling the force of the fluid under pressure, so as to cause it to move the interrupter in accordance with the movements of the transmitting-pen, substantially as set forth.

4. The combination of a transmitting-pen, circuit connections with a receiving-station, a circuit-interrupter, a chamber having a movable portion connected with the interrupter, and a supply of fluid under pressure controlled through the movements of the transmitting-pen, and caused thereby to give movement to said movable portion of the chamber in accordance with the movements of the transmitting-pen, substantially as set forth.

5. The combination of a transmitting-pen, circuit connections with a receiving-station, a circuit-interrupter, a supply of fluid under pressure, two chambers, each having a movable portion, said movable portion being connected with the circuit-interrupter, and valve mechanism operated through the movements of the transmitting-pen, whereby the force of the fluid under pressure is caused to give movement to the movable portion of said chambers, and consequently to the circuit-interrupter, alternately in opposite directions, substantially as set forth.

6. The combination of a transmitting-pen, circuit connections with a receiving-station, a circuit-interrupter, a supply of fluid under pressure, a chamber having a movable portion connected with the interrupter, a perforated plate caused to move through the movement of the transmitting-pen, and valve-passages between the supply of fluid under pressure and said chamber operated by the perforated plate in its movement, whereby the force of the fluid under pressure is caused to give movement to the movable portion of said chamber, and consequently to the circuit-interrupter, substantially as set forth.

7. The combination, with a transmitting-pen, of circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations, a receiving-pen, and a supply of fluid under pressure for giving movement to the receiving-pen and caused to operate thereon through said pulsations, substantially as set forth.

8. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a chamber having a movable portion connected with the receiving-pen, and a supply of fluid under pressure controlled through said pulsations, whereby the force of the fluid under pressure is caused to give movement to the movable portion of the chamber and thus to the receiving-pen in accordance with the movements of the transmitting-pen, substantially as set forth.

9. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, two chambers each having a movable portion, the movable portion of each chamber being connected to the receiving-pen, and a supply of fluid under pressure controlled through said pulsations, whereby the force of the fluid under pressure is caused to give movement to the movable portion of each chamber and thus to the receiving-pen alternately in opposite directions in accordance with the movements of the transmitting-pen, substantially as set forth.

10. The combination, with a transmitting-pen, of circuit connections with a receiving-station, two interrupters operated through the movement of said pen in two directions crosswise of each other and producing two series of electric pulsations traversing said circuit connections, a receiving-pen, and a supply of fluid under pressure for giving movement to the receiving-pen in two directions crosswise of each other and caused to operate thereon through said pulsations, substantially as set forth.

11. The combination of a transmitting-pen, circuit connections with a receiving-station, two interrupters operated through the move-

ment of said pen in two directions crosswise of each other and producing two series of electric pulsations traversing said circuit connections, a receiving-pen, chambers having each a movable portion connected with the receiving-pen, a supply of fluid under pressure controlled through said pulsations, whereby the force of the fluid under pressure is caused to give movement to the movable portions of the chambers and thus to the receiving-pen in two directions crosswise of each other and in accordance with the movements of the transmitting-pen, substantially as set forth.

12. The combination of a transmitting-pen, circuit connections with the receiving-station, an interrupter for producing electric pulsations operated through said transmitting-pen, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, and mechanism caused to operate by said pulsations, whereby the application of the force of the fluid under pressure to the receiving-pen is held in restraint and released at successive intervals, so that the movement of the receiving-pen is caused to correspond to that of the transmitting-pen, substantially as set forth.

13. The combination of a transmitting-pen, circuit connections with a receiving-station, two interrupters operated in two directions crosswise of each other through the movements of said transmitting-pen and producing a series of electric pulsations in each of said circuits, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen in two directions crosswise of each other, and mechanism caused to operate by said pulsations, whereby the application of the force of the fluid under pressure to the receiving-pen is held in restraint and released at successive intervals, so that the movement of the receiving-pen is caused to correspond to that of the transmitting-pen, substantially as set forth.

14. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said pen and producing pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen and caused to operate thereon through said pulsations, and means for reversing the direction of the application of the force of the fluid under pressure to the receiving-pen controlled from the transmitting-station, whereby the direction of movement of the receiving-pen is reversed upon reversal of direction of movement of the transmitting-pen, substantially as set forth.

15. The combination of a transmitting-pen, circuit connections with a receiving-station, two interrupters operated through the movements of said pen in two directions crosswise of each other and producing two series of electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid

under pressure for giving movement to the receiving-pen and caused to operate thereon through said pulsations in two directions crosswise of each other, and means for reversing the direction of the application of the force of the fluid under pressure to the receiving-pen in each of said two directions controlled from the transmitting-station, whereby the direction of movement of the receiving-pen is reversed upon reversal of direction of movement of the transmitting-pen in either of the said two directions, substantially as set forth.

16. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, and an electrically-controlled valve mechanism and means for operating the same from the transmitting-station for reversing the direction of the application of the force of the fluid under pressure to the receiving-pen controlled from the transmitting-station, whereby the direction of movement of the receiving-pen is reversed upon reversal of direction of movement of the transmitting-pen, substantially as described.

17. The combination, with a transmitting-pen, circuit connections with the receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, valve mechanism for reversing the direction of application of the force of the fluid under pressure to the receiving-pen, and a magnet and electrical connections with the transmitting-station, whereby said valve mechanism is operated upon each reversal of direction of movement of the transmitting-pen, substantially as described.

18. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said transmitting-pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, a valve mechanism for reversing the direction of the application of the force of the fluid-pressure to the receiving-pen, a polarized magnet for controlling the valve mechanism, an electric circuit connecting said magnet with the transmitting-station, and connections whereby the current upon said circuit is reversed upon each change of direction of movement of the transmitting-pen, whereby the valve mechanism is shifted and the direction of movement of the receiving-pen is reversed, substantially as set forth.

19. The combination of a transmitting-pen,

circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, and an escapement governing the application of the force of the fluid under pressure to the receiving-pen and caused to operate by said pulsations, substantially as set forth.

20. The combination of a transmitting-pen, circuit connections with a receiving-station, an interrupter operated through said pen and producing electric pulsations traversing said circuit connections, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen, an escapement governing the application of the force of the fluid under pressure to the receiving-pen and operated by said pulsations, and mechanism for reversing the direction of the application of the force of the fluid under pressure to the receiving-pen electrically controlled from the transmitting-station, substantially as set forth.

21. The combination of a transmitting-pen, two electric circuits, two interrupters operated through the movement of said pen in two directions crosswise of each other and producing a series of pulsations in each of said circuits, a receiving-pen, a supply of fluid under pressure for giving movement to the receiving-pen in two directions crosswise of each other, and two escapements governing the application of the force of the fluid under pressure to the receiving-pen, one for each of the two crosswise directions of motion of the transmitting-pen and caused to operate by the pulsations, substantially as set forth.

22. The combination of a transmitting-pen, electric connections with a receiving-station, an interrupter operated through said pen and producing electrical pulsations traversing said connections, a receiving-pen, a supply of fluid under pressure for placing the receiving-pen under tension, means for reversing the direction of said tension to correspond in direction of motion with the transmitting-pen, and a reversible escapement holding said receiving-pen in restraint as against said tension and operated through said pulsations to permit the receiving-pen to move in either direction step by step, substantially as set forth.

23. The frame-piece 94, carrying a part of the escapement adjustable to and from magnet H, substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ELISHA GRAY.

Witnesses:

J. J. KENNEDY,
G. M. BORST.