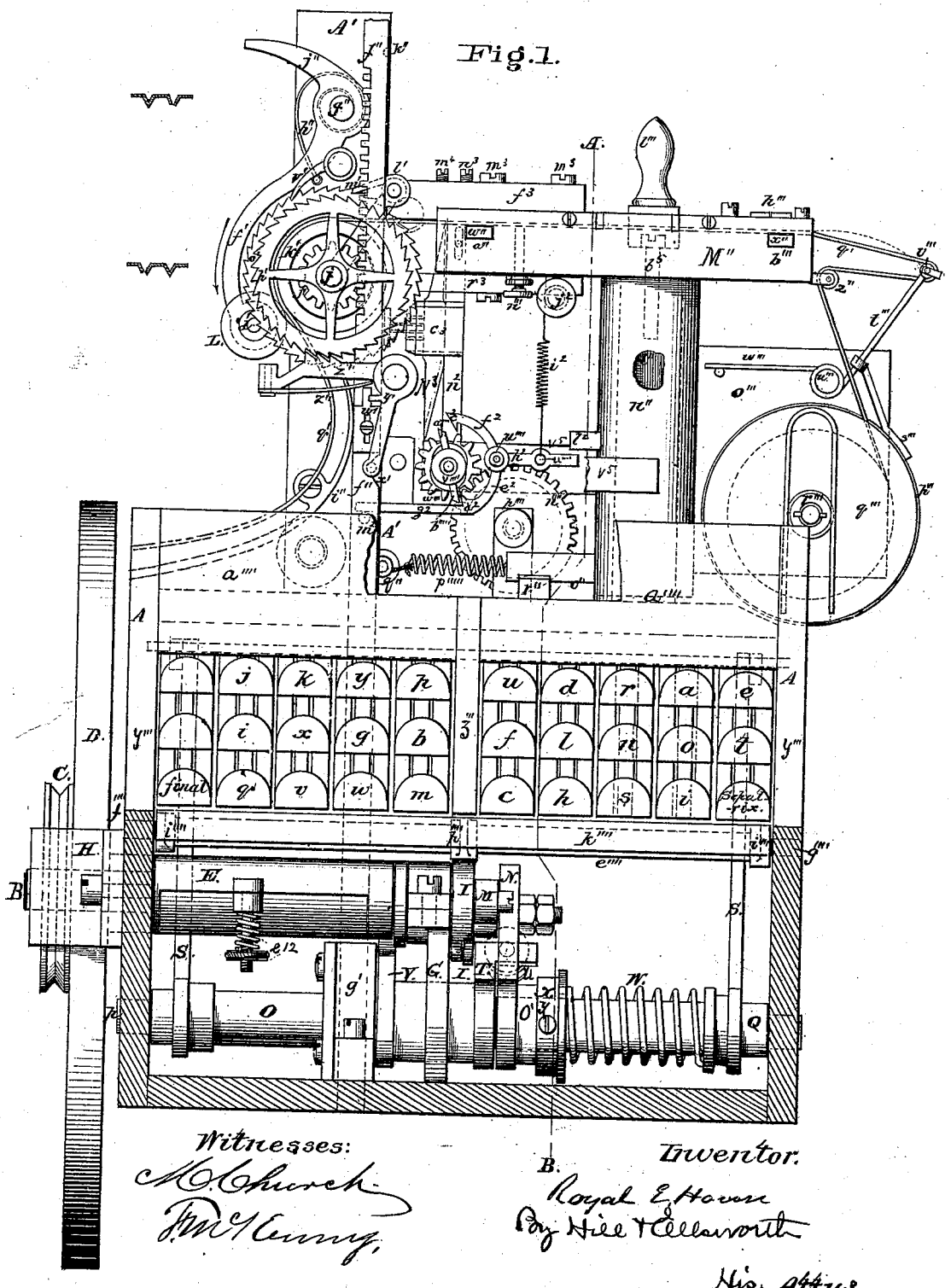
5 Sheets—Sheet 1.

R. E. HOUSE.

ELECTRIC TELEGRAPH APPARATUS.

No. 180,089. Patented July 25, 1876.

Fig. 1.



Witnesses:

M. Church

F. McEnny.

Inventor.

B.

Royal E. House

by Hill & Ellsworth

His Attys.

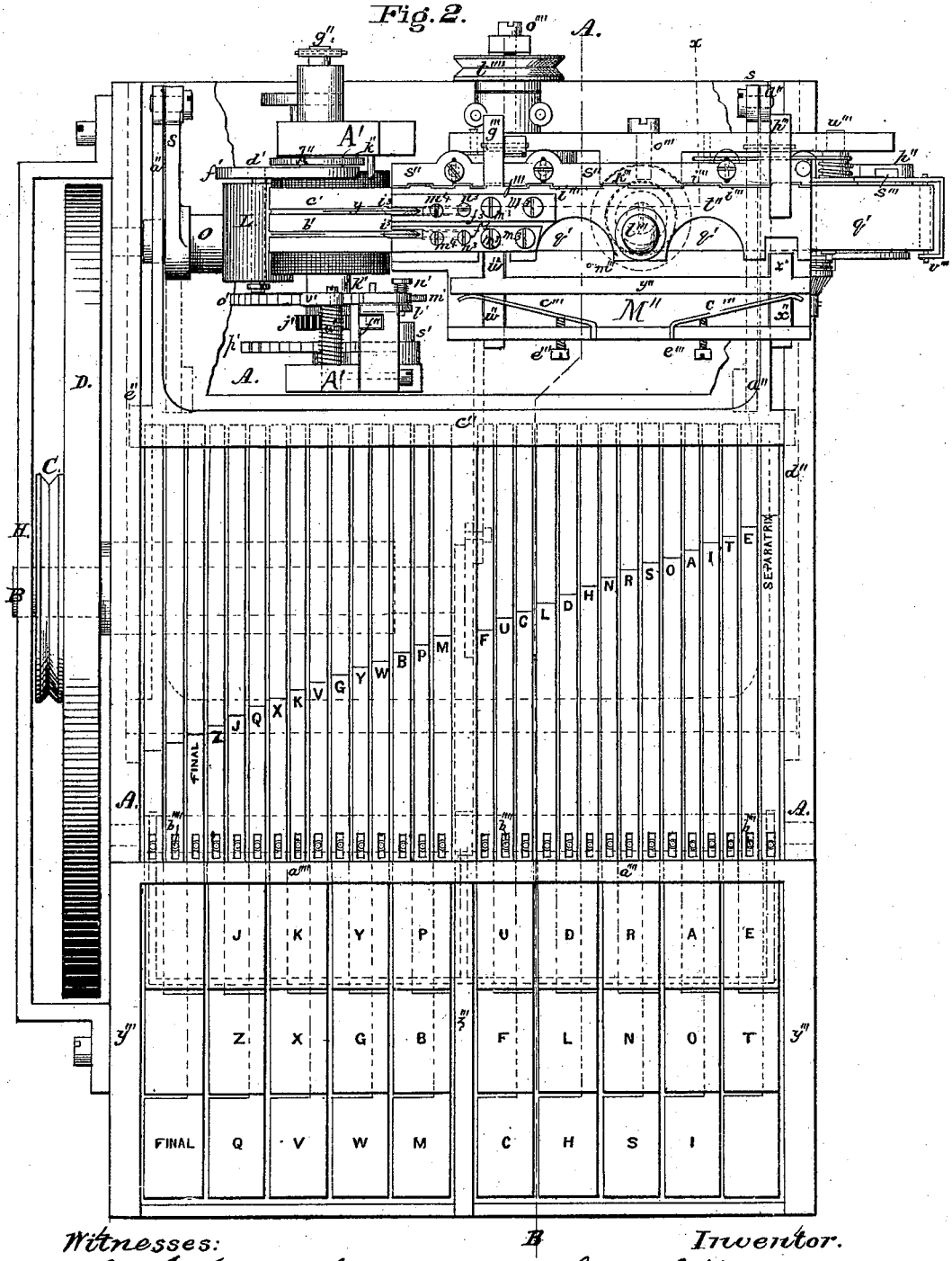
5 Sheets—Sheet 2.

R. E. HOUSE.

ELECTRIC TELEGRAPH APPARATUS.

No. 180,089. Patented July 25, 1876.

Fig. 2.



Witnesses:
A. O. Church
F. McKenny

Inventor.
Royal E. House
By Hill & Ellsworth
his Attys.

5 Sheets—Sheet 3.

R. E. HOUSE.

ELECTRIC TELEGRAPH APPARATUS.

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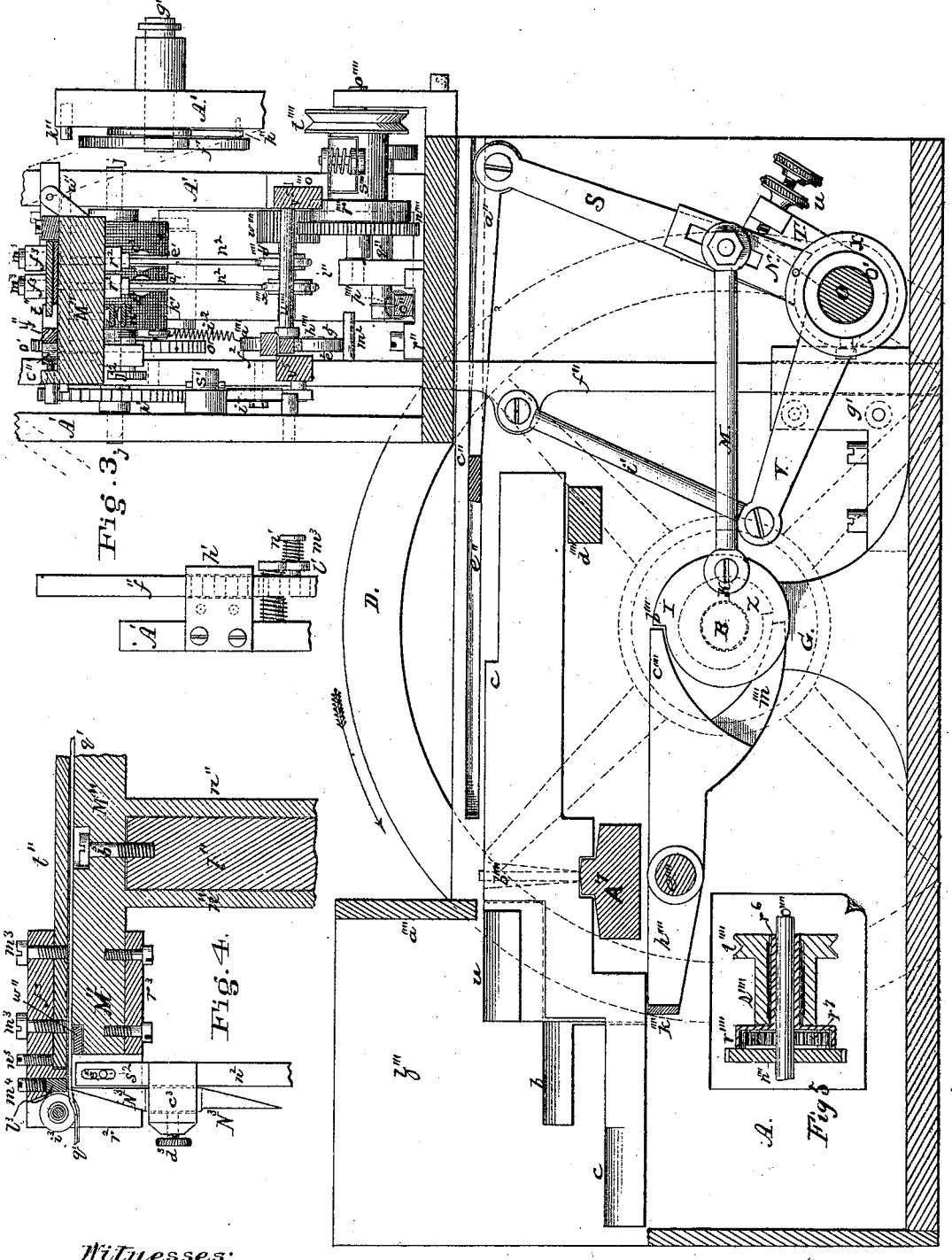

Fig. 3.

Fig. 4.

Fig. 5.

Witnesses:

M. G. Church

F. M. Kenny.

Inventor.

Royal E. House

By Hill Hillsworth.

His Attys

5 Sheets—Sheet 4.

R. E. HOUSE.

ELECTRIC TELEGRAPH APPARATUS.

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Fig. 6.

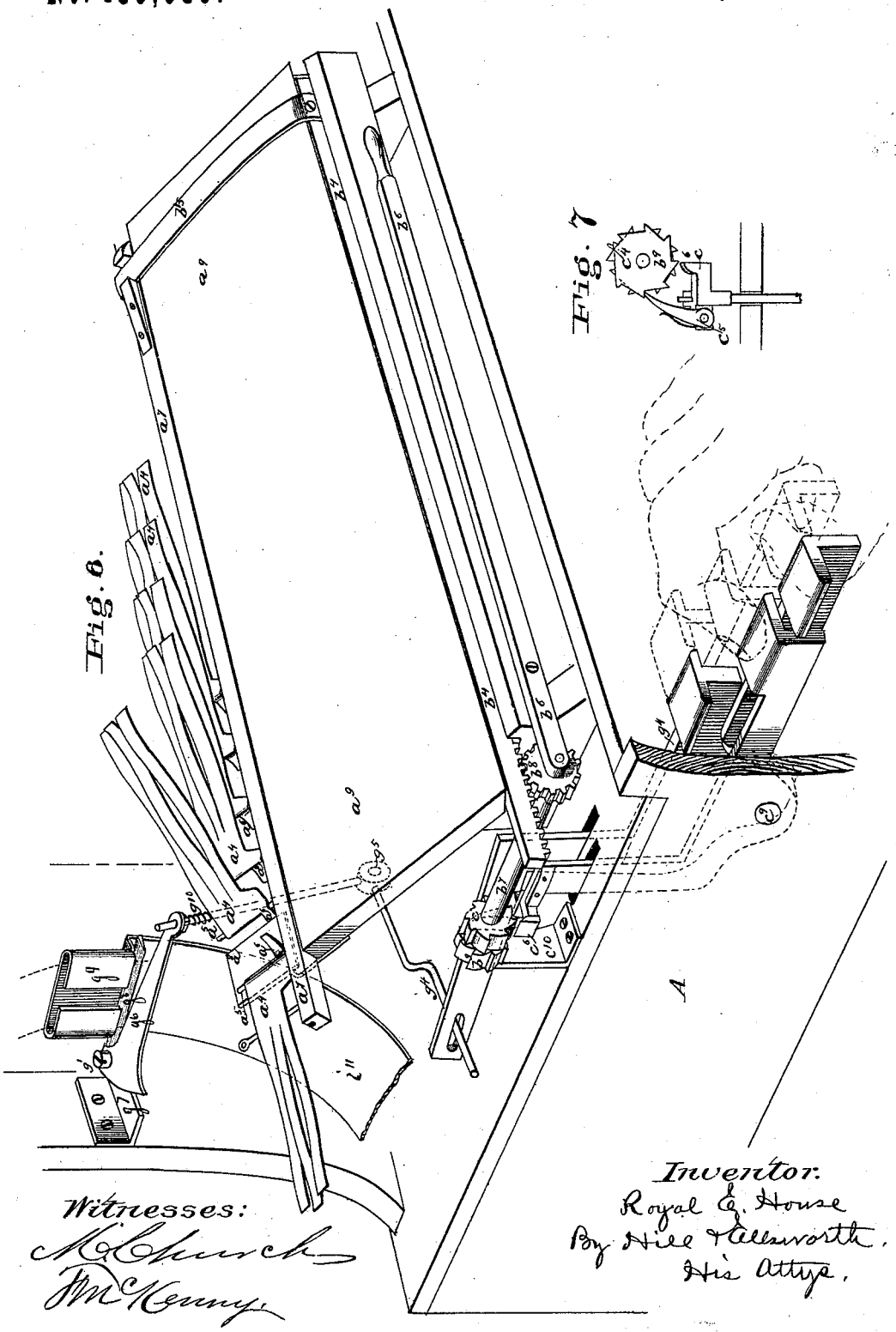

Fig. 7

Witnesses:
M. C. Church
W. McKenny

Inventor:
Royal E. House
By Hill Ellsworth,
His Attys.

5 Sheets—Sheet 5.

R. E. HOUSE.

ELECTRIC TELEGRAPH APPARATUS.

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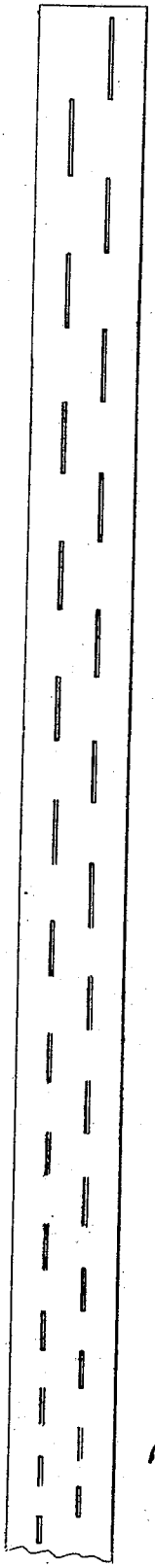

Witnesses
M. Church
F. McKenney

Inventor.
Royal E. House
By Hill & Ellsworth
His Attys.

UNITED STATES PATENT OFFICE.

ROYAL E. HOUSE, OF BINGHAMTON, NEW YORK.

IMPROVEMENT IN ELECTRIC-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **180,089**, dated July 25, 1876; application filed February 20, 1874.

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 a new and useful Recording-Instrument for Telegraph-Messages; and I do hereby declare the following to be a full and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1, Sheet 1, is a front elevation of the instrument, with part of the frame removed to show the interior mechanism under the keys. Fig. 2, Sheet 2, is a top-plan view, with parts of the frame broken away to show the mechanism for feeding the fillet of paper and making the record. Fig. 3, Sheet 3, is a longitudinal section of the instrument taken in the plane of the line A B, Fig. 2, the top being cut off to the right and left, as shown by dotted lines. Fig. 4, Sheet 3, is a vertical longitudinal section of the guide-bed and its support. Fig. 5, Sheet 3, is a sectional view of the shaft, the friction-sleeve, and other devices connected therewith, by which the eccentric shaft is operated from the prime mover of the instrument. Fig. 6, Sheet 4, is a perspective view of the message-rack. Fig. 7, Sheet 4, is a detached view of the ratchets and pawls employed to operate the message-rack; and Fig. 8, Sheet 5, is a plan view of the record or message fillet.

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

My invention has for its object to produce a record of telegraph-messages in a narrow strip of paper to be employed as the medium for automatically transmitting the messages from one telegraph-station to another. To this end the invention consists, first, in the record composed of a narrow ribbon or fillet of paper, in which are cut two parallel rows of slits, arranged to be read alternately from one row to the other, and indicating by their length the letters of the alphabet and other message-symbols.

It further consists in the mechanism for making such record.

It further consists in arranging a number of messages to be recorded, preparatory to transmittal, in such a manner that they may be successively exposed to the view of the operator, and then moved to one side out of the way by the operation of one of the finger-keys of the recording-instrument.

It further consists in the mechanism for holding the messages, and in the means for operating such mechanism from the finger-key.

It further consists in the employment of a pair of shears, adapted for operation from one of the finger-keys of the recording-instrument for cutting off the recorded messages from the fillet of paper.

It further consists in the mechanism for operating the shears from the finger-keys.

In carrying out my invention, I arrange the letters of the alphabet in the order in which they most frequently occur in telegraphic messages, designating for the one that most frequently occurs the shortest slit, and increasing the length of the slits as the occurrence of the letters diminishes. The most frequently-used sign in telegrams is the separatrix or space between words. This I make about one-half an inch in length. The order in which the letters of the alphabet most frequently occur is as follows, to wit: *e t i a o s r n h d l c u f m p b w y g v k x q j z*. For these I make the slits increase in length about one-sixteenth of an inch for each one in the above order. For example, the separatrix being one-half an inch long, the slit for the letter *e* is made nine-sixteenths of an inch long; for the letter *t* ten-sixteenths, and so on. The sign for finis, or the end of a message, should be one-sixteenth of an inch longer than the sign for *z*, the last letter of the alphabet. These lengths and this order are not imperative, being used here principally to illustrate the invention.

A is the frame or case of the instrument, made in any suitable form to receive the working parts, and B is the main driving-shaft, arranged transversely of the frame, with its bearings in the bars G H. I Z are cams secured to the inner end of the main shaft, with their shoulders upon opposite sides thereof, and O is a rock-shaft, having its bearings in the sides of the frame, near the rear end. O^1 is a sleeve, mounted loosely upon this shaft, and provided with a slotted arm, N, which is

connected, by a rod, M, to the outer cam of the main shaft. Instead of making this connection directly with the cam, it may, if found desirable, be formed by a crank-arm on the end of the main shaft.

The rock-shaft O is further provided with a central fixed collar, carrying arms T V at an angle to each other. The arm T is formed with a lateral lug, carrying a set-screw, U, to bear against a corresponding lug upon the arm N, while the arm V is connected with a vertical rack-bar, f''', by the pivoted rod i', as shown in Fig. 3. S S are upright arms, firmly secured to the ends of the rock-shaft, and pointed at their upper ends to the arms a'' of a transverse stop-bar, c'', whose ends lie within longitudinal grooves formed in the side pieces of the case, near the upper edges. W is a spring coiled about the rock-shaft, with one end secured to one of the arms S, and the opposite end to a collar, x, upon the sleeve o'. The collar is adapted for adjustment upon the sleeve by a set-screw, Y, or other suitable means, to regulate the tension of the spring.

From the foregoing description it is evident that when power is applied to rotate the main shaft the stop-bar will be moved back and forth within the grooves of the case, and that the rack-bar f'' will be reciprocated vertically. The extent of this reciprocation is regulated by adjusting the end of the connecting-rod M within the slot of the arm N, while the path of reciprocation is changed by adjusting the set-screw U to regulate the distance between the arms T and N. The tension of the spring is sufficiently strong to oscillate the rock-shaft and carry forward the stop-bar when the main shaft is rotated; but if the forward movement of the bar should be arrested before reaching its maximum throw, the tension of the spring will be overcome, so that the main shaft shall complete its rotation.

E is a sleeve mounted upon the main shaft, provided with a fly-wheel, D, and a grooved pulley, C, to receive the driving-belt of the instrument.

Inasmuch as the power applied to the sleeve must drive it continuously, and inasmuch as it is absolutely necessary that the main shaft shall rotate intermittingly, the sleeve is adapted to grasp and rotate the shaft by friction. For this purpose one half of the sleeve is held to the other half by set-screws and springs e^{12}, which may be adjusted to regulate the degree of friction, and therefore the force with which the sleeve shall hold to the shaft. The sleeve is lined with leather or other pliable material for the purpose of equalizing the friction and preventing unequal wear. The force of the sleeve must be sufficiently great to overcome the tension of the coiled spring when the stop-bar is arrested in its forward movement, and at the same time slight enough to allow the sleeve to turn continuously when the shaft ceases to move. Some connection of this kind is required for the successful operation of the instrument, since the intermittent rotation of the main shaft must be repeated many times in a second.

The key-board of the instrument is composed of three banks of keys, divided into two sections, for the right and left hand of the operator, so that each bank of a section shall number five keys.

The section-dividing board z''', together with the end boards y''' and front board a'''' of the case, form guides for the fingers of the operator, so that he can look up to read a message while manipulating the keys. The boards y''' and z''' determine the stretch of the thumb and little finger, and so regulate the position of the intermediate fingers over the keys, while guiding the hands in their backward and forward movements. The front board a'''' prevents the hands from going too far forward over the keys, and therefore forms a front guide at the upper bank.

The keys are each pivoted upon a central pin, b'''', affixed to a suitable cross-bar, A^7. Their inner ends extend beneath the path of the stop-bar c'', and are properly weighted, so as to rest, when not in operation, upon a rear cross-bar, d'''', as shown in Fig. 3.

As the signs which represent the letters of the alphabet and other message-symbols are formed by slits of different lengths in the fillet of paper, and since the slitting-instruments are operated by the rack-bar, in a manner to be presently described, it follows, in this example of my invention, that the throw of the rack-bar must be varied in proportion to the length of slits required. This is accomplished by suitable stops upon the upper edges of the keys, to arrest the stop-bar at graduated distances in its forward movements. The result may be attained in a variety of ways; but in this instance I have shown the keys formed with shoulders upon their upper edges, at varying distances from their inner ends, such distances increasing from right to left of the key-board, presenting the diagonal line shown in Fig. 2.

Since certain letters occur more frequently than others in telegraphic messages, which necessitates their representation by short slits in the fillet of paper, I have transposed the alphabet, and placed the letters in such order upon the shoulders of the keys that the stop-bar will move the shortest distance for the most-frequently occurring letter, the length of its strokes being gradually increased in proportion to the increase in the occurrence of the letters used. By this means the recording mechanism may, through the medium of the stop and rack bars, be operated with great rapidity within a given time.

The letters of designation are duplicated in the same order on the finger ends of the keys, as shown in Fig. 2.

h'''' is a lever, hung upon a cross-shaft, e'''', of the case beneath the bar A^7, and forked at its inner end, to embrace the cams I Z on the main shaft, one arm, e'''', of the fork bearing against the shoulder b''' of the cam I, and the

other arm, m'''', at the proper time, bearing against the periphery of the cam Z. The forked end of the lever should be sufficiently heavy to hold the arm e'''' in contact with the shoulder b''', and to return it rapidly against such shoulder after having been lifted.

K'''' is a cross bar, arranged under and against the forward portion of the keys, and connected to the ends and center of the shaft e'''' by arms i'''' and the short arm of the forked lever.

As above described, the power is applied to drive the friction-sleeve and fly-wheel of the instrument continuously; but the rest of the mechanism is motionless until the operator presses a key down upon the cross-bar K''''. This movement lifts the inner end of the detent-lever and releases the cam I, so that the friction-sleeve shall revolve the main shaft, and, through the intermediate devices, throw forward the stop-bar until it is arrested by the shoulder of the depressed key. The rack-bar, by this operation, is carried down in proportion to the distance traveled by the stop-bar, starting always from the same point—that is to say, it always starts downward from the same point, but descends differentially in proportion to the throw of the stop-bar.

These various parts constitute the mechanism for operating the recording devices, which I will now proceed to describe, in connection with their method of operation.

M'' is a horizontal bed for guiding the fillet of paper upon which the message is recorded, and n'' is a sleeve, secured to its under side so as to fit upon an upright spindle, l'', affixed to the frame in rear of the key-board. The guide-bed is arranged transversely of the case, and may be pivoted to the top of the spindle by a screw-pin, b^5, as shown in Fig. 4.

A^1 A^1 are uprights of t e frame placed in line with the guide-bed, to receive the feeding mechanism, by which the fillet of paper is drawn through the instrument. p'''' is a spring connecting an arm, o'', of the sleeve n'', with an adjusting-pin, q'', at the base of the outer upright, for the purpose of holding the guide-bed in position with a yielding connection. r'' is a stop attached to the case within the path of the arm o'', and adapted for adjustment to regulate the lateral swing of the guide-bed. By this method of mounting and connecting the guide-bed, it is automatically adjusted with delicacy and precision to compensate for any irregularities in the running of the paper, and to insure accuracy in its presentation to the recording-blades and feeding-cylinder.

O''' is an arm projecting to the rear of the guide-bed sleeve n'', and provided with a lateral pin, r''', upon which the paper-reel q''' is hung. q' is the paper wound upon the reel beside a flange or rim, p''', formed upon the latter, and thence passing upward on its way to the guide-bed through a guide-loop, v''', formed upon the upper end of a lever, t'''. The inner end of the paper is secured to the reel in any convenient manner to prevent it from slipping.

The lever carries a friction-brake, S''', and is hung to the side of the arm O''', so that, under the force of a spring, w''', it shall press the guide-loop away from the bed, and the brake down upon the flange of the reel.

When the instrument is in operation, the feeding devices pull the paper over the feed-bed with slight but rapid jerks, which carry the guide-loop v''' toward the guide-bed and lift the friction-brake from the reel, so that the latter may turn and release the paper.

When the paper ceases to move, the spring throws out the upper end of the lever t''', unwinding the paper from the reel until the friction-brake comes down against the flange thereof and arrests its further rotation.

To increase the quantity of paper pulled off the reel in proportion to the increase in the length of the message-slits, it is passed over an intermediate guide, x''', affixed to the end of the guide-bed, before passing over the guide v'''. After leaving the reel-guides the paper rests upon the bottom of the guide-bed, and is held against the adjustable outer or gage side S'' thereof by means of shoulders formed upon arms w'' x'', which are connected by a longitudinal bar, y'', and slide within deep transverse grooves in the bottom of the bed, as shown in Fig. 2.

The shoulders are held against the fillet of paper, so that they shall conform to its varying width, by one or more springs, c''', arranged to bear against the outer side of the bar y''. The pressure of the springs is adjusted by set-screws e''' passing through the inner side rail of the bed, or arranged in any other convenient manner.

A pin, m''', fixed to the bottom of the guide-bed, limits the advance of the yielding shoulders when the fillet of paper has passed out of the machine.

t'' is a cover or presser-bar, hinged to the outer edge of the guide-bed, so as to hold down the fillet of paper, the amount of pressure or friction being regulated by the set-screw n''', Fig. 1, upon which the free edge of the cover rests.

The cover may be weighted or held down by a spring, if preferred, but its own weight will in most cases, probably, be found sufficient for all purposes. Its outer edge is formed with suitable recesses or spaces j''', k''', and i''', to prevent the outer edge of the paper from folding up as it passes over the guide-bed and along the guide side S''. l''' is a handle affixed to the cover, for opening and closing it in applying or removing the paper.

The ends of the transverse guide-arms w'' x'' extend through the gage side S'' of the bed, in line with the hinges of the cover, so that, when the latter is thrown open for the insertion of a fillet of paper, the upper leaves of the hinges shall bear against the ends of

the arms, and force back the guide-blocks. The opening of the cover, therefore, prepares the bed for the application of the paper.

r^2 are slotted guide-blocks, attached to the inner end of the guide-bed, so that their upper surfaces shall lie flush with the top of the bed. They are each formed with a slotted arm, r^3, extending under the bed, for the passage of holding-screws, by which the blocks are independently adjusted with respect to the bed and its gage side, to regulate the distance apart of the slitting-blades and the position of the slits in relation to the edges of the paper. Instead of making the blocks in separate pieces and attaching them to the bed, they may be made directly upon the end of the latter, if preferred.

f^3 are corresponding slotted guide-blocks, attached to the cover of the guide-bed by set-screws m^3, so that their slots shall register with those in the blocks r^2. Each of the blocks f^3 carries an embossing roller or style, i^3, within its slot, to bear down, under the weight of the cover, upon the fillet of paper in its passage over the bed, and by pressing it into the grooves of the lower blocks, to form two parallel tracks or creases.

The edges of the grooves in the lower blocks may be beveled or cut out in any manner to render the tracks in the paper distinct, or to give them any desired peculiarity or characteristic in design.

The creases are intended to receive the track-hand of the transmitting-instrument, while certain electric changes are effected, as described in my application for Letters Patent of the United States filed contemporaneously herewith. Set-screws n^3, passing through the blocks f^3, serve to adjust the pressure of the styles upon the fillet of paper.

l^3 l^3 are recesses in the under side of the blocks f^3, to receive a strip of leather, rubber, or other soft material, for the purpose of forming yielding anvils for the points of the slitting-blades, which anvils are adjusted by set-screws m^4, as shown in Fig. 4.

v'''' is a horizontal shaft, having its bearings in parallel arms v^5, projecting from the guide-bed sleeve toward the uprights A^1. It carries a pinion, w'''', and two vertical eccentric bars, n^2, the upper ends of which latter pass upward through the slots of the blocks r^2, being guided by the slots and pins S^2, as shown in Fig. 4.

N^3 are pointed reversible knives attached to the front of the eccentric bars by the slotted bosses e^3 and set-screws d^3, so that the point of each shall enter the grooves in the guide-blocks r^2.

a'''' and b'''' are radial pins or detents affixed to the shaft of the eccentric bars, to engage with teeth c^2 d^2 upon the arms of a forked lever, h^2, and form an escapement.

The lever h^2 is mounted upon a shaft, u'''', in rear of the eccentric shaft, and its lower arm g^2 extends forward within the path of a pin, m^2, on the side of the rack-bar, while its rear end is connected by a spring, i^2, to an adjusting-pin, j^2, on the guide-bed. l^2 is a stop attached to the sleeve of the guide-bed to limit the upward throw of the lever h^2 under the tension of its spring. n'''' is a gear-wheel secured to a shaft, o'''', which is mounted in suitable bearings of the case, so that the gear-wheel shall engage with the pinion w'''' on the eccentric shaft. r'''' is a drum fastened to a long tubular bearing, r^6, on the shaft o'''', and containing a coiled spring, r^7, one end of which is secured to the gear-wheel, and the other end to the interior of the drum. s'''' is a friction-sleeve mounted upon the tubular bearing, and constructed and applied thereto in the same manner as the sleeve of the main driving-shaft. The outer end of the sleeve carries a grooved pulley, t'''', which is driven by a suitable arrangement of belts from the prime mover of the instrument, to rotate the gear-wheel intermittingly, in a manner similar to that in which the main driving-shaft is rotated by its sleeve, as already described.

When the instrument is operated as hereinbefore described, the fillet of paper is drawn over the guide-bed by suitable feeding mechanism, operated by the rack-bar from the keys of the instrument. The bar is arranged in suitable guides of the case, and, when a key is depressed, it commences to descend. This movement releases the arm g^2 of the escapement-lever from the pin m^2 on the bar, and permits the spring i^2 to draw up the arm h^2 and disengage the tooth d^2 from the detent b''''. The shaft v'''' is thus released, so that it may make half a revolution, or rather so that it may revolve until the same detent b'''' is arrested by the tooth c^2 on the upper arm of the lever. When the rack-bar again moves up it lifts the arm g^2 of the escapement-lever, throwing the lower tooth d^2 upward to catch the lower detent, and clearing the upper tooth c^2 from the upper detent, so that the eccentric shaft may be again moved when the rack-bar makes its next descent. One complete vibration of the forked lever, therefore, alternately clears a detent from one tooth and allows the shaft to make a half-revolution. The detent or eccentric shaft is driven from the shaft o'''', through the medium of the gearing n'''' w'''', and, as the rack-bar descends, throws up one of the eccentric bars, so that the point of its knife shall enter the fillet of paper, and there remain until a slit is cut equal in length to the distance the paper moves. The length of the slit indicates a particular letter or symbol of a message, and such length is controlled by the forward throw of the stop-bar and the consequent descent of the rack-bar, as previously explained. The greater the throw of the stop-bar the lower the rack-bar will descend, and the lower this bar descends the longer the blade will remain in the paper, and therefore the longer will be the slit cut therein. The eccentric bars are so arranged that

the two blades are alternately thrown up to puncture the paper in parallel lines, thus making a record which must be read from one line to the other alternately.

The feeding devices are constructed and operated as follows: j is a horizontal shaft, having its bearings in the uprights A^1. K' is a cylinder mounted upon the shaft in line with the recording devices, and provided with several rows of sharp teeth, which take hold of and feed the paper when the cylinder is rotated. It is also formed with peripheral grooves in line with the grooves of the guide-blocks r^2, to receive the embossed creases in the fillet of paper, and prevent them from being flattened out or otherwise injured. L is a pressure-roller mounted upon an arm, f, pivoted to one of the uprights, A^1, so as to place the roller in front of the cylinder. The pressure-roller, under the force of an adjustable spring, h'', holds the fillet of paper against the teeth of the cylinder, so as to insure the proper feed.

The surface of the roller should be made of, or provided with, leather, or some suitable yielding substance, to receive the impress of the cylinder-teeth, and prevent the paper from slipping.

o' and p' are ratchet-wheels, mounted upon the shaft j, with their teeth pointing in opposite directions. j' is a small gear-wheel, mounted loosely upon the shaft j between the ratchet-wheels, so as to engage with the teeth of the rack bar.

When in the operation of the instrument the rack-bar is moved upward, a spring-pawl, m', pivoted to an arm, l', of the gear-wheel, gages with the teeth of the ratchet-wheel o', and moves it forward, together with the feed-cylinder and ratchet-wheel p'. A spring-pawl, v', pivoted to one of the uprights, engages the ratchet-wheel o', to prevent any backward movement of the feed-cylinder when the pawl m' ceases to act. z' is an angular lever, pivoted at its angle to one of the uprights immediately under the wheel p', and having teeth formed upon its upper arm, which, when the rack-bar is thrown up, engages with the teeth of the wheel p', and locks it against farther movement. This locking mechanism, which is thrown into operation at the termination of each upward movement of the rack-bar, prevents the feed-cylinder from being carried too far by its momentum after the rapid throw of the pawl m'. The angular or locking lever is operated by an adjustable stop, w', on the side of the rack-bar, which strikes against the free end of a spring, z'', lying along the under side of the upper lever-arm, as shown in Fig. 1. The spring insures the action of the locking-lever, and is limited in its downward movement by a stop, y', formed at the angle of the lever. A recess, x', in the edge of the rack-bar, receives the lower end of the locking-lever, to permit its necessary movements in locking and unlocking the feed-cylinder.

It will thus be observed that the movements of the rack-bar govern the movements of the paper, and therefore the length of the slits therein; while the movements of the rack-bar are governed by the operation of the keys, as hereinbefore described.

There is an equal number of teeth on the ratchet-wheels o' p', but the number in each must be greater than the number of characters to be made, for the following reasons: Assuming that there are twenty-eight keys to the instrument, that the separatrix must be eight-sixteenths or one-half of an inch in length, and that the letters or characters following increase the slits in the paper one-sixteenth of an inch each, then there must be thirty-six teeth in the ratchet-wheel, one-sixteenth of an inch apart, because the moving pawl, starting always from the same point, must, as the rack-bar descends, ride back upon the ratchet-wheel to engage the eighth tooth, and, when the rack-bar ascends, move forward the wheel until the pawl again reaches the point from which it started. Now, to make the next letter—say, E—the pawl travels back to the ninth tooth; to make T, it moves back to the tenth tooth; and to form the longest character, or the one least used, it must travel back thirty-six teeth. This latter movement, however, would require a complete circuit of the ratchet-wheel by the moving pawl, which could not well be done without interfering with the locking-pawl. I therefore add a few teeth to the ratchet-wheel, to engage the locking-pawl between the point from which the moving pawl starts and the point reached by its longest throw.

It may be here observed that though the ratchet-wheel and cylinder might operate if both were made of the same diameter, yet a practical difficulty intervenes, because the best size for the cylinder is such that the teeth of the wheel would be too fine to insure the action of the driving-pawl in its rapid movements. It therefore becomes necessary to make the ratchet-wheel greater in diameter than the cylinder.

The shoulders upon the keys of the instrument govern the movement of the rack-bar, and must, therefore, be arranged in proper relation to each other and to the teeth of the ratchet-wheel. The distance traversed by the stop bar in moving down the rack-bar to form the separatrix, represents the distance traversed by the moving pawl upon the ratchet-wheel, which, as above stated, is the distance of eight teeth. To make the next character, the stop-bar travels along the adjoining key the same distance and one-eighth more, its throws increasing in this proportion through the whole number of keys. Therefore, the shoulders of the keys are separated from each other one-eighth of the distance the stop-bar travels to reach the shoulder of the first or separatrix key.

I have only used the proportions and distances above named to illustrate the principle of operation, as it is evident that they, as well

as the mechanism, may be varied indefinitely. By this means the feed-cylinder and keys operate in unison to regulate the feed of the paper, and, therefore, the length of the slits which form the record therein. i'' is a curved guide secured to the uprights beneath the feed-cylinder, for the purpose of guiding the paper out of the instrument.

Where large numbers of messages are to be sent much time is consumed by the operator in placing them in position to be read and recorded. To avoid this unnecessary delay I propose to mount the message in a rack connected through suitable mechanism with an operating-key, by whose movements the messages are successively exposed to view, and then moved to one side out of the way.

Referring to the fourth sheet of drawings, a^9 is an inclined table, supported upon the case of the instrument over the keys, and provided at its upper and lower edges with grooves to receive the parallel bars a^7 and b^4. These bars slide freely within their grooves, and are connected together at their rear ends by a strip of wood or metal, b^{15}, which is adapted for ready removal when necessary.

The bar b^4 is formed with a rack along its under side to engage with a pinion, b^8, mounted upon a short shaft, b^7. This shaft also carries the reversed ratchet-wheels b^9 and c^4, and has its bearings in an upright, c^{10}, of the case A, and in the end of a hand-lever, b^6, pivoted to the lower edge of the table. The pivotal point of the lever is removed a short distance from the shaft b^6, and the inner end of the latter fits loosely within its bearings c^{10}, so that, when the outer end of the lever is raised or lowered, the shaft may be moved to engage or disengage the pinion and rack-bar.

One of the keys in the key-board of the instrument—preferably, the left-hand one in the middle tier—is formed with a bent arm extending upward in rear of the fulcrum-pin c^9, which arm carries a fixed pawl, c^6, and a spring-pawl, c^5, to engage the reversed ratchet-wheels c^4 and b^9, respectively.

a^4 a^4 represent a series of spring-fingers, secured one behind the other, to pins a^5, projecting from the upper edge of the sliding bar a^7 in the plane of the table. These fingers are folded over upon each other, as shown in Fig. 6, and the upper edges of the messages are inserted between the springs, the main portions lying upon the table. The messages, therefore, rest upon each other like the leaves of a book, the upper one only being exposed to view so as to be read.

When it is desired to move a message out of the operator's view, in order to expose the message next behind it, the key is depressed so that its inner end shall lift the spring-pawl and rotate the ratchet-wheels one tooth. This movement, of course, rotates the shaft and its pinion, and moves the rack-bar b^4, together with the bar a^7, toward the left of the instrument, until a point, a^6, on the lower end of a spring-finger, is brought in contact with a lug, a^8, projecting from the upper edge of the table, to turn the finger over, as shown in Fig. 6. The message held by this finger is, therefore, turned over, and exposes to view the message held by the finger next behind it. As the message is turned, the fixed pawl c^6 engages the other ratchet-wheel, and locks the series of fingers against further movement until the key is again depressed. When the message has been turned over and the key released, the weight of the latter restores it to its normal position ready for the next movement.

The ratchet-teeth should be made of such size that when the spring-pawl moves the ratchet-wheels one tooth, the bar a^7 will be carried to the left the distance between two pins, a^5, the latter being arranged at equal distances apart.

The bar a^7 is designed to hold from twenty-five to thirty messages, and, when all have been recorded, the outer end of the hand-lever b^6 is raised, the strip b^{15} disconnected from the bar a^7, and the latter removed for the insertion of another carrying a fresh lot of messages.

For the purpose of cutting off the fillet of paper after the record has been made, I arrange a pair of shears or cutters in rear of the feed mechanism, and operate them by one of the keys of the instrument, in the following manner: Employing, preferably, that key which is arranged in the upper tier, immediately over the key for turning the messages, the inner end of the key selected extends upward through the case in rear of the fulcrum-pin c^9, and is slotted to receive the arm g^4, of an angular lever pivoted at g^5 to one of the uprights A^1. The upper arm of this lever is pivoted to the outer end of a horizontal cutting-blade, g^6, which is arranged between the uprights of the case, and pivoted at its inner end to a projection, g^7, of the rear upright. This cutting-blade works over the edge of a second horizontal blade, g^8, affixed to one of the uprights so as to project immediately under a loop, g^9, formed upon the upper end of the curved guide i''. The fillet of paper, guided by the loop, passes down between the blades and is cut off by depressing the operating-key so as to throw the swinging blade against the fixed blade, the two operating with a shearing cut.

A spring, g^{10}, coiled about the upper arm of the crank-lever, and connecting with the pivoted blade, forces the latter down upon the fixed blade to insure the cutting operation. When the key is released, the weight of its inner end restores it to its first position, and swings the pivoted cutting-blade outward, so that the fillet of paper may continue its downward passage.

The fixed blade is placed against a shoulder formed in the curved guide, or is otherwise connected to the latter, in such a manner that its cutting-edge shall lie in or behind the plane of the guide. Some arrangement of this kind,

in connection with the guide-loop g^9, is absolutely necessary to properly guide the fillet of paper after the cut is made; otherwise the end of the main fillet would fly out of the guide, and have to be replaced between the blades by hand before a second cut could be made. Instead of arranging the pivoted blade to swing over the fixed blade, it may be arranged to pass under it, the spring being also changed to press the swinging blade upward instead of downward.

The paper fillets are prepared for use by treating them with an extra sizing of glue, in order to prevent them from being torn by the knives during the slitting operations.

The drawings herein illustrate one form of my invention; but I desire it understood that I do not confine myself to such form so long as I do not depart from the principle of my invention.

Having thus described my invention, what I claim is—

1. The record of a telegraph-message, consisting of a narrow fillet of paper, in which are cut two parallel rows of slits, arranged to be read alternately from one row to the other, and indicating by their length the letters of the alphabet and other message-symbols, substantially as described.

2. The record prepared for transmittal, having two parallel tracks or grooves formed in the line of the message-slits, substantially as described.

3. A series of graduated finger-keys, whose depression causes a fillet of paper to be moved intermittingly over two knives, which are alternately projected through it to form the record-slits, substantially as described.

4. A motor independent of the finger-keys, for moving the paper and reciprocating the knives when the keys are operated, substantially as described.

5. Controlling the slits in the paper by means of stops on the finger keys, so that each slit shall indicate a letter or other symbol corresponding to that of the key which is operated to produce it, substantially as described.

6. Controlling the distance between the beginning of one slit in the fillet of paper and the beginning of the next slit in the adjoining row, by means of stops on the finger-keys, substantially as described.

7. Controlling the operation of the slitting-knives, by means of an escapement adapted to be set in motion through the movements of the finger-keys, for the purpose specified.

8. The combination of two alternately-reciprocating slitting-knives, adapted to puncture a strip of paper in two parallel rows, for the purpose of recording telegraph-messages, substantially as described.

9. The slitting-knives, whose operations are controlled from the finger-keys through the medium of the reciprocating rack-bar and sliding stop-bar, substantially as described.

10. The feeding mechanism, operated from the finger-keys through the medium of a reciprocating rack-bar, substantially as described.

11. The combination of a differential rack-bar and a sliding stop-bar with the graduated finger-keys for operating the feeding and recording mechanism, substantially as described.

12. The rack-bar and sliding stop-bar, having each a differential throw, to govern the feed of the paper and the movement of the slitting-knives, substantially as described.

13. The combination of the rack-bar with the graduated finger-keys, substantially as described, for the purpose specified.

14. The combination of the feeding mechanism and recording mechanism to operate in unison for producing the record, substantially as described.

15. The escapement of the slitting-knives combined with the differential rack-bar, substantially as described.

16. The combination of the sliding stop-bar C″ and the rock-shaft O with the main driving-shaft B, substantially as described, for the purpose specified.

17. The main shaft B and the rock-shaft O, united to each other and the stop-bar by a spring-connection which is sufficiently strong to oscillate the rock-shaft and throw forward the stop-bar when the main shaft is rotated, but which will yield to permit the complete rotation of the driving-shaft if the stop-bar is arrested by the finger-keys before reaching its maximum throw, substantially as described.

18. The combination of the shaft B and friction-sleeve E, to which power is applied for driving the main shaft, substantially as described, for the purpose specified.

19. The driving-sleeve E, adapted to grasp the main shaft B with sufficient frictional force to overcome the spring-connection between the shaft and stop-bar when the latter is arrested in its forward movement, and to continue its rotation when the main shaft ceases to move, substantially as described.

20. The friction-sleeve, adapted for adjustment to grasp the main shaft with greater or less force, substantially as described, for the purpose specified.

21. The combination of the sliding stop-bar with the graduated finger-keys and detent-lever, substantially as described, for the purpose specified.

22. The stop-bar, having its throw adjustable, substantially as described, for the purpose specified.

23. The coiled spring W upon the rock-shaft, combined with the loose sleeve O′ and one of the arms of the sliding stop-bar, substantially as described, for the purpose specified.

24. The coiled spring W, adapted for adjustment to regulate its tension by means of the collar x, upon the sleeve O′, substantially as described.

25. The combination of the forked detent-

lever h'''' with the finger-keys and driving-shaft, substantially as described, for the purpose specified.

26. The combination of the cams I Z with the driving-shaft B, and the forked end of the detent-lever h'''', substantially as described, for the purpose specified.

27. The combination of the rack-bar f'' with the rock-shaft O and main shaft B, substantially as described, for the purpose specified.

28. The rack-bar f'', connected to the rock-shaft O by means of the arm V, and pivoted rod i, substantially as described.

29. The arm N, connected to the driving-shaft, combined with the arm V, connected to the rack-bar, for the purpose of moving the latter downward in proportion to the throw of the stop-bar, substantially as described.

30. The combination of the arm T with the arm N and its connections to move up the rack-bar, substantially as described.

31. The connecting-rod M, adapted for adjustment within the arm N, substantially as described, for the purpose specified.

32. The arms T N, adapted for adjustment to and from each other, substantially as described, for the purpose specified.

33. The rack-bar, having its throw adjustable, substantially as described, for the purpose specified.

34. The combination of the sliding stop-bar and the reciprocating rack-bar with the rock-shaft, the main driving-shaft, and the friction-sleeve, substantially as described.

35. The combination of the graduated finger-keys, the detent-lever h'''', the stop-bar, the rack-bar, and the rock-shaft O, with the main driving-shaft, and its friction-sleeve, substantially as described, for the purposes specified.

36. The arrangement of the alphabet and other message-symbols upon the graduated stops of the finger-keys, so that the stop-bar and rack-bar will move the shortest distance for the most frequently-occurring letter, the length of their strokes being gradually and uniformly increased in proportion to the decrease in the occurrence of the letters used, substantially as described, for the purpose specified.

37. The key-board of the instrument, composed of three banks of keys, divided into a right and left hand section, substantially as described.

38. The guide-boards, combined with the keys, for guiding the fingers of the operator, so that he can look up to read a message while manipulating the keys, substantially as described, for the purpose specified.

39. The keys, provided with suitable stops to arrest the stop-bar at graduated distances in its forward movements, substantially as described, for the purpose specified.

40. The graduated keys, having the stop-letters of designation duplicated in the same order upon their finger-ends, substantially as described.

41. The horizontal guide-bed M'', for the fillet of paper, mounted upon the spindle l'' in rear of the finger keys so as to swing laterally, substantially as described, for the purpose specified.

42. The guide-bed held in line with the feeding mechanism by a yielding connection, substantially as described, for the purpose specified.

43. The connecting-spring p'', adapted for adjustment by means of the pin q'', substantially as described, for the purpose specified.

44. The adjustable stop r'', combined with the case of the instrument, and arranged within the path of the sleeve-arm o'', to regulate the lateral swing of the guide-bed, substantially as described.

45. The paper-reel, combined with the guide-bed, for the purpose of conforming to its movements in presenting the paper to the feeding devices, substantially as described.

46. The paper-reel and feeding mechanism, arranged to deliver the paper upon the guide-bed over the slitting-knives in proportion to the length of the message-slits required, substantially as described.

47. The combination of the spring-lever t''', and friction-brake S''', with the paper-reel and guide-bed, substantially as described for the purpose specified.

48. The intermediate guide x''', combined with the guide-bed, and the guide-loop v''', substantially as described, for the purpose specified.

49. The guide-bed, constructed with the adjustable gage side S'', the adjustable spring-pressure bar, and the transverse arms $w''x''$, substantially as described, for the purposes specified.

50. The hinged cover of the guide-bed, arranged to throw back the guide-arms w'' x'', when opened, substantially as described, for the purpose specified.

51. The outer edge of the cover formed with the recesses j''' k''' i''', to prevent the outer edge of the paper from folding up as it passes over the guide-bed, substantially as described.

52. The slotted guide-blocks r^2, combined with the guide-bed, substantially as described, for the purpose specified.

53. The slotted guide-blocks f^3, combined with the cover of the guide-bed, and adapted for adjustment with respect to the guide-blocks r^2, substantially as described, for the purpose specified.

54. The combination of the embossing-rollers or styles i^3, with the slotted guide-blocks f^3, to form parallel grooves in the fillet of paper by pressing it down under the weight of the cover within the grooves of the guide-blocks r^2, substantially as described.

55. The yielding anvils, combined with the blocks f^3, substantially as described, for the purpose specified.

56. The slitting-knives combined with the guide-bed and the guide-blocks $r^2 f^3$, substantially as described.

57. The slitting-knives supported by the eccentric bars from the escapement-shaft v'''', substantially as described.

58. The slitting-knives adapted for reversal and adjustment upon the eccentric bars, substantially as described.

59. The eccentric bars guided within the blocks r^2 by means of the slots and pins s^2, substantially as described.

60. The escapement consisting of the shaft v'''', to which the power is applied, the detent-pins $a''''' b''''$, and the forked lever h^2, operated by the rack-bar, substantially as described.

61. The forked lever of the escapement having its inner end held upward to engage the upper tooth c^2 with the uppermost detent-pin, by means of the adjustable spring i^2, substantially as described.

62. The stop l^2, attached to the sleeve of the guide-bed, and combined with the forked escapement-lever, to limit its upward throw, substantially as described.

63. The forked lever of the escapement having its lower arm extended within the path of a stop on the rack-bar, substantially as described, for the purpose specified.

64. The arrangement of the escapement to throw up a knife at each reciprocation of the rack-bar, substantially as described, for the purpose specified.

65. The eccentric or escapement shaft driven from the shaft o'''', through the medium of the gearing $n'''' w''''$, substantially as described.

66. The combination of a driving friction-collar with the driving-shaft o'''' of the escapement, substantially as described, for the purpose specified.

67. The combination, with the shaft o'''', of the friction-collar s'''', the loose sleeve, the drum r'''', the coiled spring, and the gear-wheel w'''', substantially as described, for the purpose specified.

68. The toothed feed-cylinder constructed with parallel grooves, and arranged in line with the recording devices, substantially as described, for the purpose specified.

69. The combination of the ratchet wheel o', the loose pinion, and moving pawl with the rack-bar and feed-cylinder, for the purpose of rotating the latter when the rack-bar is moved up, substantially as described.

70. The combination of the spring-pawl v' with the ratchet-wheel o', to prevent backward movement of the feed-cylinder when the moving-pawl ceases to act, substantially as described.

71. A locking mechanism adapted to be thrown into operation at the termination of each upward throw of the rack-bar, for the purpose of preventing the feed-cylinder from being carried too far by its momentum, substantially as described.

72. The combination of the ratchet-wheel p' and angular toothed lever z', with the rack-bar and feed-cylinder, substantially as described, for the purpose specified.

73. The combination, with the angular toothed lever z', of a spring, z'', to receive the action of an adjustable stop, w', on the rack-bar, substantially as described, for the purpose specified.

74. The combination of a stop, y', with the spring of the toothed locking-lever, substantially as described, for the purpose specified.

75. The combination of the curved guide i'' with the uprights of the frame, to guide the paper out of the instrument, substantially as described.

76. A rack-bar holding a series of telegraph-messages, connected by suitable mechanism with one of the finger-keys of the recording-instrument, so that the operation of such key shall successively expose the messages to view and then move them to one side out of the way, substantially as described.

77. The combination of the inclined message-rack with the case of the recording-instrument, substantially as described.

78. The combination of the sliding bars a^7 b^4 with the inclined bed a^9, such bars being united by a removable connection, substantially as described.

79. The sliding bar b^4, constructed with teeth, to receive the action of the pinion b^8, for feeding forward the messages, substantially as described.

80. The pivoted hand-lever b^6, forming one of the bearings of the pinion-shaft b^7, for the purpose of connecting and disconnecting the pinion and rack-bar b^4, substantially as described.

81. The reversed ratchet-wheels on the pinion-shaft b^7, in combination with the pawls upon the bent arm of the finger-key, for rotating the feeding-pinion, substantially as described.

82. The message-holding fingers a^4, pivoted to the upper edge of the sliding bar a^7, so as to hold the messages folded upon each other and resting on the inclined table, substantially as described.

83. The message-holding fingers a^4, provided each with a point, a^6, which, when the message-bar is fed along the table strikes against a stop, a^{15}, and turns the finger over so as to move the uppermost message out of the way and expose the one next under it to the view of the operator, substantially as described.

84. The message-fingers adapted for operation from a finger-key by suitable intervening mechanism, substantially as described.

85. The sliding message-bar a^7, adapted for removal from the inclined table, substantially as described, for the purpose specified.

86. The combination of a pair of shears with the recording mechanism, for cutting off the recorded messages from the fillet of paper, substantially as described.

87. The shears, adapted for operation from

one of the finger keys of the recording-instrument, substantially as described.

88. The fixed blade g^8 of the shears, arranged under the loop g^9 of the curved paper-guide, so that its cutting-edge shall lie in or behind the plane of the guide, substantially as described, for the purpose specified.

89. The pivoted cutting-blade g^6, pivoted to one of the uprights of the frame, so as to swing over the fixed blade g^8, substantially as described.

90. The combination of the pivoted crank-lever with the pivoted shear-blade and the up-turned end of the operating finger-key, substantially as described, for the purpose specified.

91. The combination of the coiled spring g^{10} with the pivoted shear-blade and the crank-lever, to hold such blade down upon the fixed blade, substantially as described, for the purpose specified.

ROYAL E. HOUSE.

Witnesses:
J. W. KEITH,
JON. F. BARRETT.