(No Model.) 3 Sheets—Sheet 1.

C. L. REDFIELD.

MATRIX MAKING MACHINE.

No. 468,974. Patented Feb. 16, 1892.

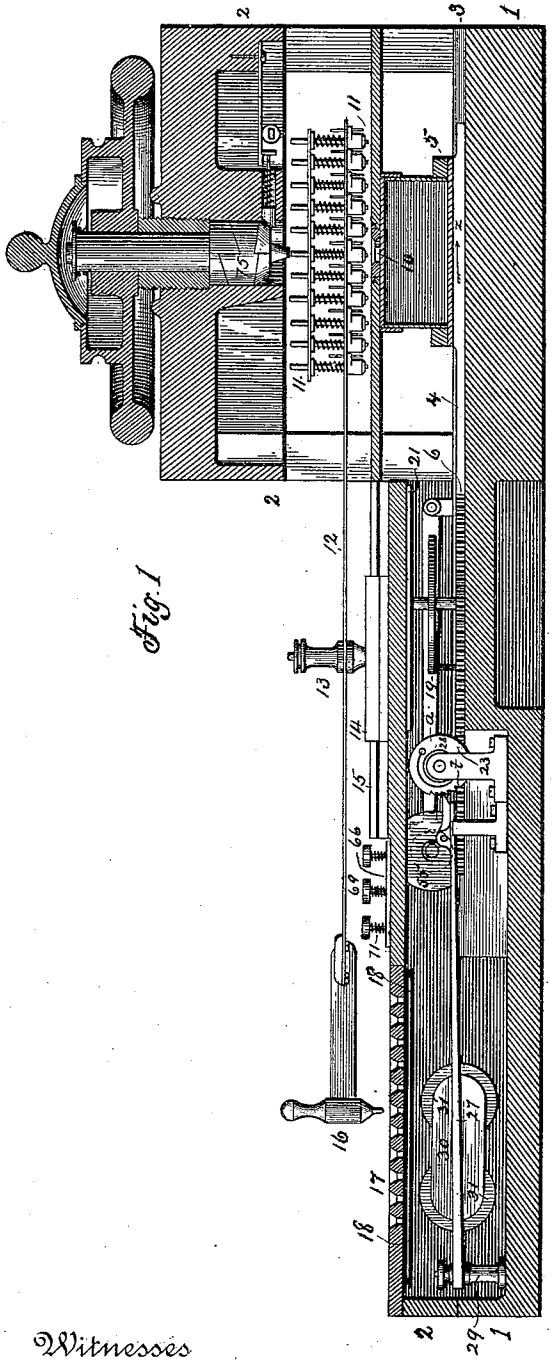

Fig. 1

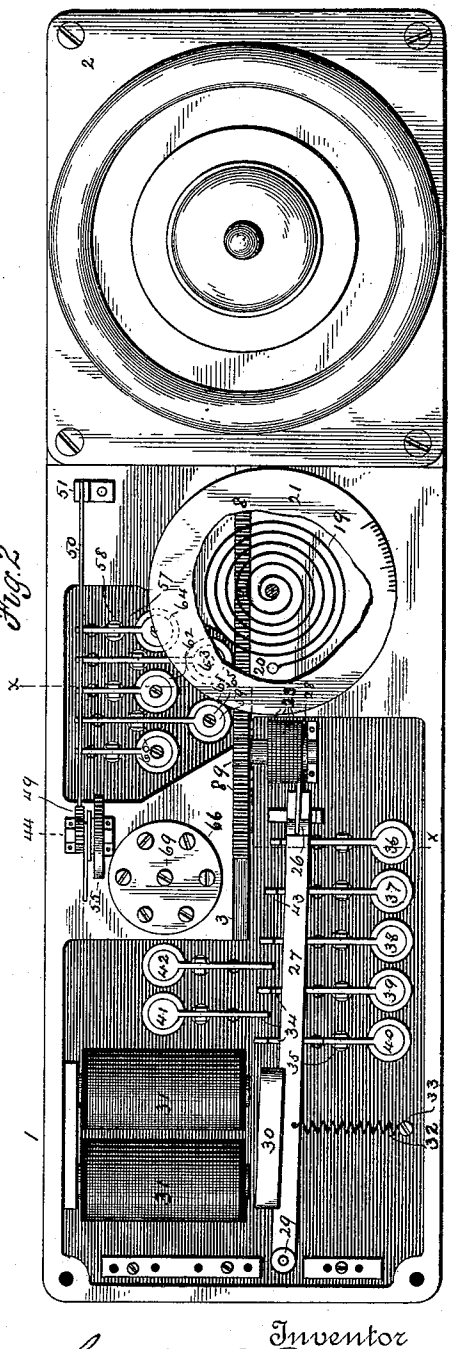

Fig. 2

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(No Model.) 3 Sheets—Sheet 2.

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MATRIX MAKING MACHINE.

No. 468,974. Patented Feb. 16, 1892.

Fig. 3

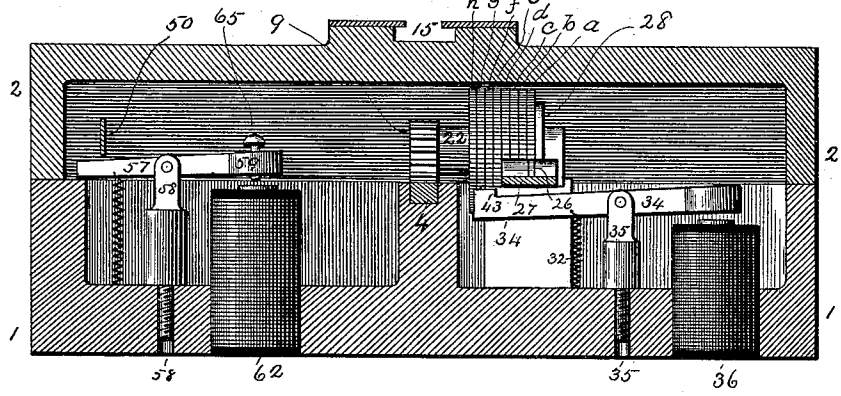


Fig. 6

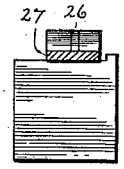


Fig. 4

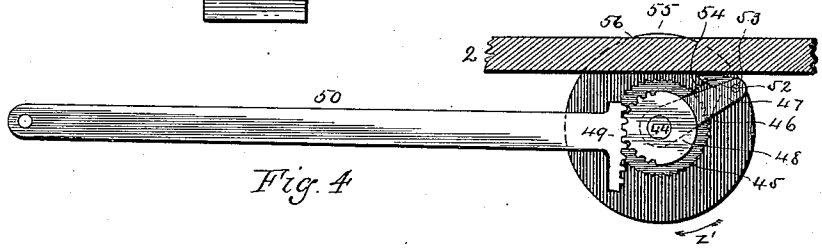


Fig. 5

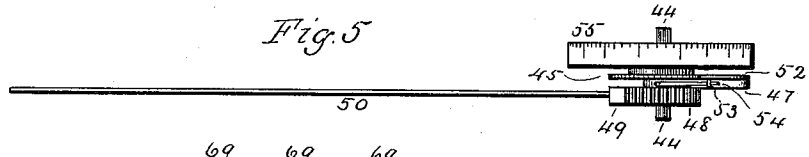
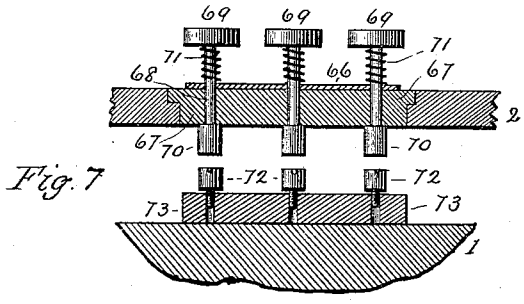


Fig. 7



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(No Model.) 3 Sheets—Sheet 3.

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MATRIX MAKING MACHINE.

No. 468,974. Patented Feb. 16, 1892.

Fig. 9

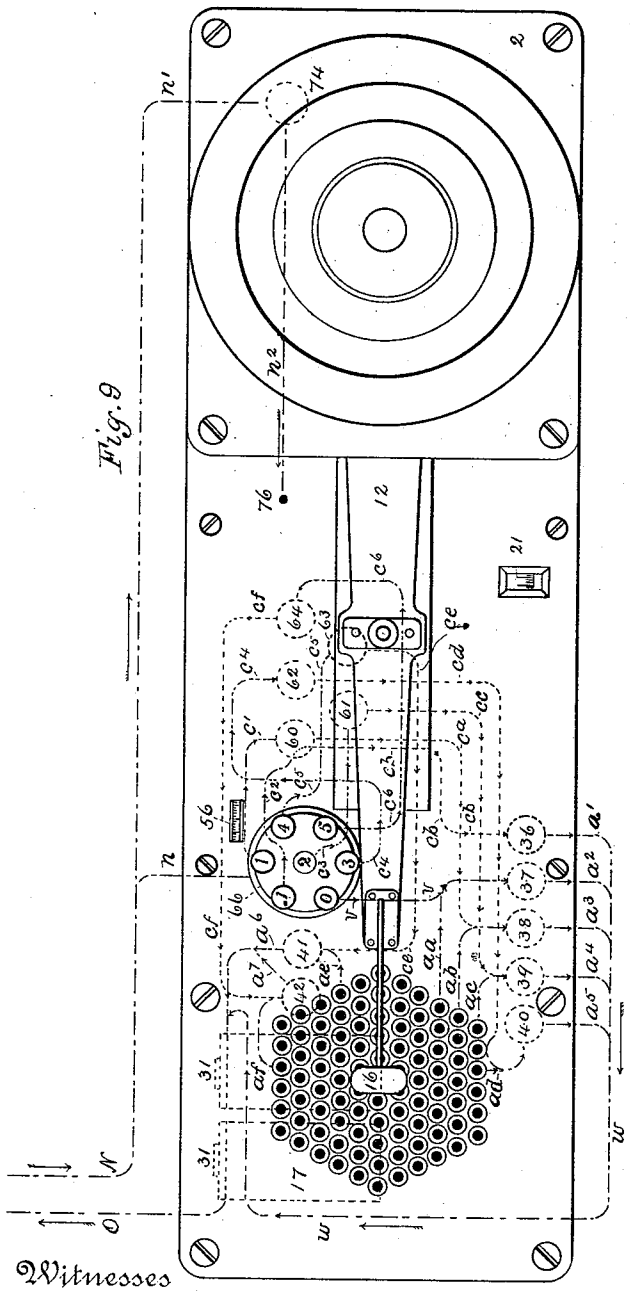
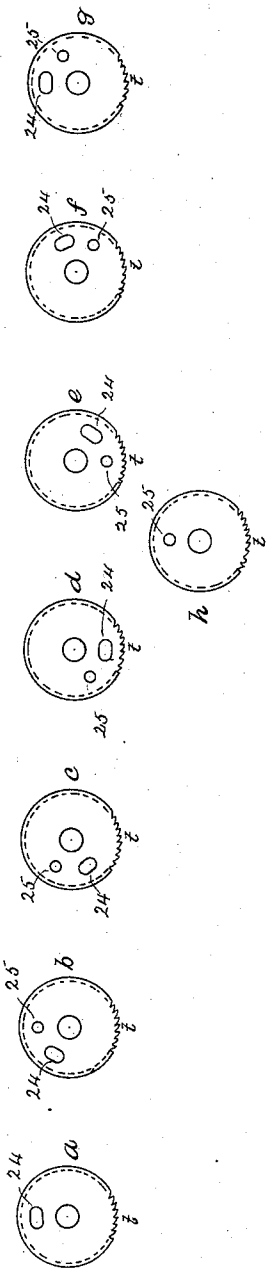


Fig. 8



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UNITED STATES PATENT OFFICE.

CASPER L. REDFIELD, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE CHICAGO MATRIX MACHINE COMPANY.

MATRIX-MAKING MACHINE.

SPECIFICATION forming part of Letters Patent No. 468,974, dated February 16, 1892.

Application filed September 20, 1890. Serial No. 365,666. (No model.)

To all whom it may concern:

Be it known that I, CASPER L. REDFIELD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Matrix-Making Machines, of which the following is a specification.

My invention relates to matrix-machines adapted to form stereotype-matrices by the successive impression of type-dies; and the object is, chiefly, the improvement of the mechanism for producing variable feed movements of the matrix material proportioned to the requirements of different characters to be impressed, and improvement of the means for spacing words, whereby justification of the lines of impressions is facilitated. These objects are accomplished by the devices illustrated in the accompanying drawings, in which—

Figure 1 is a central longitudinal section of a matrix-machine, showing a portion of the interior devices in elevation. Fig. 2 is a plan view, part of the top of the machine being removed to show the improvements. Fig. 3 is a transverse section on the line *x x* of Fig. 2. Figs. 4 and 5 are respectively a side elevation and a plan of the space-registering devices.. Fig. 6 is a detail of the block for supporting the escapement-lever. Fig. 7 shows a vertical section of the portion of the machine containing the spacing-levers. Fig. 8 is a detail showing separately the eight ratchet-wheels of the feed mechanism and the relative positions of their respective pins and slots, and Fig. 9 is a diagrammatic view showing the course of the electric currents.

In such drawings, 1 designates the lower and 2 the upper portion of the machine frame or case. In the base of the lower portion 1 is a longitudinal slot 3, providing a guide for the rack-bar 4. The rack-bar is connected to a matrix-material carriage 5, and has teeth 6 at one side for engaging the driving-gear 7, and vertical teeth 8 for engaging a gear 9 for operating the escapement. The matrix-carriage 5 is moved by the rack to present successive portions of the matrix material at the printing-point 10, and the type-dies 11 are carried and successively presented at the printing-point by the die-carrying lever 12, that is pivoted at 13 to a cross-head 14 in guides 15. On the free end of the lever is a circuit-controller 16, co-operating through a perforated index-plate 17 with an underlying series of conducting-plates 18 for completing an electric circuit in the manner indicated in my patent, No. 416,742, of December 10, 1889.

Power is communicated to the driving-gear 7 by a coil-spring 19, that has one of its ends attached to the hub of the gear and the other to a post 20, fixed in the base of the machine-frame. On top of the hub of this gear-wheel is secured a graduated disk 21, from which the movement of the gear, and hence the matrix-carriage movements, may be read.

On the hub 22 of the gear-wheel 9, that actuates the escapement devices, is a series 23 of ratchet-wheels consisting of eight wheels designated *a*, *b*, *c*, *d*, *e*, *f*, *g*, and *h*, respectively, having teeth *t* on a portion of their peripheries and placed in position to have their sides in frictional contact. Each of these, except the wheel *h*, has an oblong slot 24, and each, except the wheel *a*, has a pin 25, that enters the slot in the wheel next to it. The wheel *h* is fast to the hub 22, while the others are loose on it and are free to turn each as far as the length of its slot 24 will permit. The wheels have their respective slots and pins, so arranged that when the pins are all at either extreme of their movement in the slots the teeth of all the wheels will coincide as though they were the successive teeth of a single wheel having a rim equal in width to the combined rims of the several wheels. The slots in all the wheels are of such length as to permit each wheel to rotate in advance of the next the space of one ratchet-tooth. The relative positions of the slots and pins of the different wheels are shown in Fig. 8. A pawl 26 for restraining their rotary movements is carried on a pivoted lever 27, whose movements are in horizontal direction or parallel to the axes of the ratchet-wheels. The motor-spring 19 tends to move the rack 4 in the direction indicated by the arrow *z*, and thus turn the escapement-gear and the ratchet-wheels carried by its hub in opposite di-

rection, so that a downward pressure will be exerted by the teeth *t* on the holding-pawl 26. A spring 28, fast to the hub 22 and the wheel *a*, exerts a slight force, tending to turn that wheel and with it the others in the same direction as the advance movement of the gear 9; but when the pawl is in engagement with any one of the ratchet-wheels, except the one nearest the gear, the force of the spring 28 is overcome by the superior force of the motor-spring 19.

The operation of these devices to cause variable feed movements is as follows: In the drawings the pawl is shown in its normal position engaging the ratchet-wheel *a*, and all of the pins 25 are at the extreme ends of the slots 24 because of the tension of the motor-spring acting through the rack upon the gear 9. If, then, the pawl is made to slide laterally from the wheel *a* to the wheel *b*, the positions of the other wheels *c d*, &c., and the gear are not affected; but the spring 28 is permitted to rotate the released wheel *a* as far as its slot 24 and the pin 25 on the wheel *b* will permit, which in this instance is an advance of one tooth. Returning the pawl from the wheel *b* to the wheel *a* holds the latter in its advance position and permits the wheel *b* to be advanced by the gear the same distance that the wheel *a* was advanced by its spring 28, and the movements of the gear 9 being adapted to effect corresponding matrix feed movements a feed movement equal to the space of one of the ratchets *t* will thus have been effected. The operation of the pawl in connection with each of the other ratchet-wheels *c d*, &c., is the same as that described relative to the wheel *b*. Each successive wheel when co-operating with the pawl permits an escapement equal to as many teeth *t* as there are wheels ahead of the engaged wheel in the series. From the foregoing it will be apparent that the variations of the feed movements depend upon the extent of the lateral movements of the pawl from its initial position.

The pawl-carrying lever 27 is pivoted to a post 29 in the machine-frame, and intermediate its ends is attached an armature 30, operated by a magnet 31. A spring 32, attached to the lever and to a post 33, serves to retract the armature from the magnet when the latter is not acting and hold the lever and armature in the position shown in Fig. 2. Beneath the lever 27 is a series of seven stop-levers 34, that are pivoted on posts 35 and are actuated by a corresponding series of armatures and magnets 36, 37, 38, 39, 40, 41, and 42. These levers are arranged to be thrown upward by the operation of their respective magnets until they come in contact with the under side of the lever 27, which causes the latter lever to slide on their surface while making its horizontal movements until stopped by a shoulder 43 on the operated stop-lever 36 37, &c. These shoulders 43 are arranged in sequence as to their distance from the initial position of the lever 27, so that the throws of the latter will present the pawl to the successive ratchet-wheels in like sequence, and thus effect the desired variations of feed movements.

At the opposite side of the machine is mounted a short shaft 44, carrying a ratchet-wheel 45, that is operated by a pawl 46, Fig. 4. The pawl is carried by an arm 47, fixed to a gear-wheel 48, that is loose on the shaft 44, and in engagement with the gear 48 is a segmental gear 49, formed on the end of a lever 50, that is pivoted to a bracket 51 on the machine-frame, and the pawl has an arm 52, on which is a pin 53, and to the pawl-carrier 47 is attached a spring 54, that presses against the pin 53 and serves to hold the pawl 46 in engagement with the ratchets of the wheel 45 while the gear 48 is being rotated in the direction of the arrow *z'* by the force of the upward movement of the lever 50. When the latter lever is permitted to gravitate to the position shown in Fig. 4, the arm 52 rises to contact with the machine-frame 2 (or a suitably-arranged stop) and so, by compressing the spring 54, frees the pawl 46 from the ratchets, and the wheel 45 is thus free to be turned by hand or by other means. The shaft 44 also carries a disk 55, that has graduations corresponding in number with the teeth of the ratchet-wheel 45, and when the latter wheel is turned the disk rotates with it and shows the extent of the ratchet-wheel rotations. This disk projects through a slot 56 in the machine-frame, so that its registrations may be read from without.

Beneath the lever 50 are the ends of five levers 57, that are pivoted to posts 58 and carry on their other ends armatures 59, that are operated by magnets 60, 61, 62, 63, and 64, respectively. Each of the armatures 59 is provided with a set-screw 65, by the adjustment of which the throw of each of the levers 57 may be varied to regulate the extent of movement that will be given by it to the lever 50, and hence regulate the extent of rotation of the ratchet-wheel 45.

Near the disk 55 is a circular plate 66, supported on a piece of insulating material 67, that is set in the machine-frame, and through the pieces 66 and 67 are stems 68, having figured buttons 69 upon their upper ends and enlarged heads 70 on their lower ends, the keys being held in an elevated position by springs 71. Beneath the lower heads 70 is a series of contact-points 72, supported in an insulating-piece 73, and from these contact-points extend wires to the various magnets 60 61, &c. These keys 69 are spacing-keys, and the numbers inscribed on them signify the amount of space which they are adapted, respectively, to throw in between words in addition to the normal space used.

The type-dies and the feed movements as well are assumed to be based upon some system of measurement having gradations proportioned to the width of characters, preferably a unit system of measurement, in which all characters and the feed movements are

represented by the unit or by multiples of the unit. Then, if in such system the ordinary space thrown in between words be assumed to be equal to two of the units of measurement, the key or button 69 for providing such space may be indicated with a 0.

In case it is desired, in order to crowd more matter into a line to perfect the justification, that a space less than two units be thrown between words, a key indexed 1 is provided that will throw one less unit than the normal space—that is, will throw but one unit; and for throwing units of space additional to the normal space thrown by the key 0 the other keys 1 2 3, &c., are provided. These keys co-operate with the register 55 and enable the latter to register only the spaces thrown that are in excess of the normal space, and which may be termed "extra" spaces. The connections between these keys and their respective magnets 60 61, &c., are such that their operation causes the disk 55 to register what the operated keys indicate and not what the actual space thrown is. Thus, when the key marked 0 is struck, the disk 55 does not register. When the key marked 1 is operated, it causes the disk to register one, and so when the key marked 1 is operated the register indicates one. These are arranged to register alike, because the minus and plus quantities are not to be used in the same combination, and when by mistake they are so used the error can be corrected by mental subtraction from the register. When the key 2 is operated, two units of movement will be indicated on the register, and these are extra spaces or spaces thrown in additional to the normal two-unit space, and so the keys 3 4, &c.; will cause a registration of a corresponding number of extra spaces. The electric current enters at N, and has two branches, one branch n running to the plate 66 and the other n' running to a magnet 74, that controls the impression device 75, and thence to the machine-frame at the point 76.

From the conducting-plates 18, under the index-plate 17, wires extend to the several magnets 36 37, &c., for controlling the various feed movements, the first magnet 36 effecting a one-unit feed, the second 37 a two-unit feed, and so on in the series.

The magnet 60 of the series of extra-spacing magnets has two separate coils on the same core, so that if a circuit is completed through either the armature is attracted and the disk 55 is rotated one graduation. One of these coils is connected with the magnet 36 and the other with the magnet 38, the former being adapted to effect a movement equal to one unit and the latter a movement equal to two units, but each being adapted to cause the registration of but one unit on the disk 55. The magnet 61 is connected with the magnet 39, and controls a two-unit extra-space movement and registration. The magnet 62 is connected with the magnet 40, and effects a like three-unit movement. The magnet 63 is connected with the magnet 41, and controls a four-unit movement, and the magnet 64 is connected with the magnet 42, and controls a five-unit movement. The wires running out from the magnets 36 to 42, inclusive, are grouped into one and pass through the magnet 31, and thence out through the line O.

The operation is as follows: The operator presses the index-pin 16, that serves as a circuit-closer, through one of the holes on the index-plate, and if the character is one requiring two units of space—as i, for example—the current enters through the line N and n' to the magnet 74, thence through the line n^2 to the machine-frame at 76, thence through the lever 12 and the pin 16 to the two-unit contact-plate 18, thence through the wire $a\ a$ to the magnet 37 and out through the wire a^2 and the wire w to the magnet 31, and thence out on the wire O to the source. When a letter requiring three units of space is operated, the course of the electric current is the same as for a two-unit letter, until it reaches the appropriate conducting-plate 18, whence it passes on the wire $a\ b$ to the magnet 38, thence on the wires a^3 and w to the magnet 31, and out, as in the former instance. For a four-unit character the current passes from the proper conducting-plate 18 through the wire $a\ c$ to the magnet 39, thence through the wires a^4 and w to the magnet 31 and out, as before, and so the other feed movements are controlled by currents passed by the wires $a\ d$, &c., in the same manner to the different magnets 40, &c., and away from them by their respective wires a^5, &c. If a normal space is to be thrown in between words, the operator presses the key marked 0, and thus closes a circuit through the wires N n, the plate 66, the pin 68, the contact 72, the wire v, that is connected to the wire $a\ a$ to the magnet 37, and thence through the same course as when the operation has been for feeding for a letter requiring two units of space; but of this feed movement no record is made on the register 55, for the reason that none of the magnets 60 61, &c., have been energized. If a space of one unit more than the normal space is to be thrown between words, the operator presses the button marked 1 and closes a circuit from the plate 66 through the wire c', one of the coils of the magnet 60 and the wire $c\ a$ to the magnet 38, thence the course is as before indicated. Energizing the magnet 60 causes its armature-lever 57 to be operated to lift the lever 50 and cause a movement of the registering device to indicate a feed of one unit. This, as will be understood, means one unit in excess of the normal space of two units. If less than the normal space is to be thrown, the button marked 1 is depressed and closes a circuit through the wire c^2 to the second coil of the magnet 60. The course is thence by the wire $c\ b$ to the magnet 36, thence by the wire a' to the wire w and mag-

net 31, and thence to the return wire. The effect upon the operation of the registering device of the energizing of this second coil of the magnet 60 is the same as in the instance of the other coil and causes a registration of a single unit; but this will be understood to be the registration of a unit less than the normal—that is, of only one unit of movement—though the registration in both instances is indicated in like manner on the register 55. If a space equal to two units in excess of the normal is to be thrown, the button marked 2 is operated, closing the circuit through the wire c^3 to the magnet 61, thence by the wire $c\,c$ to the magnet 39, and thence by the wire a^3 to the wire w. This operation causes the armature-lever of the magnet 61 to lift the lever 50 and cause a movement of the register 55 equal to two units. In the same manner each of the other spacing-keys causes a circuit to be completed through the appropriate wires and magnets, as indicated in Fig. 9 by broken lines and arrow-heads. From the foregoing it will be understood that each unit movement of the matrix material is recorded on the register 21, and that spacing movements of greater or less extent than the normal spacing movement are indicated by the register 55.

In order to utilize the two registers to indicate proper spacing and justification, it is desirable to use prepared copy that indicates either the number of units of space occupied by the print in the copy or the number of units of space required to complete the line, an arbitrary number of units of space having been selected as the maximum for the lines. Then from the copy the operator will see whether the lines to justify require to be expanded or contracted and to what extent.

In operating a machine to produce a matrix the register 21 will show when the line is finished whether it contains the required number of units of measurement, and if it does, and the register shows the required number of units of spacing movement for either the expansion or contraction of the line, then it will be apparent to the operator that the line is of the proper length and the spaces are such as are required, and hence it will be apparent from the registers, without inspection of the matrix, that the justification and the spacing are correct.

Patentable subject-matter herein disclosed and not claimed in the subjoined claims relating to the means for carrying, selecting, and impressing the dies, means for effecting the proper differential feed of the matrix-material carriage, as well as the specific devices disclosed for controlling the feed movements, and the means for effecting the variable spacing of words is reserved to be claimed in my pending applications, Serial No. 300,536, filed February 20, 1889; Serial No. 301,178, filed February 26, 1889; Serial No. 303,657, filed March 18, 1889; Serial No. 309,288, filed May 1, 1889; Serial No. 339,644, filed February 8, 1890; Serial No. 340,323, filed February 13, 1890, and Serial No. 365,175, filed September 16, 1890.

What I herein claim, and desire to secure by Letters Patent, is—

1. A series of ratchet-wheels providing variable feed movements, a pawl adapted to permit such movements, a magnet for moving the pawl, and a series of magnets and armatures each adapted to arrest said pawl at a different position relative to the ratchet-wheels, substantially as set forth.

2. In a variable spacing mechanism actuated by the sliding of a pawl into or out of engagement therewith, a magnet for sliding said pawl, and a series of magnets each adapted to stop the pawl in a different position relative to the ratchet, substantially as set forth.

3. In an escapement, a series of co-operating ratchet-wheels, a pawl and means for moving it from one wheel to another, and electrically-operated stops for controlling such movements of the pawl, substantially as set forth.

4. A series of ratchet-wheels each adapted to move the space of one tooth, a pawl normally in engagement with one of said ratchet-wheels, electrical devices for moving it to any of the other wheels, and means for retracting the pawl to the normal position, substantially as set forth.

5. In an escapement, a series of co-operating ratchet-wheels, a pawl, electric devices for shifting it from one wheel to another, and movable stops for selecting the wheels to be engaged, substantially as set forth.

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