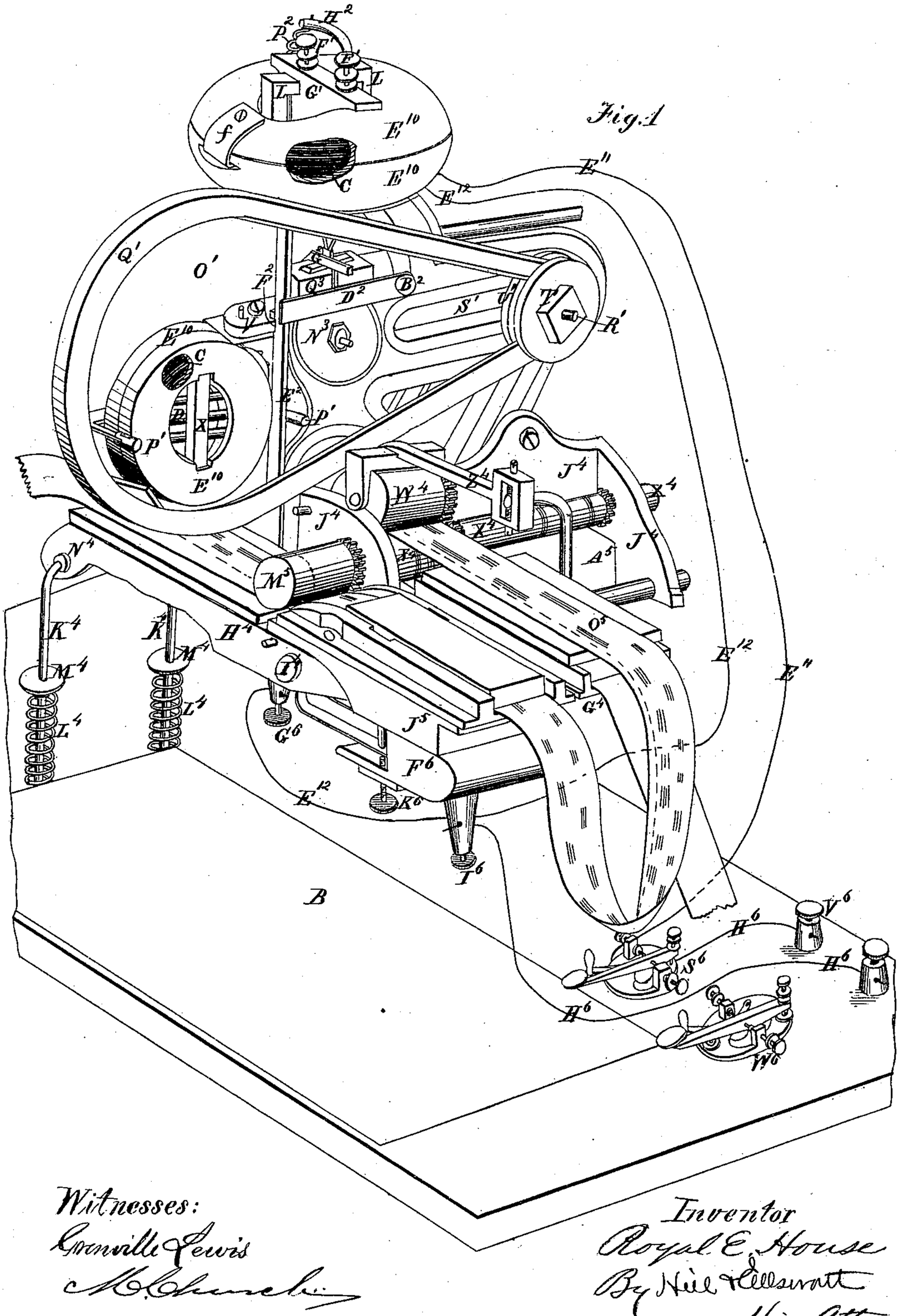
4 Sheets—Sheet 1.

R. E. HOUSE.

ELECTRO-MAGNETIC TELEGRAPH.

No. 180,092. Patented July 25, 1876.

Fig. 1



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4 Sheets—Sheet 2.

R. E. HOUSE.

ELECTRO-MAGNETIC TELEGRAPH.

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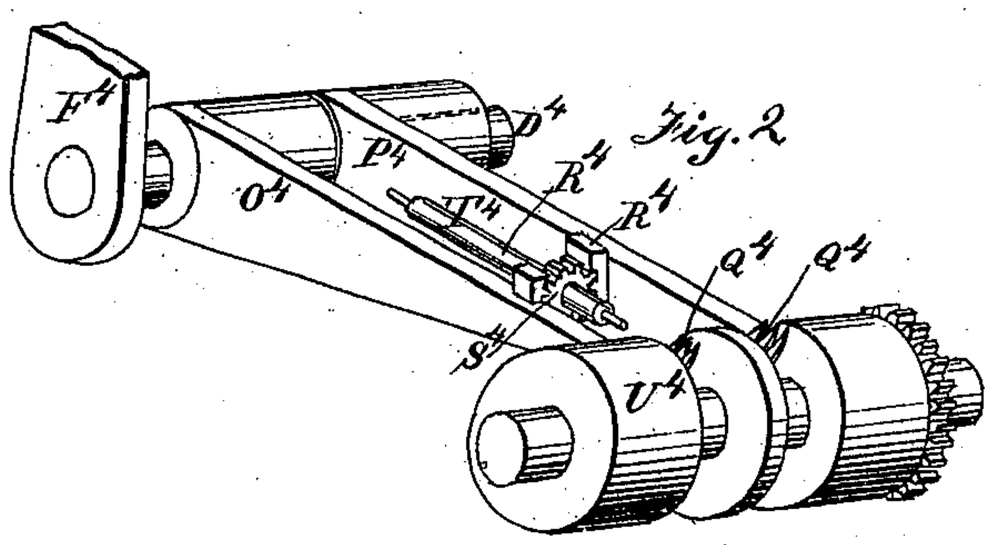

Fig. 2

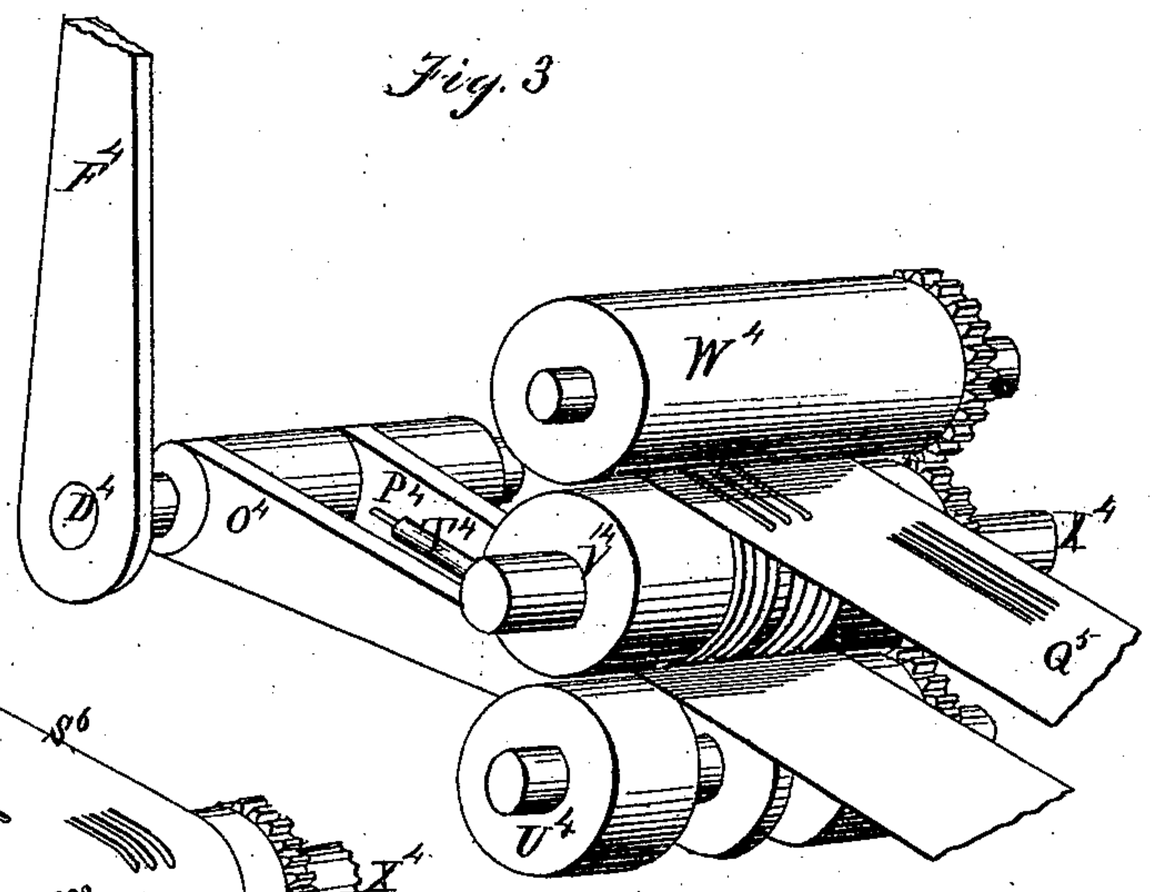

Fig. 3

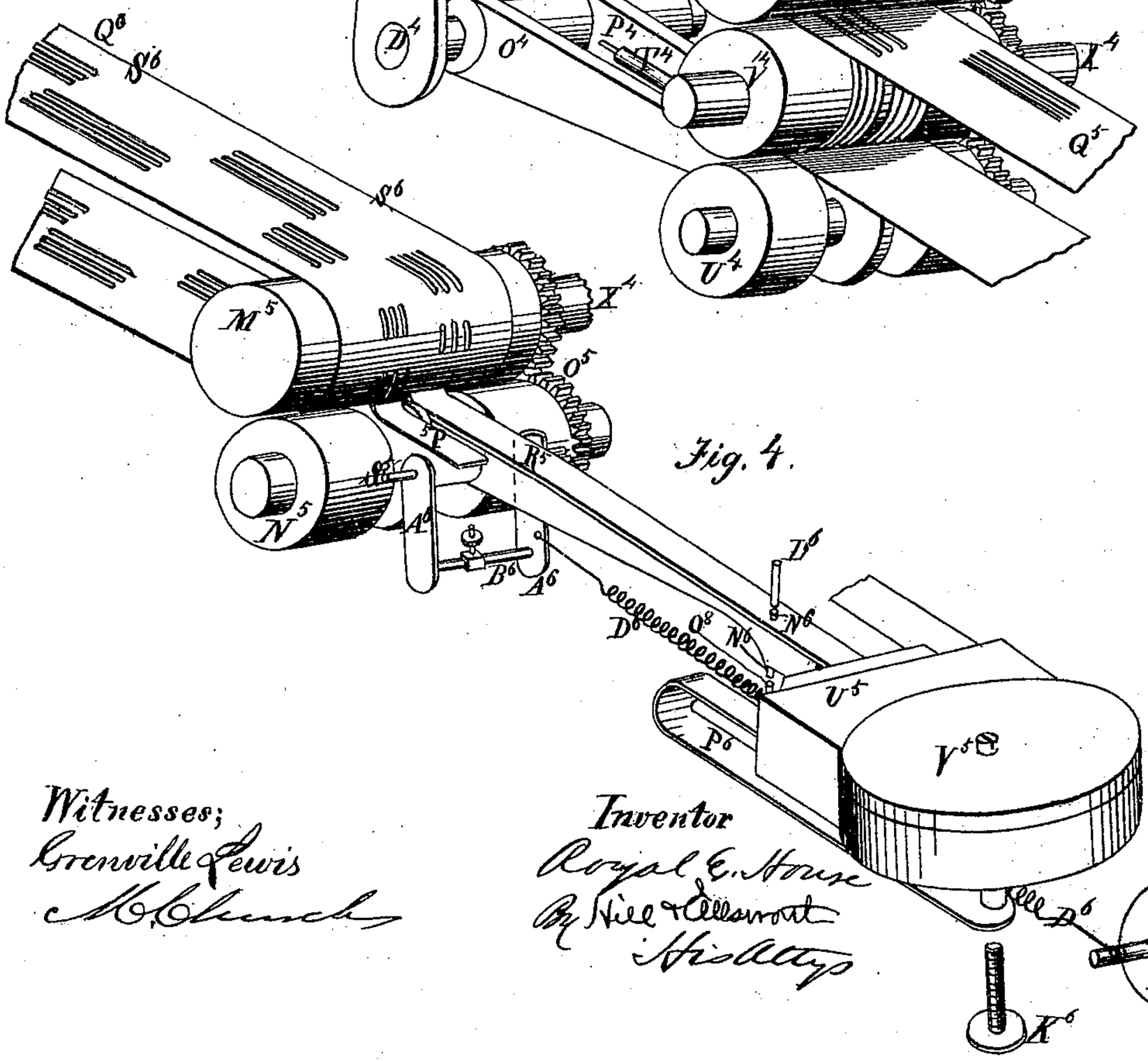

Fig. 4.

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4 Sheets—Sheet 3.

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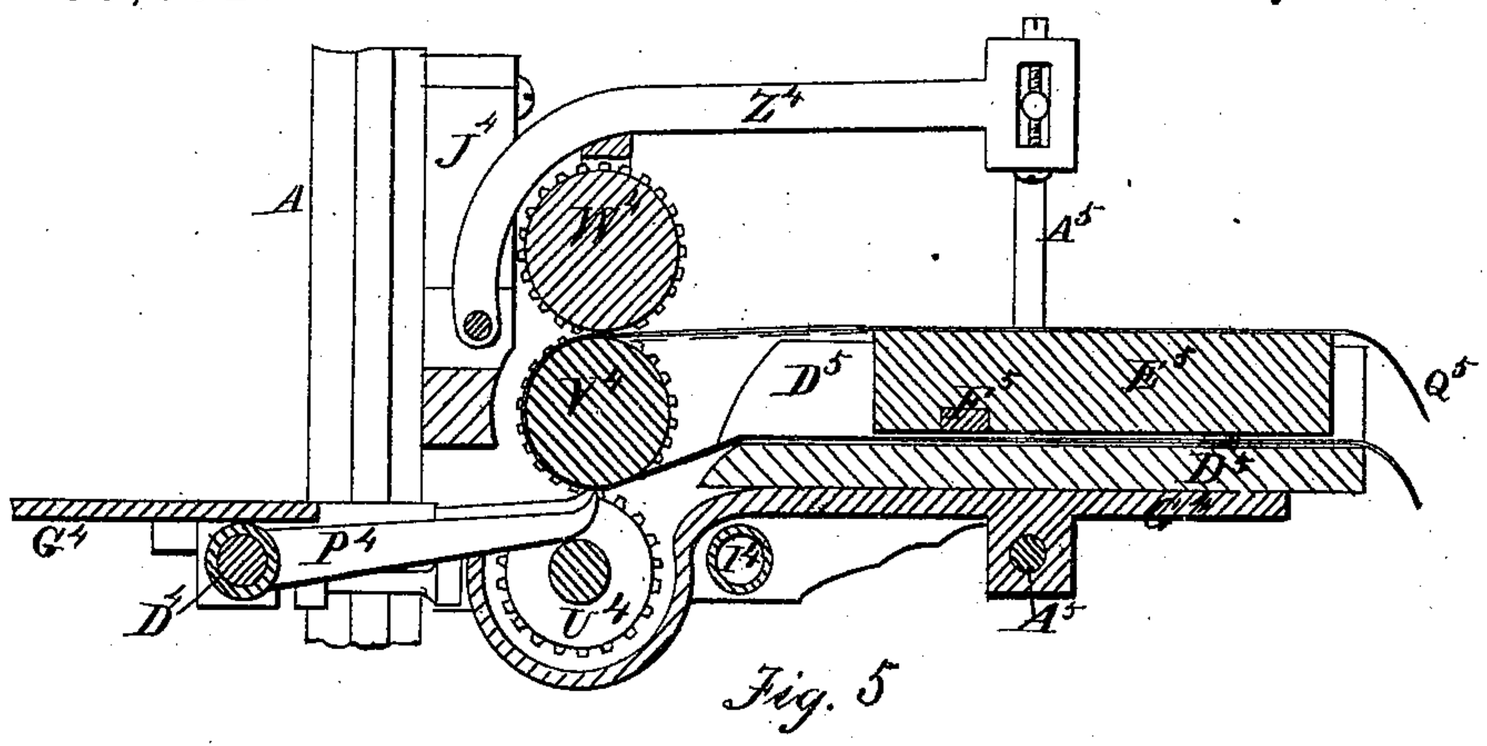

Fig. 5

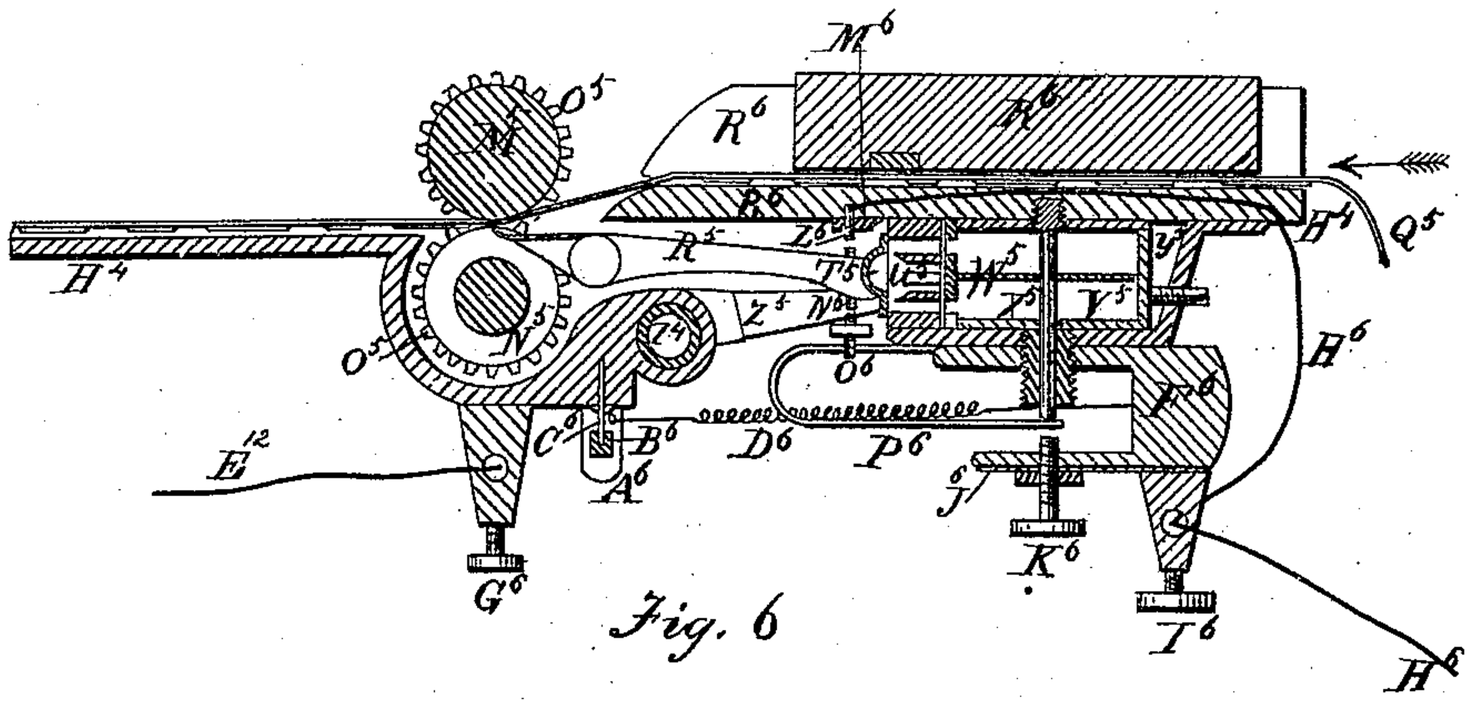

Fig. 6

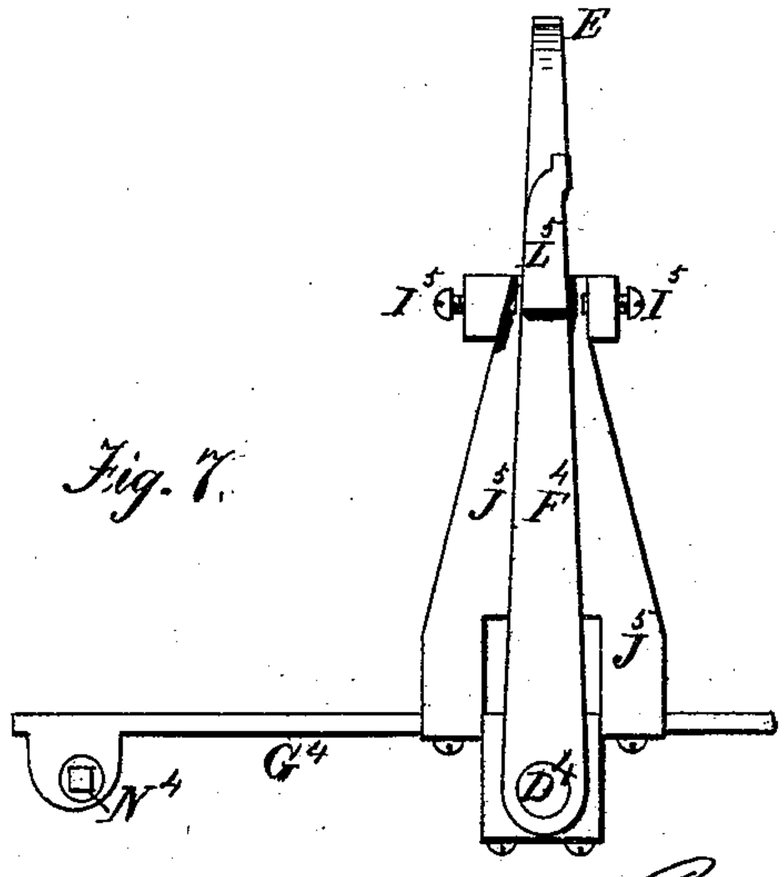

Fig. 7.

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4 Sheets—Sheet 4.

R. E. HOUSE.

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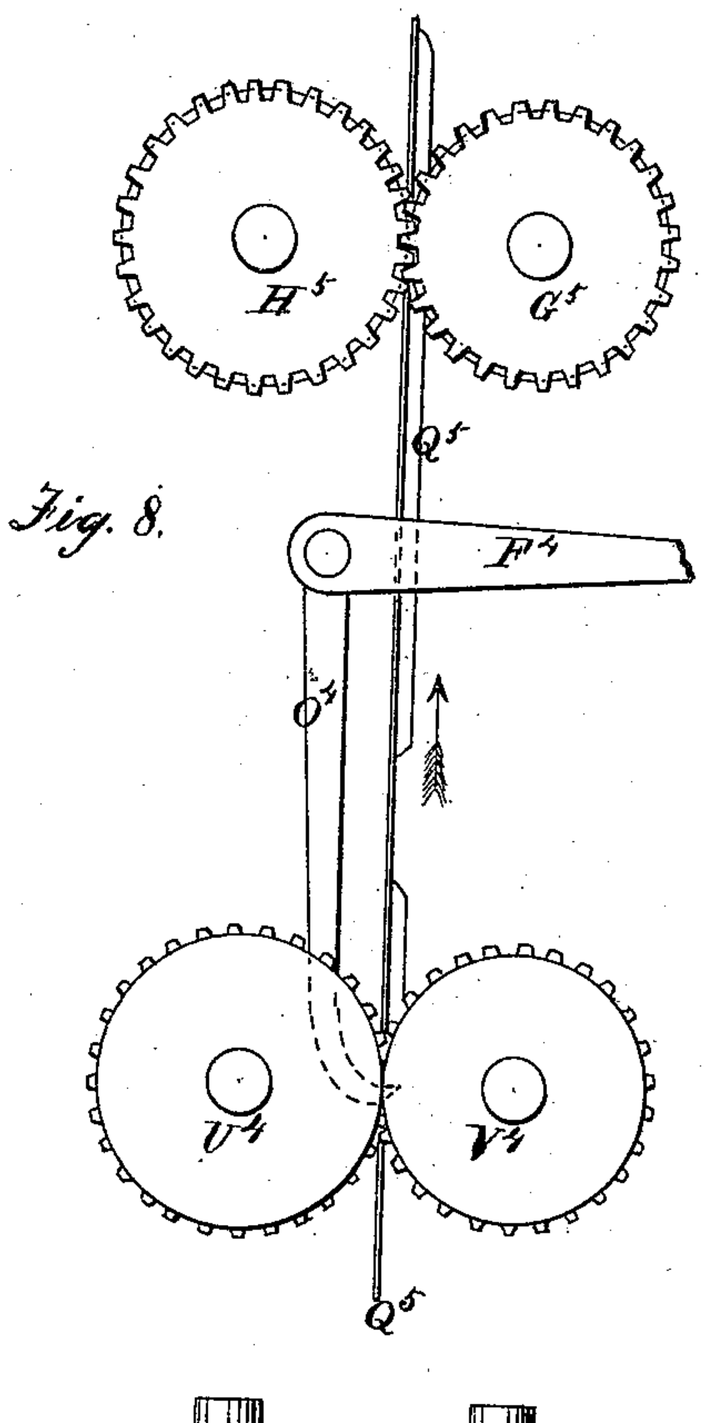

Fig. 8.

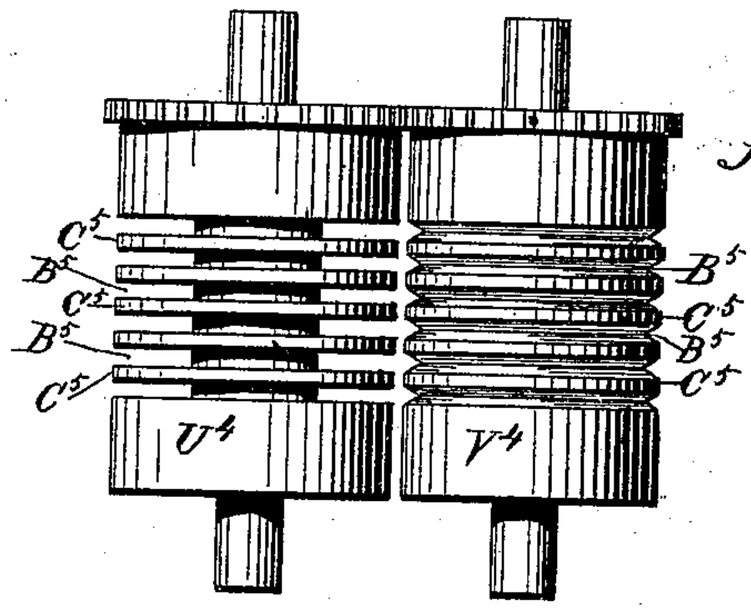

Fig. 9

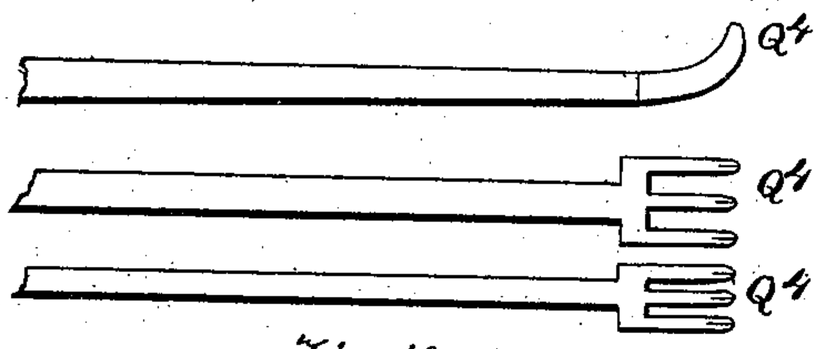

Fig. 10

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UNITED STATES PATENT OFFICE.

ROYAL E. HOUSE, OF BINGHAMTON, NEW YORK.

IMPROVEMENT IN ELECTRO-MAGNETIC TELEGRAPHS.

Specification forming part of Letters Patent No. **180,092**, dated July 25, 1876; application filed July 1, 1876.

To all whom it may concern:

Be it known that I, ROYAL E. HOUSE, of Binghamton, in the county of Broome and State of New York, have Invented certain new and useful Improvements in Electro-Magnetic Telegraphs; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1, Sheet I, is a perspective view, showing the frame of the telegraph apparatus mounted upon a desk or table and supporting the receiving-magnet and accessories, with the recording and transmitting devices attached. Fig. 2, Sheet II, is a perspective view of the marking device and lower feed-roller of the recording-instrument. Fig. 3, Sheet II, is a similar view, with the addition of the two remaining feed-rollers and a section of the paper fillet. Fig. 4, Sheet II, is a perspective view of the feed mechanism, the transmitting devices, and the circuit-breaker of the transmitting-instrument. Fig. 5, Sheet III, is a longitudinal section of the recording mechanism detached from the frame of the apparatus. Fig. 6, Sheet III, is a similar view of the transmitting-instrument. Fig. 7, Sheet III, is a detached view, showing the upright vibrating arm and its adjustable limiting devices, together with their position upon the guide-frame of the recording-instrument. Fig. 8, Sheet IV, is an end view of a modification in the feeding devices of the recording-instrument. Fig. 9, Sheet IV, is a side elevation of the feed-rollers shown in Fig. 8, and Fig. 10, Sheet IV, is a plan view and elevation of the modified embossing-style shown in Fig. 8.

Similar letters of reference in the accompanying drawings denote the same parts in the several figures.

The present application is a division of the application filed by me in the United States Patent Office June 17, 1870.

My invention has for its object to adapt a telegraph for the automatic transmission of a message recorded in a fillet of paper over a succession of telegraph-lines without the delays incident to the re preparation of the record at the end of each line.

To this end the invention consists, first, in the mechanism by which a telegraphed message is recorded in a fillet of paper at the receiving-station of a telegraph-line. It further consists in the mechanism for automatically transmitting a message from the record. It further consists in the employment, with the transmitting mechanism, of one or more circuit-breakers, either separately or combined. It further consists in the method of automatically transmitting a message from one telegraph-line to another. It lastly consists in the devices and combination of devices hereinafter set forth.

In the accompanying drawings, A is the frame of the telegraph apparatus, mounted upon a table or desk, B, from which it is properly insulated. The frame is constructed in such a manner as to brace and support itself, to prevent trembling while the instruments are working, and it is so arranged upon the table as to leave sufficient room for the use of the operator.

For the purpose of automatically recording telegraph-messages in a fillet of paper or other appropriate material which have been transmitted over a line or part of a telegraph-line, when such record is composed of two parallel rows of symbols, as described in my application for Letters Patent now pending in the United States Patent Office, I employ substantially the following mechanism:

G^4 and H^4 are, respectively, the guide-beds of the recording and transmitting mechanisms, and are hung side by side, slightly in rear of their centers, but independently of each other, upon a tubular shaft, I^4, having its bearings in the arms of a bracket, J^4, affixed to the main frame A of the instrument. The guide-beds both lie in a horizontal position, and their front ends are supported from the table B by rods K^4, which pass down through the table, and by springs L^4, surrounding the rods between the table and finger-pieces M^4. The tension of the springs is exerted to hold up the guide-beds for a purpose to be presently described, and it may be regulated by making the finger-pieces adjustable on the rods, if desired.

The rods are provided with side notches to engage the edges of the table at the holes, or the edges of metal plates around the holes,

when the springs are compressed, for the purpose of holding down the front ends of the guide-beds. The upper bent ends of the rods are journaled to the guide-beds within insulating-tubes N^4 to prevent electric connection with the table B, from which the main frame is also insulated, and to allow the beds freedom of motion in turning upon their tubular shaft. D^4 is a shaft having an upright arm, F^4. It has its bearings in the under side of the guide-bed G^4, and carries two parallel arms, O^4 and P^4, extending toward the rear of the bed, and lying partly within longitudinal grooves therein. The outer end of each arm is formed with one or more upturned styles or embossing-points, Q^4, to bear against the fillet of paper Q^5 as it is fed over the guide-bed. The outer arm O^4 is firmly keyed to the shaft D^4, and moves with it; but the inner arm P^4 is loosely hung upon such shaft, and receives its motion from the outer arm through the medium of two racks, R^4, affixed to the proximate faces of the arms, and an intermediate pinion, S^4, engaging with the racks and mounted upon a short shaft, T^4, having its bearings in the under side of the guide-bed, between the arms. When the upright arm F^4 is vibrated by means of an electric current on the telegraph-line, through intermediate devices not described herein, the styles are alternately moved up against the fillet of paper to make two parallel rows of depressions or embossments therein, which, by their length, form symbols of intelligence and constitute the record of a message. The style whose arm O^4 is firmly fixed to the shaft of the vibrating arm F^4 makes its embossments in the paper when the main electric circuit of the line is closed or reversed, and may therefore be called the "closed-circuit embossing-style," and the style of the other arm is moved up to make embossments in the paper when the main circuit is broken or reversed, and may be termed the "broken-circuit embossing-style."

The object of this arrangement is to break and close or reverse the circuit of the main line in transmitting from the record in the same order that it was broken and closed or reversed to make the record for the purpose of producing at a receiving-station a fac-simile of the message-record at the transmitting-station. The feeding mechanism for the record is composed of three rollers, U^4, V^4, and W^4, arranged one over the other transversely of the guide-bed in front of the tubular shaft I^4, and geared together at one end, as shown in Fig. 5. The lower roller U^4 is let into the guide-bed, and is formed with two parallel grooves to receive the styles and keep them, when depressed below the periphery of the roller, out of contact with the paper. The middle roller V^4 is mounted upon a shaft, X^4, having its bearings in the bracket J^4, and is made with a series of peripheral grooves upon opposite sides of a central bearing-surface, Y^4, which grooves constitute matrices wherein the embossings are formed by the styles, and also serve to prevent the embossings from being flattened down while passing out between the rollers. The upper roller W^4 has a plain periphery, and is hung in the arms of a bent bar, Z^4, Figs. 1 and 5, pivoted at one end to the top of the bracket J^4, and formed with a loop at its opposite end to receive the end of an upright rod, A^5, jointed to the guide-bed with a spring-connection. Motion is communicated to the feed-rollers by applying the power of any suitable prime mover to the shaft X^4 of the middle roller V^4.

The lower and middle rollers have corresponding guiding and feeding surfaces at the ends and center, which hold the fillet of paper firmly while being fed, and prevent it from becoming stretched or wrinkled at the margin and center during the formation of the embossments, as such wrinkling or unevenness would interfere with the subsequent operation of the mechanism for automatically transmitting the recorded message. This difficulty may, perhaps, be best avoided by constructing the lower and middle rollers with a number of grooves, B^5, and intermediate bearing-surfaces C^5, as shown in Fig. 9; but in this case the styles should be made longer, and formed with angular recesses, as shown in Fig. 10, to receive the bearing-surfaces of the lower roller.

With the feeding mechanism arranged as above described, the depression of the front end of the guide-bed will disengage the upper and lower rollers from the middle roller to stop the rotation of the two former, and permit the application and removal of the paper fillet.

The front end of the guide-bed is depressed by bearing upon the finger-piece M^4 so as to compress the spring L^4, and it may be locked in such position to hold the rollers out of gear by engaging the notch of the rod K^4, with the edge of the hole in the table B, as hereinbefore described. When the guide-bed is released, the pressure of the spring holds the rollers in gear, and bears them properly upon the paper fillet. The paper fillet is delivered to the feed-roller from a reel arranged at any convenient point upon or near the frame of the instrument, and a tension device of some kind must be employed to stretch and guide the paper in its passage to the rollers. This may be effected by a weight, spring, or frictional connection with the reel; but in this example of the invention I have shown a tension-guide affixed to the rear end of the guide-bed, and consisting of an open box, D^5, containing a block, E^5, which rests upon the paper and presses it against the bottom of the box.

The weight of the block is sufficient to maintain the necessary tension of the paper, while the sides of the box guide the latter properly to the rollers. The box is adjustably connected to the guide-bed, so that its position may be changed for guiding the paper, and the pressure-block has a transverse bar,

F^5, let into its under surface. The ends of the bar project somewhat beyond the sides of the block, and enter vertical grooves in the proximate sides of the box, for the purpose of preventing the block from being fed forward with the moving paper, and to form, at the same time, the means for readily applying and removing the paper.

After the paper from the reel has been passed through this tension device, it is inserted between the lower roller U^4 and intermediate roller V^4, and carried round the latter, between it and the upper roller W^4, from whence it is drawn back over the pressure-block E^5, as shown in Fig. 5. The pressure of the feed-rollers should be so regulated, by adjusting the force of the springs L^4, or by other convenient means, that the movement of the paper shall correspond to that of the rollers during its retardation by the tension device and the action of the styles in making the embossments.

If desired, the paper to be embossed can be run through the feed in a direct line lengthwise of the guide-bed, by being passed between the lower and intermediate feed-rollers only. In this case the upper roller may be removed, but the others will require an increased pressure to impart the necessary friction between them and the paper for moving the latter. The increased pressure of the rollers may be produced by strengthening the springs L^4, or by other suitable devices. With this arrangement it is, perhaps, preferable to substitute toothed rollers for the rollers U^4 V^4, in order to insure the movement of the paper. Should it be deemed advisable, a pair of drawing-rollers, G^5 H^5, may be placed in front of the feed-rollers, as shown in Fig. 8, but the upper one must be formed with peripheral grooves to receive the embossments and prevent them from being flattened out. The drawing-rollers may have their bearings attached to the guide-bed, and they should be geared with the feed-rollers U^4 V^4, so that the feeding-surfaces of each pair shall move with equal velocity to prevent tearing or unduly stretching the paper. The drawing-rollers may be pressed together to move the paper by any appropriate means, and they should also be so arranged as to be thrown out of gear to stop the feed of the paper when required. The first record for automatic transmission may be made by the machines heretofore used for automatically transmitting a message by merely making the type correspond to my symbols, instead of the Morse characters.

When a message is being received and recorded in the fillet of paper, the alternate contact of the embossing-styles with the moving paper continues throughout the duration of each electric condition of the main line. For example, the closed-circuit embossing-style remains in contact with the paper during the time the circuit is closed, and the broken circuit-embossing style remains in contact with the paper during the time the circuit is broken. The length of each embossment is determined by the distance the paper is moved during each electric condition of the main line—that is to say, during the time the circuit is broken or closed, or reversed, and the letters of the alphabet, or other message-symbols, are designated by the different lengths of the embossments.

The velocity of the feed-rollers should be the same at all the stations of a telegraph-line, in order to produce, at any one station, a fac-simile of a record at any other station, because the length of like embossments in the record must be the same at all the stations of the line, in order to prevent confusion, and to enable the messages to be read by the same scale or standard.

The depth of the embossments is regulated by suitable adjustable stops to limit the movement of the vibrating arm F^4. These stops may be made in the form of set-screws I^5, placed in the upper end of a standard, J^5, rising from the guide-bed, as shown in Fig. 7.

A telegraphed message having been automatically received and recorded at a station of a line, as above described, the record-fillet is employed as the agent for automatically transmitting the message along the line to another station. The principle of this transmission consists in using the embossments of the record as the controlling means for making automatic electrical changes in the main circuit of the line, that shall correspond in all essential respects to the electrical changes which were produced in making the embossments. These electrical changes may be made either by breaking or closing the main circuit or reversing its direction at such intervals of time as will cause a fac-simile of the record at one station to be produced at another station. The electrical changes in transmitting the record-signs may be developed from either the raised or depressed side of the embossments, and the power which they furnish to close the main circuit may be used alone, or in connection with an atmospheric circuit-breaker, or the latter may be used alone according to the construction of the line and the work to be done.

The mechanism upon which the embossments operate to effect the transmission of a message may be constructed in a variety of ways, one of which I will now proceed to describe, together with its mode of operation.

M^5 N^5 are two feed rollers or cylinders arranged one over the other transversely of the guide-bed H^4. The upper overhanging roller M^5 is the driving-roller, and is mounted upon the same shaft, X^4, that drives the feeding-rollers of the recording mechanism; and the lower roller N^5 has its bearings in the guide-bed, and receives its motion from the upper roller by means of the gearing O^5. The feed-cylinder M^5 of the transmitting mechanism is

of the same diameter as the feed-cylinder Y^4 of the recording mechanism. The lower roller is formed with two broad peripheral grooves each side the center, to receive the wide upturned ends of two flat arms, P^5 R^5, which are hung independently of each other upon a pivot or shaft, S^5, in rear of the roller. The front edges of these arms project forward the same distance from their pivot; but while the rear end of the arm P^5 terminates at, or a trifle behind, the pivot, the other arm R^5 extends rearward a considerable distance, and is provided with a valve, T^5, to work over a valve-chest, U^5, affixed to an air-cylinder, V^5, on the guide-bed. The cylinder contains a piston, W^5, mounted upon a vertical piston-rod, X^5, and is held by any suitable means within a chamber or recess, Y^5, formed in the rear end of the guide-frame H^4. Condensed or rarefied air is supplied to the cylinder from a suitable reservoir through the tubular shaft I^4, upon which both guide-beds G^4 and H^4 are hung, and through a short tube, Z^5, connecting the tubular shaft with the valve-seat, as shown in Fig. 6. The arms P^5 and R^5, although hung independently upon their pivot, are yet so connected as to be alternately raised and depressed by contact with the alternate rows of embossments in the record for operating the valve T^5. One method of forming this connection consists in fastening a short vertical plate or strip, A^6, to the outside of each arm P^5 R^5, at or near their pivot, and joining their lower ends together by a cross-bar, B^6, pivoted centrally to the under side of the guide-bed, as shown at C^6. The ends of the cross-bar fit loosely within the pendent strips, and the bar turns freely upon its pivot, so that when the front end of one arm, say P^5, is depressed the lower end of the pendent strip connected therewith will move rearward, carrying its end of the cross-bar with it. This movement throws forward the opposite end of the cross-bar and the plate A^6, which connects it with the arm R^5, and therefore throws up the front end of such arm. The reverse of these movements takes place when the front end of the arm R^5 is depressed, as will be readily understood. Thus the alternate depression of the arms vibrates the valve T^5 across the face of the valve-chest.

The weight of the valve is counterbalanced to hold it normally in front of the center of the valve-chest by means of a spiral spring, D^6, connecting the lower end of one of the pendent strips A^6 with an adjusting-pin, E^6, in the side of a wooden or other insulating-block, F^6, fastened to the guide-frame under the air-cylinder. By turning the pin E^6 the tension of the spring is adjusted to regulate the position of the valve with respect to the valve-chest.

The receiving-magnet helix (shown at C) and guide-frame H^4 of the transmitting mechanism are made a part of the main telegraph-line, connecting the protruding end E^{11} of the helix directly with one end of the main wire H^6, and by connecting the end E^{12} of the helix with a binding-screw, G^6, attached to the under side of the guide-frame at or in front of the center, the other end of the line-wire H^6 being joined to the binding-screw I^6, attached to the insulating-block F^6 at the rear end of the guide-bed, all as shown in Fig. 1. This latter binding-screw is connected, by a wire or metal strip, J^6, with an inverted adjusting-screw, K^6, in the insulating-block F^6, and, by a continuation of the line-wire H^6, as shown in Fig. 6, to a platinum-faced anvil, L^6, inserted in an insulating-block, M^6, secured in the guide-frame over the rear end of the arm R^5. This arm also carries a platinum hammer, N^6, which, when the arm is vibrated, alternately strikes the anvil L^6 and a limiting insulated anvil, O^6, secured to the guide-frame beneath the vibrating arm.

P^6 is a bent spring secured to the guide-frame between it and the insulating-block F^6, and having its free end projecting within a recess of the latter to support the piston-rod normally out of contact with the adjusting-screw K^6, and hold the piston midway between the two valve-ports of the air-cylinder.

When the message is to be automatically transmitted from one station to another, the record-fillet is inserted between the feed-rollers M^5 and N^5, which are in motion, and is fed forward over the upturned front edges of the arms P^5 R^5 in the direction of the arrow, Fig. 6. The tension of the spring L^4 at the front end of the guide-frame insures the necessary pressure of the rollers to feed the paper, which, like that of the recording mechanism, may be depressed to disengage the rollers and stop the feed of the paper when necessary.

In this illustration of the invention the raised portions of the embossments in the paper lie underneath and alternately present themselves to the front edges of the arms P^5 and R^5, to depress them and vibrate the valve T^5. When the front end of the arm R^5 is depressed, its hammer N^6 is thrown upward in contact with the anvil L^6, so that the current of electricity which entered the guide-frame along the wire E^{12} will pass through the pivot of the arms P^5 R^5; thence along the arm R^5 to the anvil L^6, and from the anvil to the main wire H^6 of the line. When the front end of the arm P^5 is depressed, it throws down the rear end of the arm R^5, as already explained, and breaks the circuit through the guide-frame. Thus the circuit is alternately broken and closed by the action of the record-embossments upon the pivoted transmitting-arms P^5 and R^5.

Those embossments marked Q^6, which were formed by the closed-circuit embossing-style, operate the arm R^5 to close the circuit in the main line, and are therefore called closed-circuit embossments, while those made by the broken-circuit embossing-style operate the arm P^5 to break the main circuit, and are de-

nominated broken-circuit embossments. Unless this relationship is preserved between the styles of the recording mechanism and the transmitting-arms a fac-simile of the record cannot be automatically produced.

Each electric condition of the main line continues throughout the time each transmitting-arm is depressed by the alternate embossments of the record, and, therefore, the duration of the respective breakings and closings of the main circuit will be the same at the receiving-station as at the transmitting-station, so that the record of the received message will be a fac-simile of that transmitted from a distant station, provided the speed of the feed-rollers is the same at each station.

As already explained, the feed-rollers of the recording and transmitting mechanisms or instruments are driven from the same shaft X^4 by any suitable prime mover. The velocity of the prime mover at each station, however, must be governed by a regulator of some kind, so that the operators can adjust the feeds to the same speed at all the stations of a telegraph line.

In the selection of a prime mover and regulator to actuate and govern the two feeds care must be taken to choose such as are adapted to impart a uniform velocity to that feed which is employed when the other is not in use. The feed for the recording-instrument requires much more power than that for the transmitting-instrument, and this difference must be provided for either in the prime mover or regulator.

The record-fillet is guided to the feed-roller of the transmitting-instrument by a frictional tension-guide, R^6, arranged upon the rear end of the guide-frame H^4, and constructed like the tension-guide of the recording-instrument, excepting that the bottom of the box is grooved, as shown in Fig. 6, and that the weight of the pressure-block bears upon the edges of the paper outside the lines of embossment for the purpose of preventing the latter from being flattened out as they pass through the guide.

When the record is guided to the feed-roller in a direct line or lengthwise of the guide-frame the tension-guide is arranged upon the rear end of the frame, and the groove is made in the bottom of the box, as shown in Figs. 1 and 6; but in case the record is fed over the upper feed-roller, and then turned between the two rollers as shown in Fig. 4, the tension-guide should be arranged in front of the roller, say between the points S^6 S^6, and the groove must be made in the pressure-block instead of in the bottom of the box, because, in this changed direction of the record the raised surfaces of the embossments are uppermost when they pass through the guide.

As the embossments of a record furnish only a feeble power to break and close the circuit the atmospheric power is used to re-enforce it in the following manner, to wit: As the hammer N^6 of the transmitting-arm R^5 is thrown upward in contact with the anvil L^6, to close the main circuit, the valve T^5 moves up over the valve-chest, opening the lower side chamber to the external air, and establishing communication between the central chamber, the upper side chamber, and the cylinder above the piston. The condensed air from the reservoir then rushes into the cylinder and moves down the piston against the tension of the spring P^6 until the latter is arrested by contact with the point of the adjusting-screw K^6. The spring and screw, whose contact-surfaces are faced with platinum, form an electrical connection between the guide-bed and plate J^6, along which the current passes to the binding screw I^6, and thence along the main wire H^6. When the valve is moved down over the valve-chest by the depression of the short transmitting-arm P^5 communication is effected between the central chamber and the cylinder under the piston, so that the incoming air shall lift the latter to break the contact of the spring and adjusting-screw, and thus open the electric circuit. The upward movement of the piston is limited by a set-screw, R^6, in the upper head of the cylinder, against which the piston-rod impinges, and which, together with the screw K^6, may be adjusted to regulate the strokes of the piston.

This division of the telegraph-line into two branches—one of which will be broken and closed by limiting the motions of the transmitting-arms, and the other by the action of the piston or piston-rod—is for the purpose of insuring uniformity in making the electric changes, and so that if one branch be discontinued the other may be used.

In case it should be desired to make the electric changes by changing the direction of the main-line current, the well-known instrument called a "reverser" may be arranged in the line to be operated by the piston W^5 of the transmitting-instrument. Each station of a telegraph-line is provided with a recording and a transmitting instrument, and the poles of the main batteries are so connected to the line that each time the main circuit is closed all the arms F^4 will be moved in one direction by the devices connected with the receiving-magnets, and each time the circuit is broken they shall all move in the opposite direction. The same result is obtained if the line is worked by reversed currents. All the local powers of the line also act in harmony with each other.

When several telegraph-lines are joined together so as to form a telegraph-route, the end stations of adjoining lines are called junction-offices. Those stations which are intermediate between the end stations of a line are termed intermediate or way offices. Those where two or more lines cross each other are called intersection-offices, and those which form the ends of the entire route are the terminal offices, as described in my application for Letters Patent of the United States filed and now pending.

By employing automatic recording and transmitting instruments with this combina-

tion of telegraph-lines, a message can be automatically reproduced at the end of one line, and the record thereof employed to automatically transmit it over the next or any number of succeeding lines to the place of its destination, thereby saving the time and labor required by the system now in use in repreparing the message at the end of each line, as also explained in another application for Letters Patent of the United States filed by me.

A message to be transmitted over several lines of a telegraph-route is first incorporated in a record at the transmitting-office, and then automatically transmitted over the line to the intersection or junction office, where it is automatically reproduced in fac-simile. The operator at this latter office then places the record in the transmitting-instrument of the next succeeding line, when the message is automatically transmitted over the same to the intersection or junction office, where it is again automatically recorded, this operation continuing over each succeeding line until the delivery-station is reached, where the message is finally recorded, and either written out or converted into printed characters for delivery.

A message may also be transmitted from the depressed, instead of the raised, side of the record, but the transmitting-arm must be formed with points to enter the depressions, and arranged in line with the depressions, as will be readily understood. This method of transmission also requires a change in the feed-roller and guide-bed, so as to suitably guide and move the paper-fillet without flattening the embossings.

Having thus described my invention, what I claim as new is—

1. A telegraph apparatus having two marking points or styles, which are alternately thrown in contact with a moving fillet of paper to form message-symbols therein, by reversed currents upon the main line, or by alternately breaking and closing the main circuit, substantially as described.

2. Two marking-styles, mechanically connected, so that when one is moved up to the record the other is moved away from it, substantially as described, for the purpose specified.

3. The arrangement of the recording-styles to break and close the main electric circuit when the message is transmitted, in the same order in which it was broken and closed to make the record of the telegraphed message, for the purpose of producing at a receiving-station a fac-simile of the record at the transmitting-station, substantially as described.

4. A transmitting-instrument, consisting essentially of two transmitting-arms, which are operated by the message-signs in a moving fillet of paper, to reverse the electric current of the main line, or to alternately break and close the main circuit, for the purpose of telegraphing such signs from one station to another, substantially as described.

5. Two transmitting-arms so connected that when one is moved up to the message-fillet the other is moved away from it, for the purpose specified.

6. The combination of adjustable stops I^5 with the upright vibratory arm F^4, substantially as described.

7. The standard J^5, mounted upon the guide-bed G^4, to carry the adjustable stops I^5, substantially as described.

8. The combination of the two style-arms O^4 P^4 with the shaft of the upright arm F^4 and the guide-bed G^4, substantially as described, for the purposes specified.

9. The combination of the pinion S^4 and racks R^4 with the style-arms, substantially as described, for the purposes specified.

10. The combination of the styles with the lower grooved feed or pressure roller U^4, substantially as described, for the purposes specified.

11. The feed mechanism of the recording-instrument, consisting of the upper and lower adjustable feed-rollers W^4 U^4 and the non-adjustable intermediate or middle feed-roller V^4, substantially as described.

12. The middle feed-roller, constructed with parallel circumferential matrices, into which the fillet of paper is pressed by the styles to form embossments, substantially as described, for the purposes specified.

13. The lower feed and pressure roller U^4, constructed with a feed-surface between the grooves and at each end outside the grooves, substantially as described, for the purposes specified.

14. The middle feed-roller V^4, constructed with a feed-surface, Y^4, between the two sets of matrices, and at each end outside the matrices, substantially as described, for the purposes specified.

15. The combination of a feed and pressure roller, U^4, a lever or guide-bed, G^4, a finger-piece, M^4, a spring, L^4, and a latch, K^4, substantially as described, for the purposes specified.

16. The combination of the upper feed-roller W^4, pivoted bar Z^4, upright rod A^5, and the guide-bed G^4, substantially as described, for the purposes specified.

17. The upper and lower feed-rollers W^4 U^4, adapted to be thrown out of operation or out of gear with the middle roller V^4, by depressing the end of the guide-bed G^4, substantially as described, for the purposes specified.

18. The combination of a paper-guiding and tension device, with the feed-rollers of the recording-instrument, substantially as described.

19. The paper-guiding and tension device, mounted upon the guide-frame G^4 of the recording-instrument, substantially as described.

20. The paper-guiding tension device of the recording-instrument, consisting of the open box D^5, and the pressure-block E^5, substantially as described.

21. In transmitting a telegraph-message, the embossments of the record adapted by suitable mechanism for making automatic

electrical changes in the main-line circuit, that shall correspond to the electrical changes which were produced in making the embossments, substantially as described.

22. The feeding mechanism for the transmitting-instrument, consisting of the feed-roller M^5, and grooved roller N^5, substantially as described, for the purposes specified.

23. The feed-roller M^5, mounted upon the same shaft that carries the middle feed-roller V^4 of the recording-instrument, substantially as described, for the purposes specified.

24. The transmitting-arms P^5 and R^5, combined with the feed-rollers M^5 and N^5, substantially as described, for the purposes specified.

25. The transmitting-arms P^5 and R^5, and the feed-rollers M^5 and N^5, in combination with the guide-bed H^4, substantially as described, for the purposes specified.

26. The transmitting guide-bed H^4, interposed in or forming a part of the telegraph-line, substantially as described, for the purposes specified.

27. In transmitting a telegraph-message, one or more transmitting-arms, combined with embossments in a fillet of paper, for making the necessary electrical changes in the main line, substantially as described.

28. The combination of a circuit-breaker with the transmitting guide-frame, substantially as described, for the purposes specified.

29. The combination of an atmospheric circuit-breaker with the transmitting guide-bed, substantially as described.

30. The combination, with the transmitting-arms, of the vertical side strips A^6 and the cross-bar B^6, pivoted centrally to the under side of the guide-bed H^4, substantially as described, for the purposes specified.

31. The combination of an atmospheric circuit-breaker with a transmitting-instrument, substantially as described.

32. The atmospheric circuit-breaker, combined with the guide-bed H^4 of the transmitting-instrument, substantially as described.

33. The valve T^5, combined with the transmitting-arm R^5, to work over the face of the valve-chest U^5 upon a thin stratum of air, substantially as described, for the purposes specified.

34. Counterbalancing the weight of the valve T^5 and transmitting-arm R^5 by means of the adjustable spring D^6, substantially as described.

35. The valve T^5, vibrated across the face of the valve-chest by the raised or depressed side of the embossments in a fillet of paper operating through suitable mechanism intervening between the valve and embossments.

36. The combination of the bent spring P^6 with the piston-rod X^5, to hold the latter normally out of contact with the adjusting-screw K^6, and the piston W^5, midway between the two valve-ports of the cylinder V^5, substantially as described, for the purposes specified.

37. The division of a telegraph-line into two branches, one of which is broken and closed by limiting the motions of the transmitting-arms, and the other by the action of the piston W^5 and piston-rod X^5, substantially as described, for the purposes specified.

38. A tension-guide for the record-fillet, having one or more grooves to prevent the embossments in the record-fillet from being flattened down in their passage to the feeding devices of the transmitting mechanism, substantially as described.

39. The combination of the lower feed-roller N^5, the guide-bed H^4, finger-piece M^4, spring L^4, and latch K^4, substantially as described, for the purposes specified.

40. The combination of the lower feed-roller N^5, the guide-bed H^4, finger-piece M^4, spring L^4, and latch K^4, substantially as described, for the purpose specified.

ROYAL E. HOUSE.

Witnesses:
E. D. PRENTICE,
TRACY R. MORGAN.