4 Sheets—Sheet 1.

L. S. CRANDALL.

TYPE WRITING MACHINE.

No. 251,338. Patented Dec. 20, 1881.

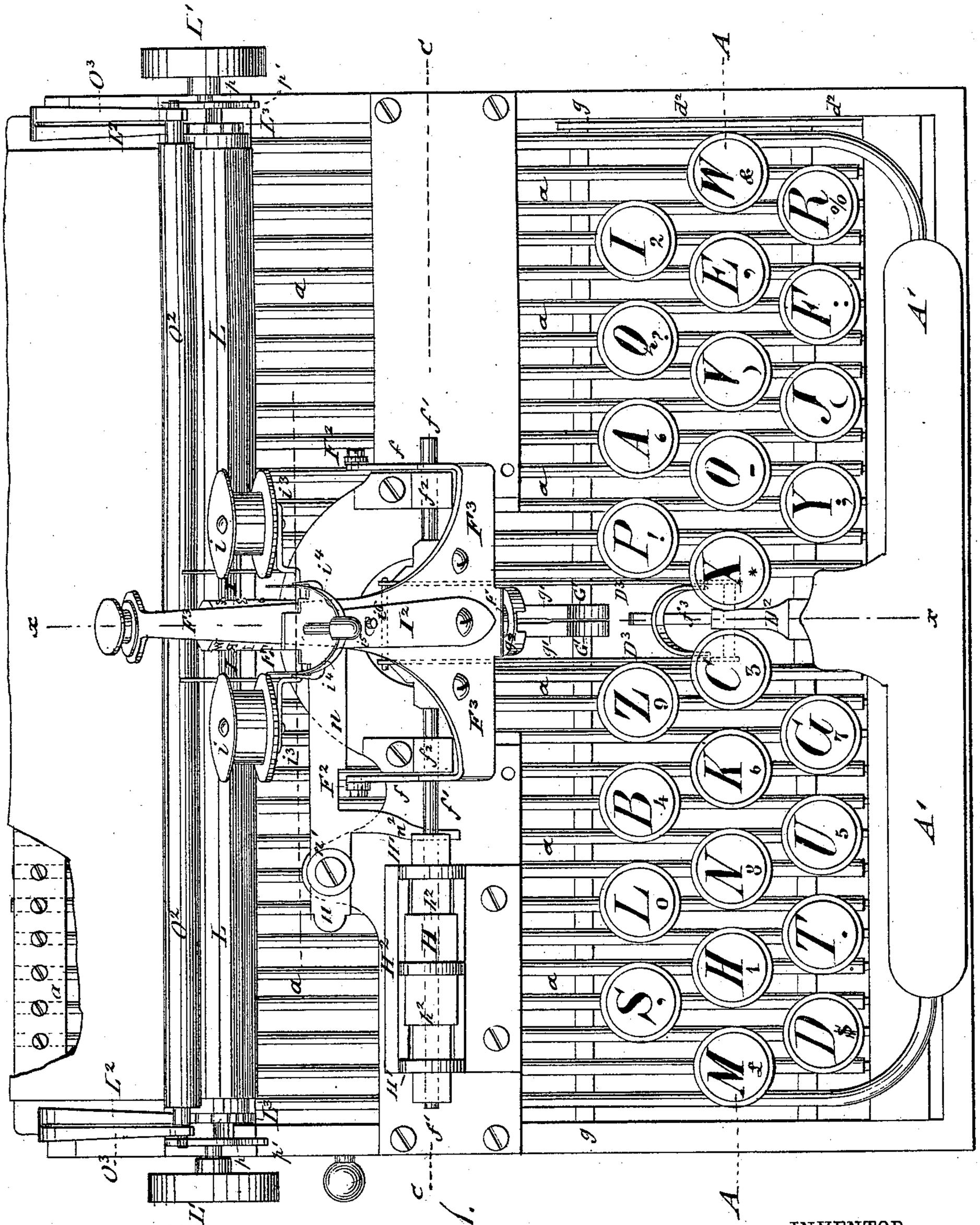

Fig. 1.

WITNESSES:

Carl Karp

Gustav J. Ehrmann

INVENTOR

Lucien Stephen Crandall

By Paul Goepel

ATTORNEY

4 Sheets—Sheet 2.

L. S. CRANDALL.

TYPE WRITING MACHINE.

No. 251,338. Patented Dec. 20, 1881.

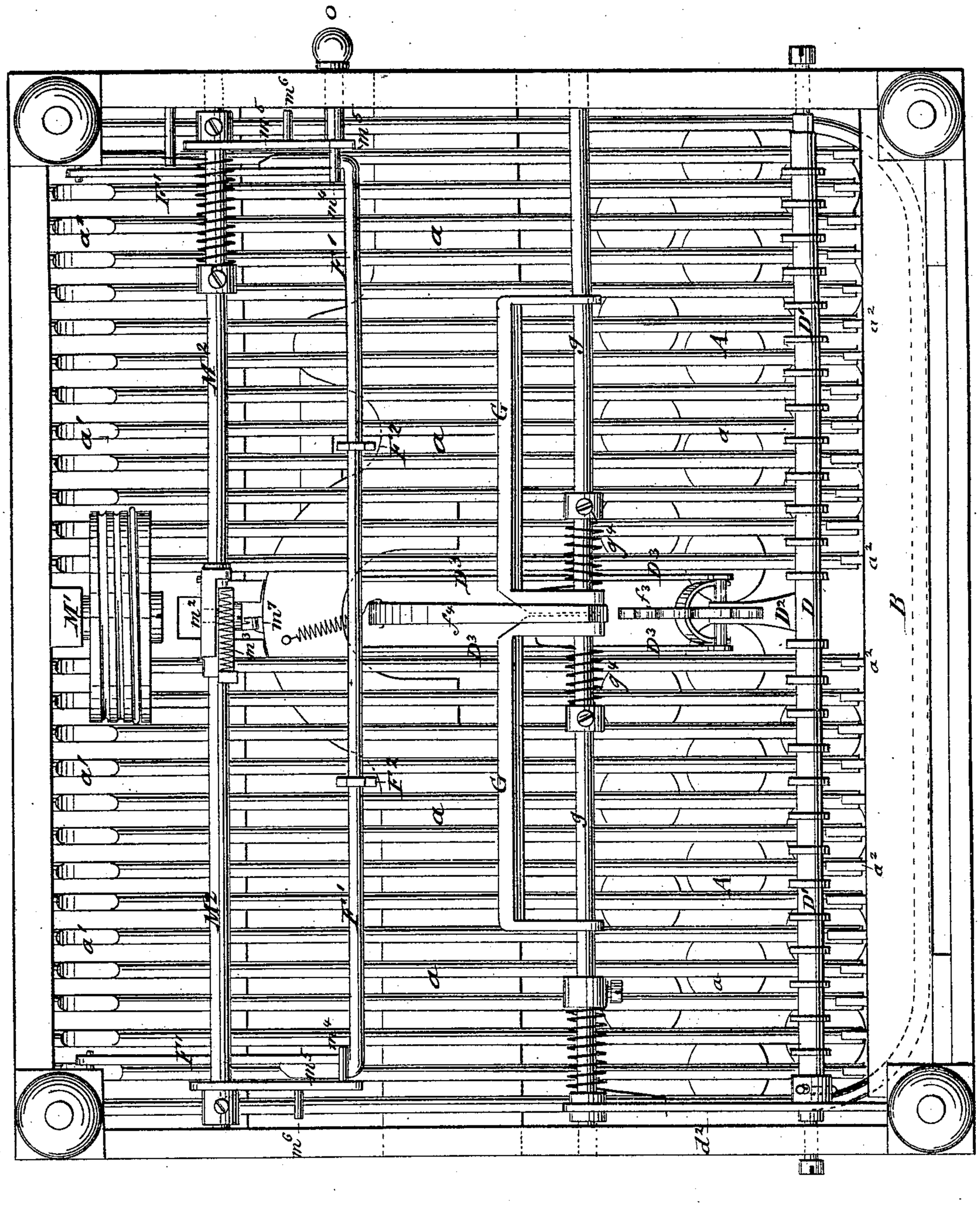

Fig: 2.

WITNESSES:

Carl Happ

Gustav J. Ehmann

INVENTOR

Lucien Stephen Crandall

By Paul Goepel

ATTORNEY

4 Sheets—Sheet 3

L. S. CRANDALL.

TYPE WRITING MACHINE.

No. 251,338. Patented Dec. 20, 1881.

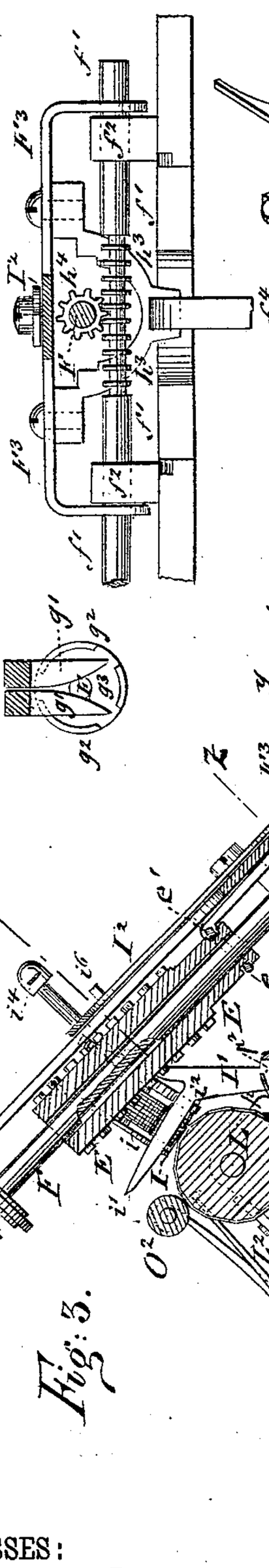

Fig. 4.

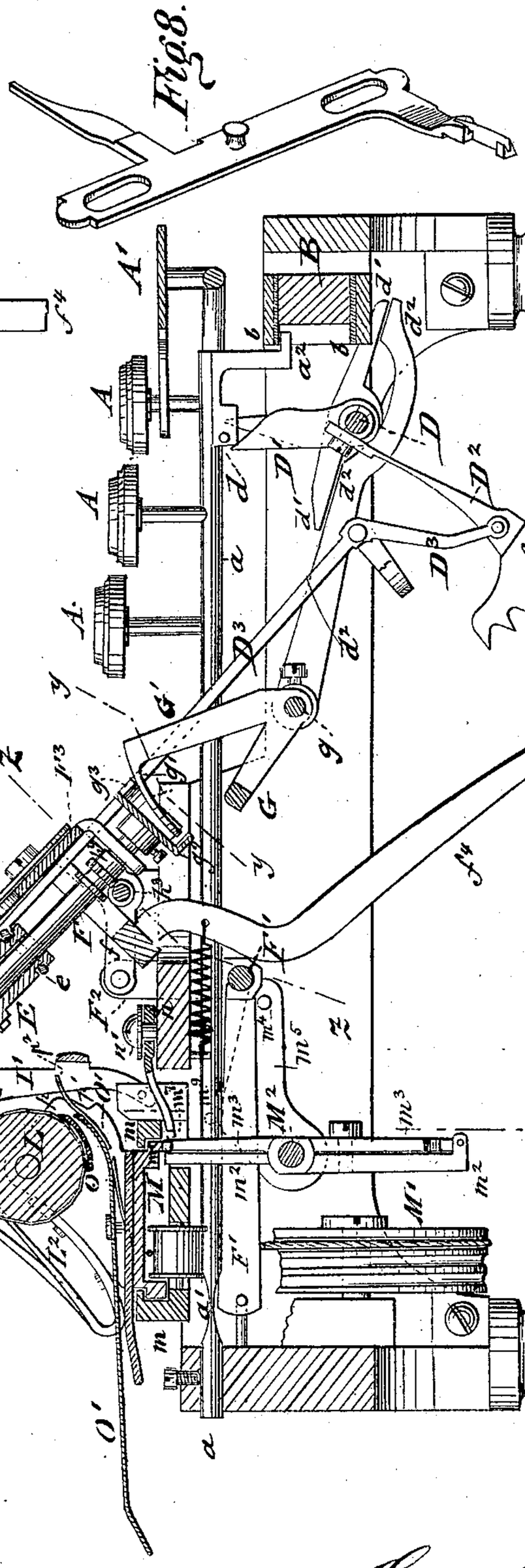

Fig. 5.

Fig. 3.

WITNESSES:

Carl Harp

Gustav J. Ehrmann

INVENTOR

Lucien Stephen Crandall

By Paul Goepel.

ATTORNEY

4 Sheets—Sheet 4.

L. S. CRANDALL.

TYPE WRITING MACHINE.

No. 251,338. Patented Dec. 20, 1881.

Fig. 7.

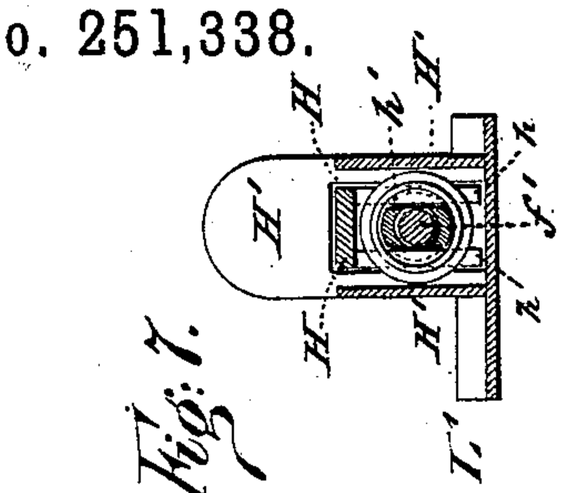

Fig. 6.

WITNESSES:

Carl Kapp

Gustav J. Ehrmann

INVENTOR

Lucien Stephen Crandall

By Paul Goepel.

ATTORNEY

UNITED STATES PATENT OFFICE.

LUCIEN S. CRANDALL, OF NEW YORK, N. Y.

TYPE-WRITING MACHINE.

SPECIFICATION forming part of Letters Patent No. 251,338, dated December 20, 1881.

Application filed December 17, 1879. Patented in England August 12, 1879.

To all whom it may concern:

Be it known that I, LUCIEN STEPHEN CRANDALL, of the city, county, and State of New York, have invented certain new and useful Improvements in Type-Writing Machines, of which the following is a specification.

The main objection to the more general introduction of type-writing machines is their high price, which is the result of their rather complicated construction.

My invention is design to furnish a type-writing machine of simple and cheaper construction and with a greater range of type, combining upper and lower case letters, figures, and punctuation-marks, and working them all with one set of keys merely.

The invention consists, in its general features, of a series of keys which, by depressions, oscillate a printing-lever on which a longitudinally and axially shifting type-sleeve is arranged. All the type on the type-sleeve strike a printing-point which is formed on a polygonal platen, over which the paper is stretched, while an intermittently-movable inking-ribbon supplies the ink for the impressions. The platen is supported on a traversing paper-carriage, which is moved for the distance of a type-space, when the key is released and the printing-lever returned to its place. A variable spacing for different widths of letters is provided by suitable mechanism. The line-spacing of the paper is obtained by giving to the platen an axial movement.

My type-writing machine consists more especially of the following elements:

First. A type-bearing sleeve, on which the types are grouped, preferably in nine rows of nine type each, three rows of which form a type field or system. The type-sleeve is arranged on an oscillating printing-lever, and is capable of a longitudinally sliding and an axially-shifting motion, so that any type thereon may be brought to a common printing-point.

Second. A mechanism by which the exact longitudinal motion of the type-sleeve on the printing-lever is governed and simultaneously therewith the type-sleeve shifted axially into the adjoining row of a type-field, if required.

Third. A mechanism by which the type-sleeve is axially shifted on the printing-lever to bring the proper type field or system to the under side of the sleeve.

Fourth. A mechanism by which the positive locking of the type-sleeve is obtained after any type thereon is brought to the common printing-point.

Fifth. A mechanism by which simultaneously with the release of the keys a variable letter-space is obtained that provides the required space for the larger letters in each type field or system.

Sixth. An intermittently-movable inking-ribbon, which is operated by the oscillating printing-lever alternately in opposite direction.

Seventh. An axially-adjustable polygonal platen common to all the type, on which the paper is retained by suitable devices. The platen is mounted on a traversing paper-carriage, which is fed forward for the type-spaces and for the spaces between the words.

Eighth. A mechanism for laying on and stretching the paper over the platen, and also for moving it with the same for the proper line-spacing.

In the accompanying drawings, which illustrate my invention, Figure 1 represents a top view of my improved type-writing machine; Fig. 2, a bottom view, and Fig. 3 a vertical transverse section, of the same on line *x x*, Fig. 1. Fig. 4 is a detail vertical transverse section on line *y y*, Fig. 3, showing the row-shifting device. Fig. 5 is a detail section on line *z z*, Fig. 3, showing the field-shifting mechanism. Fig. 6 is a vertical longitudinal section of the type-writing machine, taken on line *c c*, Fig. 1, and *k k*, Fig. 3; and Fig. 7 is a vertical transverse section on line *s s*, Fig. 6, of the field-shifting mechanism. Fig. 8 is a detail view of the step-shaped stop by which the proper type-space for the capital letters is obtained.

Similar letters of reference indicate corresponding parts.

The key system.—A A in the drawings represent a series of keys, which are grouped in any desired manner, according to convenience and to the frequency of use of the letters which they represent. The keys are marked with the proper letters, figures, or characters, twenty-six or more forming a key system. Besides these letter-keys, there is a larger space-key, A′, which extends, preferably in front of the letter-keys, across the machine, so as to be readily

operated from any part of the key system. The space-key A′ serves to impart to the paper-carriage of the type-writing machine the proper intermittent motion for producing the space between the words. The keys A A are attached to a corresponding number of key-levers, *a a*, which extend backward, and are rigidly secured by set-screws to the rear part of the supporting-frame of the machine. The key levers *a a* are made of straight metallic bars or rods, which are flattened near the rear ends, the flattened parts *a′* being tempered so as to form springs, by which the keys are returned to place after each depression. Each key-lever *a* is provided at the front end with a lip, a^2, which projects into recesses or spaces formed by vertical plates and by horizontal-projecting and cushioned flanges *b b* of a transverse front bar, B. These flanges *b b* serve as stops for the key-levers, and limit the extent of their oscillations when depressed by the fingers or returned by their flattened spring portions *a′*. Each key-lever is further provided near its lip a^2 with a laterally-projecting pin, *d*, which serves to engage a cam, D′, of a rock-shaft, D. The number of cams D′ correspond exactly to the number of keys, so that by depressing any key its proper cam is engaged and the cam-shaft rocked. The cams are of different degrees of eccentricity, and so secured to the cam-shaft that they face in different directions. The effect of this arrangement is that the cam-shaft is rocked to a greater or less extent in one or the opposite direction, according to the eccentricity of the cam and to the direction in which the cam-face is placed. This motion is transmitted by a fixed arm, D^2, to a forked pitman, D^3, which engages, by a yoke-shaped collar, *e*, at its upper end, a circumferential groove, *e′*, at the lower end of a type-sleeve, E, which is moved thereby in longitudinal direction forward or backward on an oscillating printing-lever, F. The rock-shaft D is returned into normal position after each depression of a key by a fixed cam-lever, *d′*, which extends at both sides of the rock-shaft, and is acted upon by a spring-pressed lever-arm, d^2, which swings loosely on a fixed pivot or rod at one side of the machine, and bears by a seat in front of and back of the rock-shaft D on the cam-lever *d′*. The pressure exerted by the spring-lever d^2 carries the rock-shaft D and cams D′ back into position.

The type-sleeve.—The type-sleeve E is longitudinally guided on the printing-lever by a groove and tongue, so as not to turn axially thereon, but be only allowed to slide in longitudinal direction, the extent of sliding motion being determined by the eccentricity of the cams acted upon by the key-levers, as described. The type-sleeve E carries on its outer round or polygonal perimeter a number of type, which are grouped, for convenience' sake, into nine equidistant longitudinal lines or rows, each row consisting of nine type, more or less. Of these lines or rows, three adjoining rows form a type field or system, of which one system contains an alphabet of lower-case letters, the second an alphabet of upper-case letters, and the third a corresponding number of numerals, punctuation-marks, and other conventional characters. The type of each row or line are preferably disposed of on the sleeve according to their frequency of use, the most frequently used letter—such as the letter "e"—being placed in the center of the middle row of a type-field, while the letters next frequent in use are placed near the center, and the remaining ones are disposed of in the more remote positions in the rows. The cams of the key-levers of the central letters of the rows are so formed that they impart no longitudinal motion to the type-sleeve, while for each letter in the same row the cams impart a longitudinal up or downward motion to the type-sleeve. For each letter in one of the side rows of a type-field, with the exception of the central letter of each side row, there is required, besides the longitudinally-sliding motion, at the same time a row-shifting axial motion of the type-sleeve, which takes place simultaneously with the sliding motion. The object of the sliding and axially-shifting motion of the type-sleeve is to bring each letter of a row and type-field into such a position at the under side of the oscillating printing-lever F that each type, whatever be its relative position in a type-field, strikes a printing-point upon a common platen. To obtain the same result for the rows of the remaining two type-fields, an independent separated field-shifting mechanism is provided, by which, first, an axial field-shifting motion is imparted to the printing-lever and type-sleeve, after which the row-shifting and longitudinally-sliding motion is imparted in the manner before described, so as to bring thereby every individual type of any type-field to the same point at the under side of the printing-lever. The type-sleeve E is preferably constructed of an outer metallic letter-bearing shell, obtained by electro-deposition, and of a core or filling of hard rubber, celluloid, papier-maché, or other suitable material. Each machine may be provided with several type-sleeves, so that when one is worn out by use it may be readily replaced by a new one. It may be provided with additional type-slevees on which different styles of type may be arranged, if such be desired. By this feature the scope of the machine is enlarged and the same in a higher degree adapted to the practical wants of business men. The depression of each key-lever *a* actuates, simultaneously with the motion given to the type sleeve, an oscillating impression-bail, F′, which extends transversely below all the key-levers. The impression-bail F′ is connected by pivoted links F^2 with the rearwardly-extending arms *f f* of the fulcrumed supporting-lever frame F^3 of the printing-lever F, so that by the depression of any key the lever-frame and the printing-lever are oscillated. The lever-frame F^3 is fulcrumed to a laterally-sliding pivot-rod, *f′*, which is supported in guide-bearings f^2 of the

transverse top plate of the machine. The printing-lever F is supported in upper and lower bearings at the central part of the lever-frame F^3, in line with the transverse axis of the machine. The printing lever turns readily around its axis, but is prevented from changing its position longitudinally in its bearings, it being, however, so secured to its frame as to be readily removed therefrom when it is desired to remove the type-sleeve and replace it with another one.

Locking mechanism for the type-sleeve.—As stated, the printing-lever is oscillated at each depression of a key-lever, so as to carry the type corresponding to the key-lever down to the common printing-point. To bring each type, however, into the proper position above the printing-point and hold it with absolute accuracy and precision therein, the longitudinally-sliding as well as the axially-shifting motion of the type-sleeve has to be confined within accurately defined limits for each individual type. This is produced by means of a locking device for the longitudinal motion of the type-sleeve, which consists of a toothed segment, f^3, at the lower end of the fixed transmitting-arm D^2 of the rock-shaft D, and of an extension-arm, f^4, of the oscillating frame F^3 of the printing-lever F. When, therefore, a key-lever is depressed, the oscillating lever-frame throws up the extension arm f^4 so that it enters with its pointed end into one of the teeth of the segment f^3, whereby the extent of longitudinal motion of the type-sleeve is exactly determined and the proper type locked firmly in place over the printing-point. This locking mechanism is actuated at every depression of a letter-key, and thereby a fixed position imparted to the type-sleeve for every type thereon. The return of the type-sleeve to its central normal position on the printing-lever, as well as the return of the locking extension-arm, is accomplished by the spring-arm d^2 and rocking cam-lever d' of the cam-shaft, as shown in Fig. 3.

The row-shifting mechanism.—The row-shifting motion of the type-sleeve is necessary for all type which are disposed of in the side rows of each type field or system. The key-levers of those letters which are placed in the side rows engage therefore one of two row-shifting bails G, which are placed loosely by sleeves onto a fixed transverse rod, g, of the machine. Each bail G is provided with an upwardly-extending arm, G′, which terminates at the upper end into an arc-shaped cam, g', one side of which is straight, the other curved, as shown clearly in Fig. 4. The cam-arms G′ are placed sidewise of and symmetrically to the axis of the machine, their curved sides facing each other and engaging respectively a symmetrically-recessed flange, g^2, of a disk, g^3, keyed to the lower end of the printing-lever F, the latter being extended beyond the lower bearing in its lever-frame to admit the attaching of the flanged disk g^3. The depression of a row-shifting bail G carries the arm G′ down, so that the curved face of its cam passes into one of the recesses of the flange, and causes thereby the twirling or shifting of the printing-lever and of the sleeve. When the cam has entered so far into the recess of the flange that it fills up the recess entirely the sleeve is locked in position as to axial motion by the contact of the straight and curved faces of the cam with the flange of the disk. When the curved cam g' has fully entered the recess of the disk it moves forward a short distance with the parallel faces in the slot, so that the sleeve is not twirling at the moment of striking, and cannot produce a blurred letter. On the release of the key the bail is returned by means of a spiral spring, g^4, attached to the fixed rod g and the sleeve of the bail.

The field-shifting mechanism.—As one and the same set of keys and key levers is intended to serve for three different type fields or systems, it is necessary to provide, besides the longitudinally-sliding and row shifting motions of the type-sleeve, a separate mechanism for setting it into the proper type-field. This is required whenever a capital letter or punctuation occurs, in which case the type-sleeve is first shifted so as to bring the corresponding type-field to a central position above the printing-point. This can be accomplished either by a laterally-oscillating key-lever and by a suitable mechanism for transmitting the oscillating motion to the type-sleeve, or preferably, to avoid multiplicity of keys, by arranging on one of the top plates of the machine, sidewise of the oscillating lever-frame of the printing-lever, a separate field-shifting mechanism. This field-shifting mechanism is shown in plan view in Fig. 1 and in vertical longitudinal and transverse sections in Figs. 6 and 7. It is preferably operated by the left hand, and composed of a laterally-sliding casing, H, which is guided in recessed standards H′, secured to the top plate. The casing H is moved to either side by taking hold of a central finger-rest or handle, H^2. By recessed end plates, h, the casing H engages the flanged ends of sleeves h', which are placed on an extension of the pivot-shaft f' of the lever-frame F^3. These sleeves h' are forced by a spiral spring, h^5, placed intermediately between the inner heads of the sleeves, in opposite directions and against fixed cross-pins of the shaft f'. A second spiral spring, h^6, is interposed between the end plates, h, of casing H, and bears on the end plates and standards, H′, by means of collars, as shown in Figs. 6 and 7, for returning the casing into position as soon as the handle is released. When, for the purpose of shifting the printing-lever and type-sleeve, the casing is pushed to one side, one of its end plates engages one of said collars. When the casing is pushed in opposite direction the same result is obtained, but the direction of lateral slide-motion of shaft f' is changed. The casing H is arrested in either direction by projecting shoulders h^2, which come in contact with the fixed guide lugs H′. The laterally-sliding shaft f' engages, by a rack, h^3, formed at that portion below the print-

ing-lever F, a pinion, h^4, of the printing-lever, which is thereby axially shifted or twirled to such an extent that one of the side type fields of the type-sleeve E is thrown into proper central position above the printing-point. The longitudinally-sliding and row shifting motion is then produced in the same manner and by the same mechanism as for the central type-field, and thereby any letter or character in the side type fields printed. In the central type-field are disposed lower-case letters, while the side fields carry respectively the upper-case letters and the numerals and punctuation-marks. As soon as the letter or character belonging to either one of the side systems has been printed the handle of the slide casing H is released and the casing returned by means of the interior springs, h^6. The type sleeve is thereby also returned to its normal position with the type-field containing the lower-case letters at the under side of the printing-lever and above the printing-point. The printing of the lower-case letters and the spacing between the words are then continued until a capital letter or punctuation-mark is again required, in which case the type-sleeve is first set into the required type-field by the field-shifting mechanism before the key is depressed. The field-shifting motion of the type sleeve is also made positive by the shoulders or stops of the casing and the stop pins on the slide shaft f', so that the accurate position of each type-field toward the common printing-point is obtained.

The inking mechanism.—The proper quantity of ink for printing is received from an inking-ribbon, I, which extends transversely to and below the type-sleeve, and is wound up on two loosely-turning spools, i, which are supported one at each side of the type-sleeve. The spools i are supported on fixed pins of a pivoted and spring-pressed frame, I′, said frame having also two parallel rearwardly-extending arms, i', between which and their retaining-springs i^2 the inking-ribbon is guided. Both of the spool-heads are provided with ratchet-teeth i^3, or with a separate ratchet device, said ratchets being alternately engaged by means of spring-pawls i^4, secured to a pivoted and laterally-shifting plate, I^2, of the oscillating lever-frame F^3. The shifting-plate I^2 is pivoted at its lower end to the lever-frame F^3, and guided by a short slot, i^5, along a fixed stud or pin, i^6, of lever-frame F^3. According as the plate I^2 is shifted to one side or to the other, one of the spring-pawls is thrown into the teeth of the spool at one side or at the other side of the type-sleeve. The oscillating motion of the lever-frame F^3 causes thereby the engaging of one of the ratchets and the turning of one of the spools. As the ends of the inking-ribbon are attached to the spools and the ribbon wound upon one spool, it is obvious that the intermittent rotary motion which is given by the pawl and ratchet mechanism to the other spool will produce the winding up of the inking-ribbon on the empty spool and the simultaneous unwinding of the ribbon from the wound-up spool. When the ribbon has been thus transferred to the other spool the pawl-carrying plate is shifted to the other side, and thereby the ribbon moved in opposite direction and wound up on the spool engaged by the pawl, and so on alternately. In this manner a new portion of the inking-ribbon is exposed continually to the type on the type-sleeve, and thus the uniform and distinct printing of the same secured. The ink can be supplied to the ribbon in any approved manner, as customary in ribbon stamps. The pivoted spool-frame I′ may be thrown back for adjusting the inking-ribbon on the slitted guide-arms, and also for looking at the letters on the paper.

The traversing paper carriage.—The paper on which the type-sleeve prints is stretched taut over a polygonal platen, L, which is supported on a laterally-traversing paper-carriage, M. This carriage is guided on longitudinal ways m, with or without anti-friction rollers, and drawn forward from the right side of the machine to the left by a spring-drum, M′, provided with gear-wheel and rack, or cord and pulley, or otherwise. The traversing motion of the paper-carriage is regulated by a rack, m', at the under side of its guided base-frame, said rack being engaged by a fixed pawl, m^2, keyed to a spring-pressed rock-shaft, M^2, and by a spring-pawl, m^3, pivoted to the fixed pawl m^2, as shown in Figs. 3 and 6. The rock-shaft M^2 is moved at each depression of a key by the impression-bail F′ of the printing-lever, said bail engaging side pins, m^4, of crank-arms m^5 at the ends of the rock-shaft M^2. The levers of the space-key A′ also engage projecting pins m^6 of the crank-arms m^5 and oscillate the latter whenever the space-key is depressed. The motion of the rock-shaft throws the fixed pawl m^2 forward into the teeth of the rack, so as to hold the rack and paper carriage firmly in position for printing. The spring-pawl m^3 clears simultaneously therewith the teeth of the rack, and is thrown by the spring against a step-shaped stop, m^7, in front of the rack shown in Figs. 3 and 6. On the release of the key the pivoted pawl passes back into the rack, while the rigid pawl clears the rack, as shown in Fig. 3. The action of the spring-drum carries the rack and carriage against the pivoted pawl, which is thereby thrown back against a stop, m^8, keyed to the rock-shaft. A second stop m^8 of the rock-shaft, on the other side of the pawls, limits the extreme lateral oscillations of the spring-pawl in opposite direction. By the joint action of the fixed and spring pawls the paper-carriage is fed forward for the space of one or more teeth, according to the space required for the letters. This arrangement, in its principal features, is well known and in use in other systems of type-writing machines, and I therefore do not lay any claim to the same.

Variable letter-space.—For the purpose of providing, however, for the wider letters "m" and "w," of the upper and lower case letters a comparatively greater space than for the remaining letters of both alphabets, provision for va-

riable spacing for these letters has to be made. This is accomplished by means of the step-shaped stop m^7 which is shown in Figs. 3 and 6. This step-shaped stop m^7 arrests the lateral movement of the pivoted spring-pawl m^3 either upon the first or second step of said stop, according as the same is either thrown forward far enough to be in line with the first or with the second step. The steps of stop m^7 correspond in size with the rack-teeth of the paper-carriage. All keys except the "m" and "w" keys cause the pivoted pawl to move forward only far enough to clear the teeth of the rack and to strike them against the first step on the stop by the action of its spring. The levers of the "m" and "w" keys, however, engage by projecting pins m^9 the crank-arms m^5 of the rock-shaft M^2 and throw the pivoted pawl forward to a greater extent, so that the latter, in its lateral movement, clears the first step and is thrown against the second step of the stop m^7. On the release of the keys the spring-pawl passes back again into the rack, and admits thereby the forward movement of the paper-carriage for the space of an additional tooth, which provides a larger space for the lower-case letters "m" and "w." For providing a correspondingly larger space for the capital letters, the step-shaped stop m^7 is arranged so as to be shifted for the space of an additional tooth. The step-shaped stop m^7 is for this purpose secured to a slide-bar, n, which is guided by slots and pins n' on the top plate of the machine. From the opposite end of the slide-bar n extends an arm, n^2, forward toward the field-shifting mechanism, so as to be engaged by the end plate of the slide-plate H and be pushed forward for the space of one tooth whenever the type-sleeve is shifted into the capital type-field. By this shifting of the stop m^7 the pivoted spring-pawl is allowed to escape laterally for a distance that is one tooth in excess of the distance taken for the lower-case letters whenever the type-sleeve is shifted into the capital type-field. For the capitals "M" and "W" the spring-pawl is thrown, in analogous manner as in the lower case "m's" and "w's" against the second stop, so as to move the carriage forward for the space of an additional tooth. When, for instance, the space required for the lower-case letters is obtained by skipping two teeth of the rack of the paper-carriage, the lower-case "m's" and "w's" take the space of three teeth, the capitals the space of three, and the capital "M's" and "W's" the space of four teeth. This variable letter-spacing can, however, be also accomplished by a different division of the rack, though a rack with too small teeth is unreliable and objectionable. It is obvious that this variable spacing may be also so arranged as to provide a suitable smaller space for the thin letters "i" "l" "f," for the purpose of obtaining throughout a spacing which is proportioned to the width of the letters, and of the same regularity as now found with lead type. The space between the words is obtained by depressing the enlarged space-key A', whose key-levers actuate the rock-shaft and cause the forward motion of the parts. The spring-pawl springs into contact with the first step, and provides thus for the forward motion of the carriage, in the manner described. If a larger space between words is required, the space-key is depressed a second and third time, and so on. When the paper-carriage has arrived at the end of its lateral movement, or is to be set for the next line, it is moved over to the right-hand side by depressing with the left hand a knob or button, o, on the left of the machine, which button slides in a vertical guide-slot of the frame, and is attached to the oscillating crank-arm of the rock-shaft. The lowering of the button throws the pawls forward so as to clear the rack-frame entirely and admit the return of the paper-carriage to its position on the right-hand side of the machine by taking hold with the right hand of the milled knob at the end of the paper carriage. The return motion of the paper-carriage winds up the spring in the drum in the customary manner for renewed action.

The platen and paper-feeding devices.—On the paper-carriage is supported the polygonal platen L, which turns by end-pivots in the end standards of the paper-carriage M. To both end pivots of the platen L are secured milled knobs L', of which the right-hand knob serves for returning the paper-carriage, as described, and also for turning the platen for the proper line-spacing of the paper. This is regulated by means of spring-pawls L^2, which enter equidistantly-notched end disks, L^3, of the platen. The paper is passed along a rigid apron, O, below the platen, and hugged tightly against the rigid apron by a vibrating and spring-pressed apron, O', between which and the rigid apron the paper is passed in for being placed in position on the polygonal platen. It is tightly held on the platen by a feed-roller, O^2, which is pressed by strong V-shaped steel springs O^3 against the upper part of the platen. For inserting the paper the feed-roller and platen are jointly turned forward by means of the left-hand knob, L', the feed-roller bearing first against the extension-arms i' of the spring-pressed spool-frame I', so as to lift the inking-ribbon away from the platen. On continuing the turning of the knob the feed-roller passes down toward the loose apron, while the projecting ends of its shaft pass at the same time along cam-shaped portions p of the platen-standards until they are thrown into contact with stop shoulders p' shown in Figs. 3 and 6. The cam-shaped portions p exert a lifting action on the feed-roller and cause the latter to recede to some distance from the platen. The feed-roller O^2 bears at the same time on the curved rear lip, p^2, of the yielding paper-apron O', so as to carry it away from the fixed apron. The paper may then be readily inserted, it passing through between the aprons and between platen and feed-roller. By turning the left-hand knob, L', in opposite direction the feed-roller and platen are returned to

their former position, as shown in Fig. 3, the feed-roller drawing the paper along, while the spring-pressed apron hugs it closely to the fixed apron. In turning the right-hand knob for a line-space the feed-roller is revolved by the platen and drags the paper by the friction exerted thereon forward for the space of one line. The pressure exerted by the hugging-apron on the papers, together with the dragging action of the feed-roller, holds the paper taut over the printing point on the platen. The platen is made polygonal to furnish a flat surface for printing, the sides upon which the printing takes place being narrower than the intervening sides, and of a width equal to or but slightly wider than the height of the upper-case letters. As the paper is tightly drawn over the polygonal platen it is laid flat over the printing-sides and held at an angle thereto at both sides, so that only one type on the type-sleeve can print at the time—viz., the one carried over the printing-point by the joint action of the sleeve-shifting mechanism.

By properly arranging the letters and punctuation-marks on the keys and grouping them in corresponding positions on the type-sleeve, and by providing additional type-sleeves, my type-writing machine is adapted for every important language spoken by civilized nations. By employing a system of phonetic characters on the type sleeve and keys it may be employed for stenographic purposes.

The comparatively small number of parts which are employed in the construction of the machine admits of a cheaper manufacture than other more complicated systems heretofore devised, while the lightness and compactness of its mechanism admit of its being readily carried from place to place and adapted for convenient use at nearly any place and in every vocation, business, and pursuit.

I do not herein claim, broadly, the combination, with a series of key-levers each of which operates to impel the type-sleeve, of an oscillating type-sleeve, mechanism between the finger key-levers and type-sleeve, whereby the motion imparted to the key-levers is transmitted to the type-sleeve, and means for retaining the type-sleeve in the desired position.

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

1. A type-sleeve, in combination with means, substantially as described, for vibrating the same in either direction from a normal position, substantially as described.

2. A type-sleeve, in combination with means, substantially as described, for vibrating the same in either direction from a normal position, and means, substantially as described, for arresting the same, as set forth.

3. A type-sleeve, in combination with means, substantially as described, for vibrating the same in either direction from a normal position, and means, substantially as described, for returning the same, as set forth.

4. A type-sleeve, in combination with means, substantially as described, for vibrating the same in either direction from a normal position, and means, substantially as described, for arresting the same, and means, substantially as described, for returning the same, as set forth.

5. In a type-writing machine, the combination, with a type-sleeve adapted to turn on its bearings in either direction from a normal position to present any given letter to the paper, of finger key-levers by which the operating power is applied, of intermediate mechanism, as described, between said key-levers and the sleeve, by which the proper motion is imparted to said sleeve, and of a stop mechanism, substantially as described, set in motion by the key-levers and acting in opposition to the motion imparted to the type-sleeve, to arrest said type-sleeve at the proper point, as set forth.

6. In type-writing machines, the combination of a series of key-levers, of an oscillating printing-lever, and of a type-sleeve placed thereon with intermediate mechanism, substantially as described, between the key-levers and type-sleeve, whereby the type-sleeve is moved longitudinally and rotated axially by motion imparted directly to the key-levers, substantially as set forth.

7. In type writing machines, the combination of a series of key-levers, of an oscillating printing-lever, and of a type-sleeve placed upon the printing-lever with intermediate mechanism, substantially as described, between the key-levers, printing lever, and type-sleeve, whereby the printing-lever and type-sleeve are rotated and the type-sleeve moved simultaneously therewith in longitudinal direction by motion imparted directly to the key-levers, all as described.

8. In type-writing machines, the combination of a series of key-levers, of an oscillating printing-lever, and of a type-sleeve placed thereon with intermediate mechanism between the key-levers and type-sleeve, whereby the type-sleeve is moved longitudinally and rotated axially, and finally locked into fixed position for printing, substantially as set forth.

9. In type-writing machines, the combination of a series of key-levers, of an oscillating printing-lever, of a type-sleeve placed thereon, and of intermediate mechanism between the key-levers and type-sleeve, whereby longitudinal and axial motion is imparted to the type-sleeve, with an inking-ribbon and mechanism actuated by the printing-lever, whereby the inking-ribbon is fed forward at each oscillation of the printing-lever, all substantially as set forth.

10. In type-writing machines, the combination of the vibrating key-levers *a*, having projecting side pins, *d*, with a rock-shaft, D, having cams D′ of different degrees of eccentricity, and a fixed lever-arm, D^2, with forked pitman D^3, and with type-sleeve E, to impart the longitudinally-sliding motion to the latter, substantially as set forth.

11. In type-writing machines, the combina-

tion of the key-levers *a*, having side pin, *d*, rock-shaft D, having cams D′, and fixed lever-arm D^2, having toothed segment f^3, with pitman D^3, type-sleeve E, and extension-arm f^4 of the oscillating lever-frame F^3, to lock type-sleeve in position after the longitudinal motion is accomplished, as specified.

12. In type-writing machines, the combination of rocking cam-shaft D, having crank-arms *d*′, extending at opposite sides of the cam-shaft, with a pivoted and spring-pressed lever-arm, d^2, acting on either end of the crank-arms *d*′ to return cam-shaft to normal position after each depression of a key-lever, as described.

13. In type-writing machines, the combination of the vibrating key-levers *a* with pivoted and spring bails G, having cam-arms G′, and with a flanged disk, g^3, keyed to printing-lever F, to produce the row-shifting motion of printing-lever and type-sleeve, as specified.

14. In type-writing machines, the oscillating cam-arms G′, having arc-shaped cams *g*′, with straight and curved faces, in combination with disk g^3 of printing-lever F, said disk having a circumferential and symmetrically recessed flange, g^2, into the recesses of which the cams enter, so as to turn and lock the disk, substantially as described.

15. In type-writing machines, the combination of a laterally sliding and guided casing, H, having stop-shoulders h^2 and guide-standards H′, with a laterally-sliding rod, *f*′, having spring-pressed sleeves *h*′ and a rack, h^3, and with the printing-lever F, having pinion h^4, all as set forth.

16. In type-writing machines, the combination of the laterally-traversing paper-carriage M, having rack *m*′, and of a transversely-oscillating fixed pawl, m^2, and a pivoted and spring-pressed pawl, m^3, with a step-shaped stop, m^7, for the purpose described.

17. In type-writing machines, the combination of a traversing platen, M, having rack *m*′, and of an oscillating fixed pawl, m^2, and a pivoted and spring-pressed pawl, m^3, with a step-shaped stop, m^7, said stop being capable of shifting motion to provide a variable letter-space, as set forth.

18. In type-writing machines, the combination of the step-shaped stop m^7, extending from a guided slide-bar, *n*, with the field-shifting mechanism of the type-sleeve, to produce the shifting of the stop for variable letter-space whenever the field-shifting device is set for capital letters, substantially as set forth.

19. In type-writing machines, the combination of the "M" and "W" key-levers *a*, having projecting side pins, with a rock-shaft, M^2, having cam-arms, a fixed pawl, m^2, a pivoted and spring-pressed pawl, m^3, and a step-shaped stop, m^7, to oscillate the pawls to such an extent that a larger space for the "M" and "W" letters is obtained, substantially as described.

20. In type-writing machines, a polygonal platen having narrow printing sides and wider intermediate sides, substantially as specified.

21. In type-writing machines, the combination of a polygonal platen, L, with a fixed paper-apron, O, an oscillating and spring-pressed paper-apron, O′, and with a spring-pressed feed-roll, O^2, to hold the paper taut on the platen, as set forth.

22. In type-writing machines, the combination of an axially-turning platen, L, having a spring-pressed feed-roll, O^2, pressed thereon, with the pivoted spool-frame of the inking-ribbon, having rear-extending guide-arms *i*′, and with the oscillating and spring-pressed paper-apron O′, to produce the lifting of the spool-frame by the feed roll when turning the platen forward for inserting the paper, substantially as specified.

23. In type-writers, the combination of the axially-turning platen L and spring-pressed feed-roll O^2, having extended pivots, with the supporting-standards of the paper-carriage, having cam-shaped portions *p* and stops *p*′, to carry feed-roll away from platen for insertion of paper, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 3d day of December, 1879.

LUCIEN STEPHEN CRANDALL.

Witnesses:

S. BELDEN SMITH,

W. R. BIGGAR.