Oct. 8, 1940. R. D. DODGE 2,217,159

TYPEWRITING MACHINE

Filed July 2, 1938 6 Sheets-Sheet 1

FIG. 14.

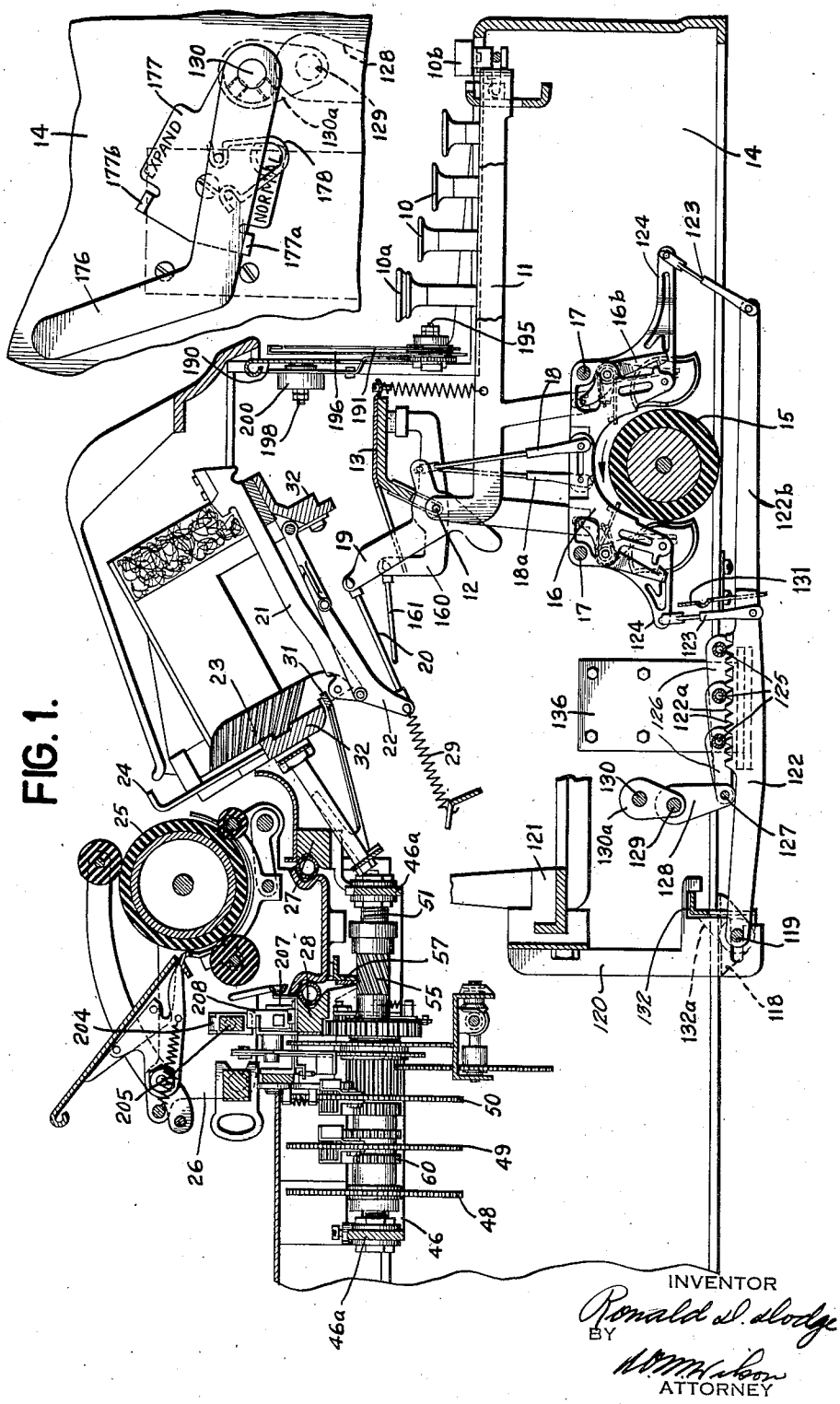


FIG. 1.

INVENTOR
Ronald D. Dodge
BY
W. M. Wilson
ATTORNEY

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TYPEWRITING MACHINE

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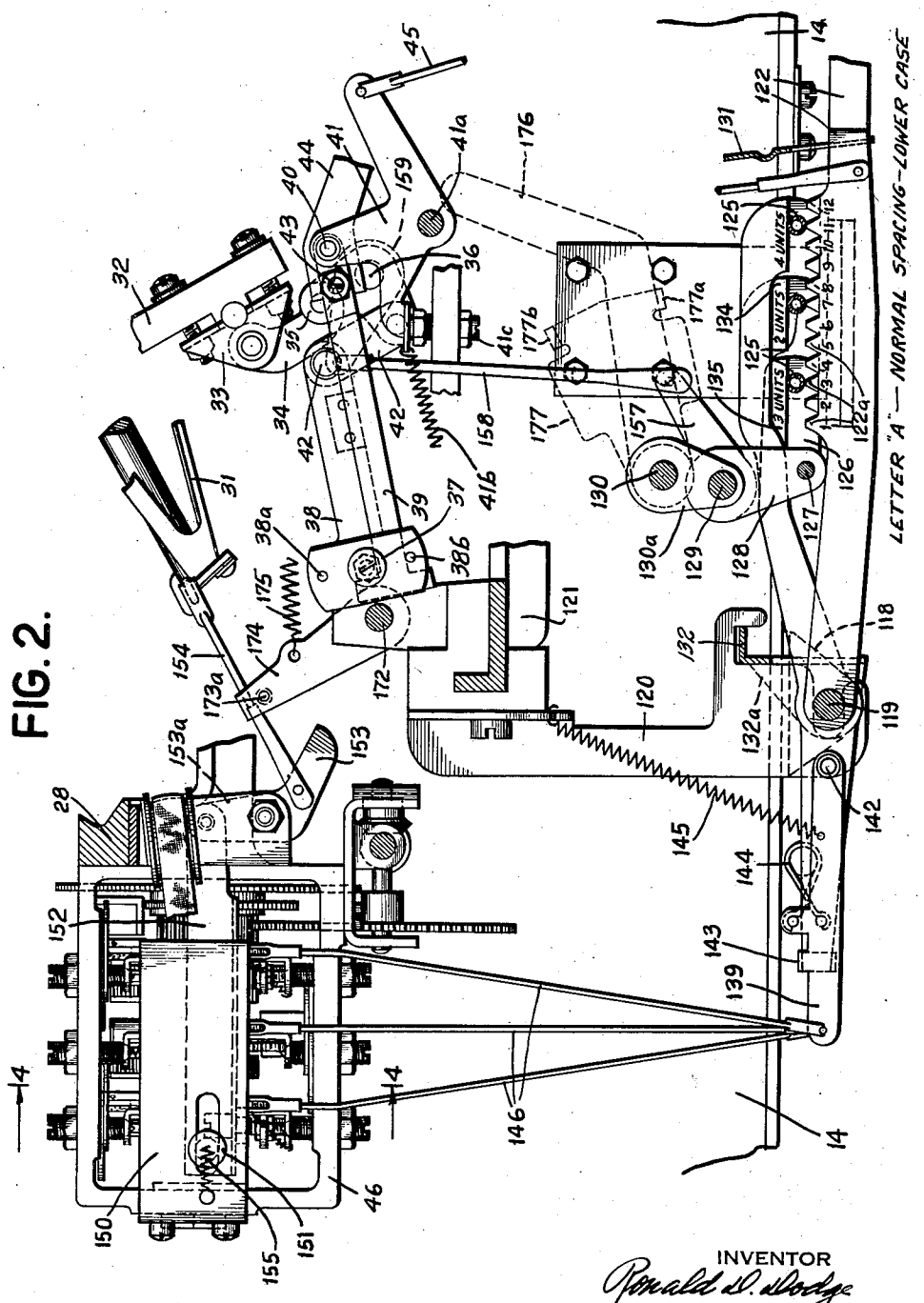


FIG. 2.

INVENTOR
Ronald D. Dodge
BY
W. M. Wilson
ATTORNEY

Oct. 8, 1940. R. D. DODGE 2,217,159

TYPEWRITING MACHINE

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FIG. 3.

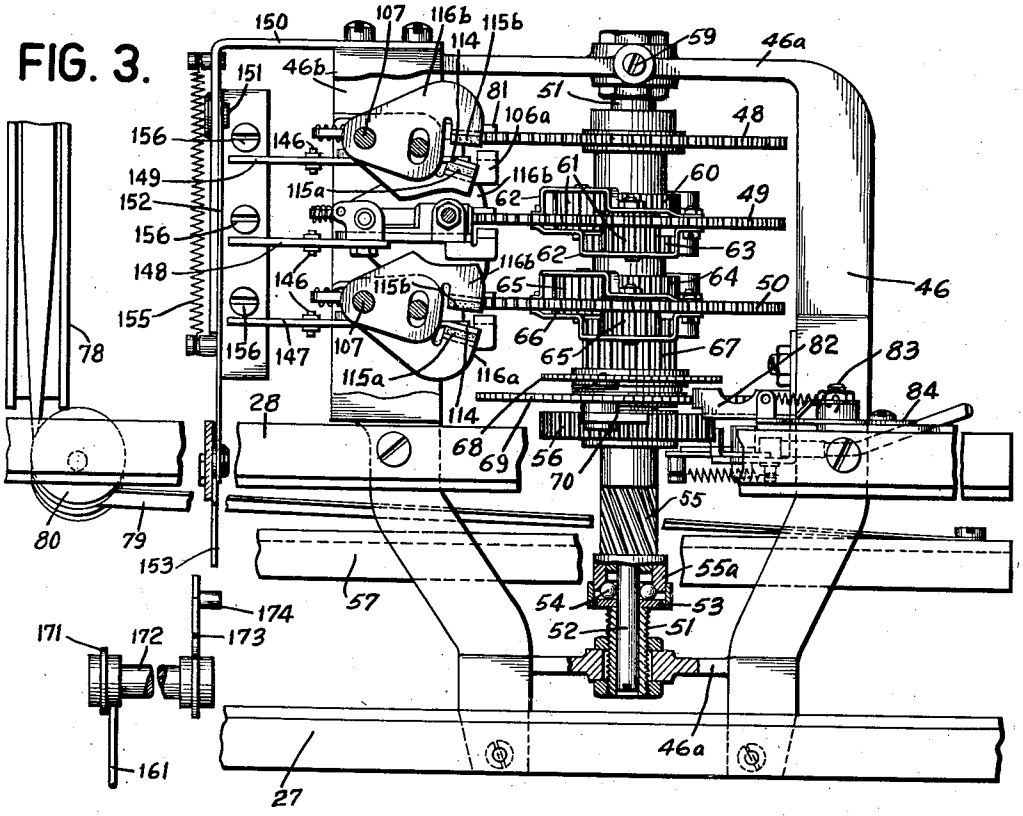
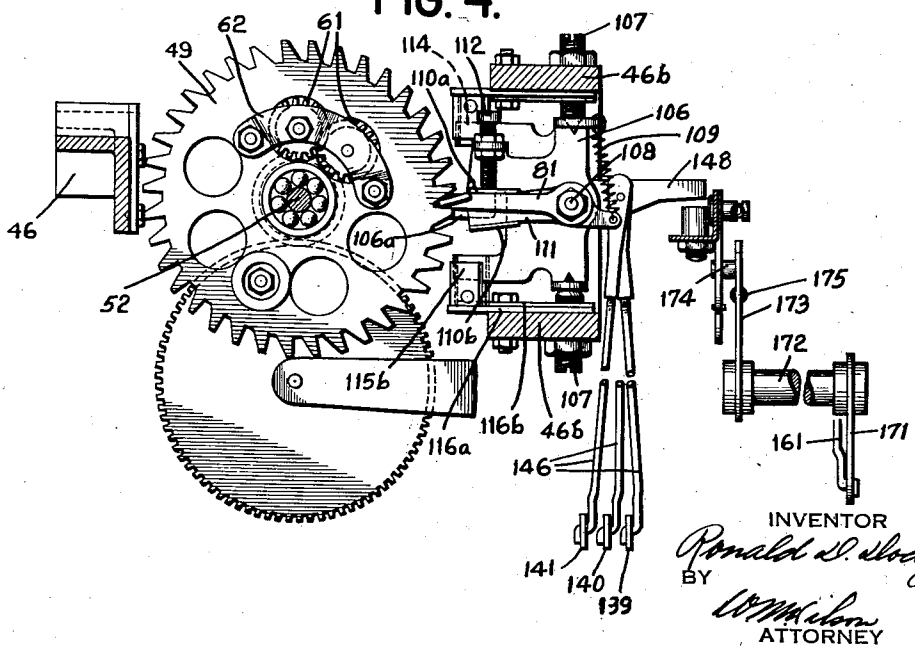


FIG. 4.



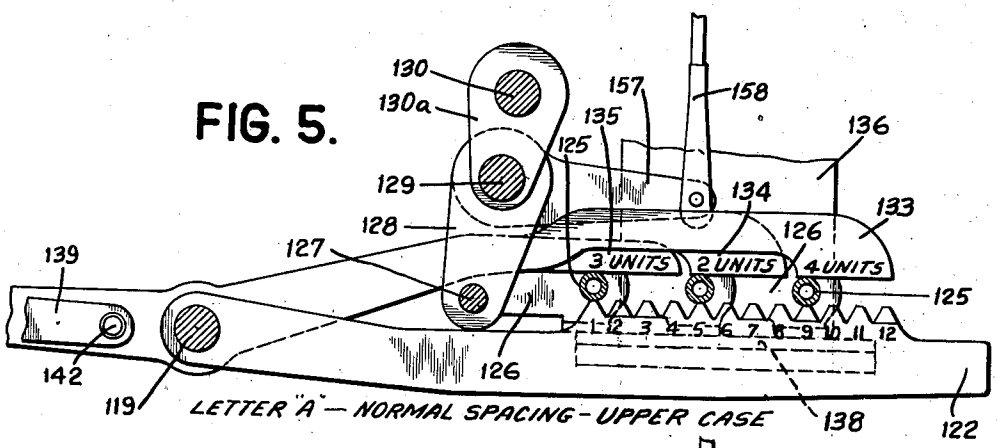
INVENTOR
Ronald D. Dodge
BY
W. M. Wilson
ATTORNEY

Oct. 8, 1940. R. D. DODGE 2,217,159

TYPEWRITING MACHINE

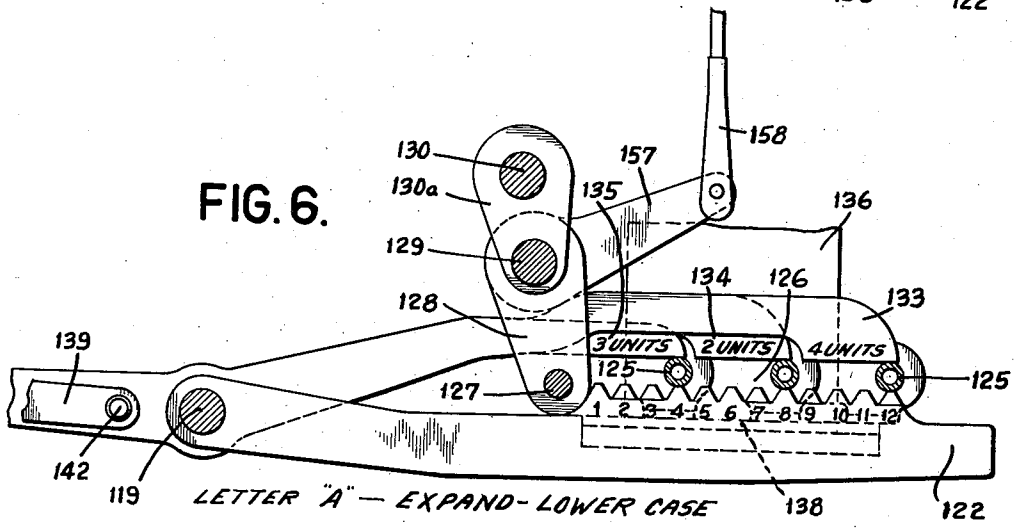
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FIG. 5.



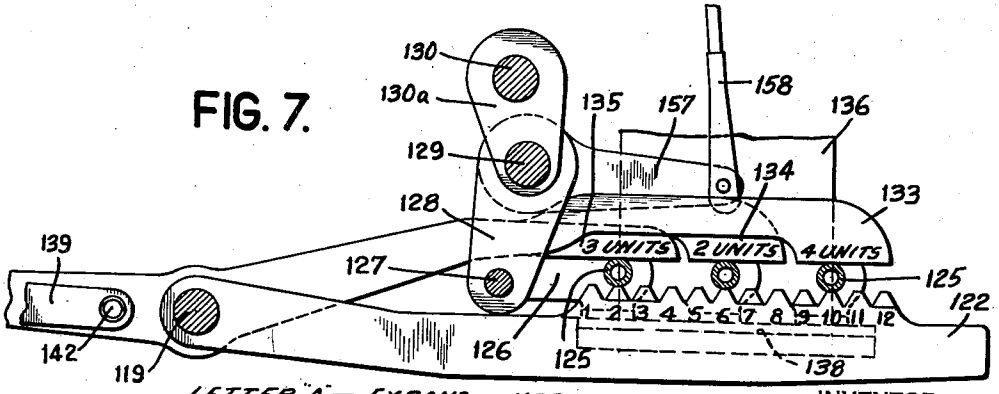
LETTER "A" — NORMAL SPACING - UPPER CASE

FIG. 6.



LETTER "A" — EXPAND - LOWER CASE

FIG. 7.



LETTER "A" — EXPAND — UPPER CASE

INVENTOR

Ronald R. Dodge

BY

W. M. Wilson

ATTORNEY

Oct. 8, 1940. R. D. DODGE 2,217,159

TYPEWRITING MACHINE

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FIG. 11.

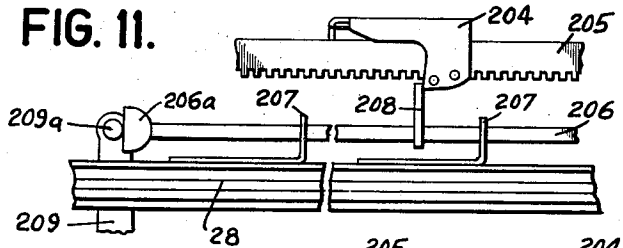


FIG. 8.

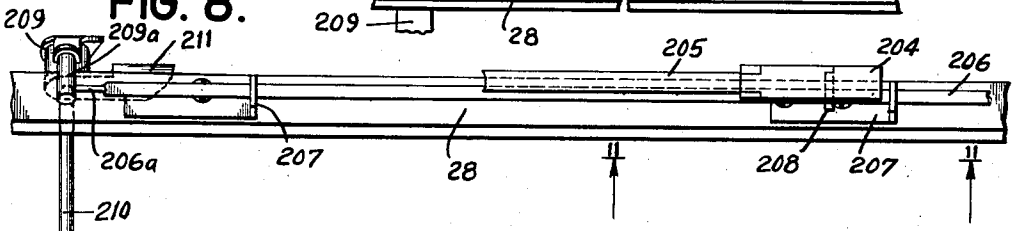


FIG. 10.

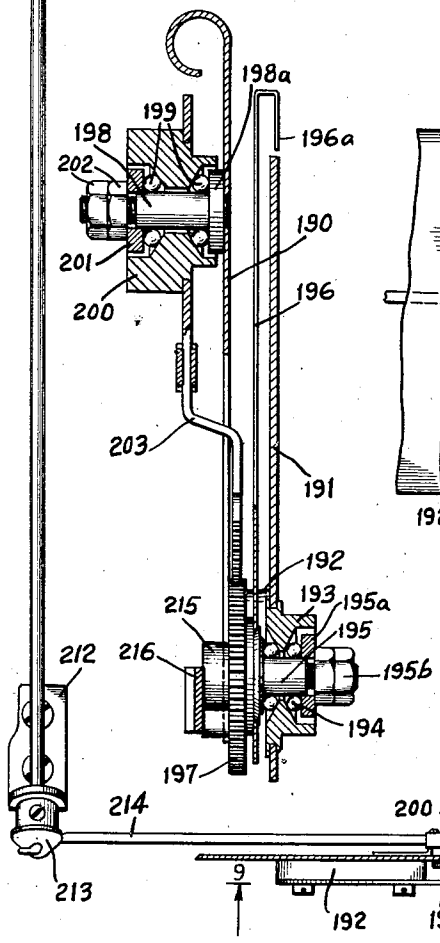
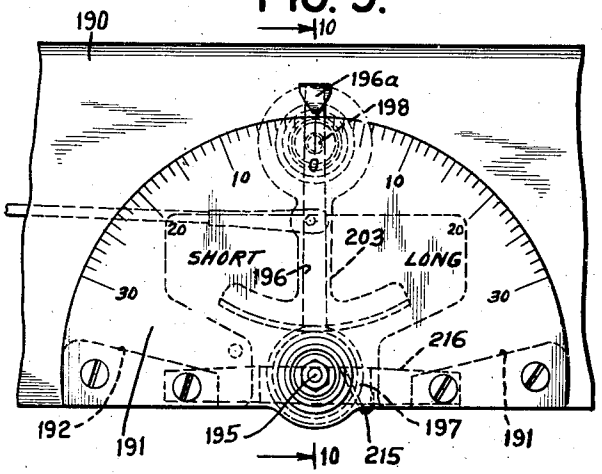
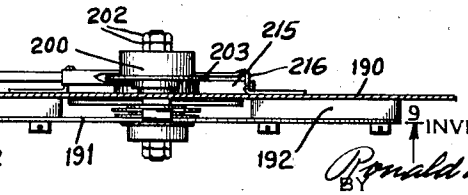


FIG. 9.





INVENTOR

BY Ronald R. Dodge

ATTORNEY

Oct. 8, 1940. R. D. DODGE 2,217,159

TYPEWRITING MACHINE

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FIG. 12.

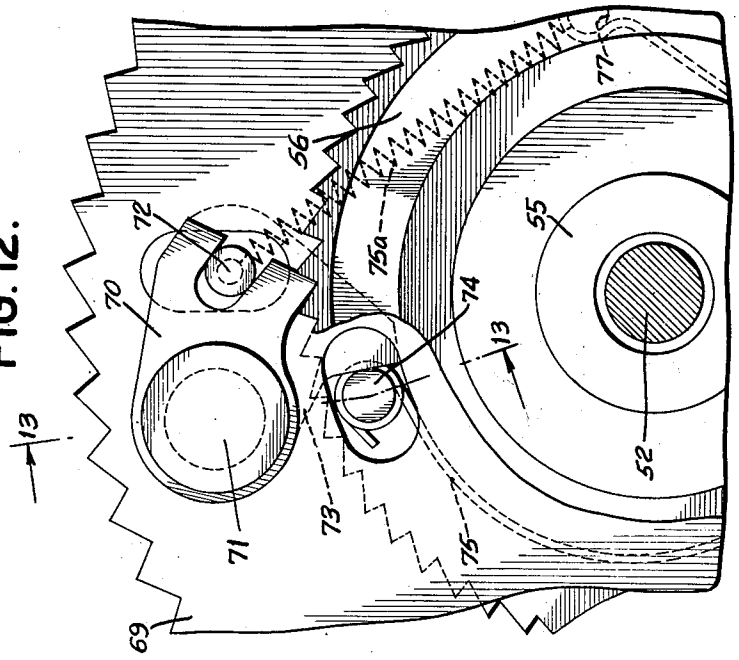
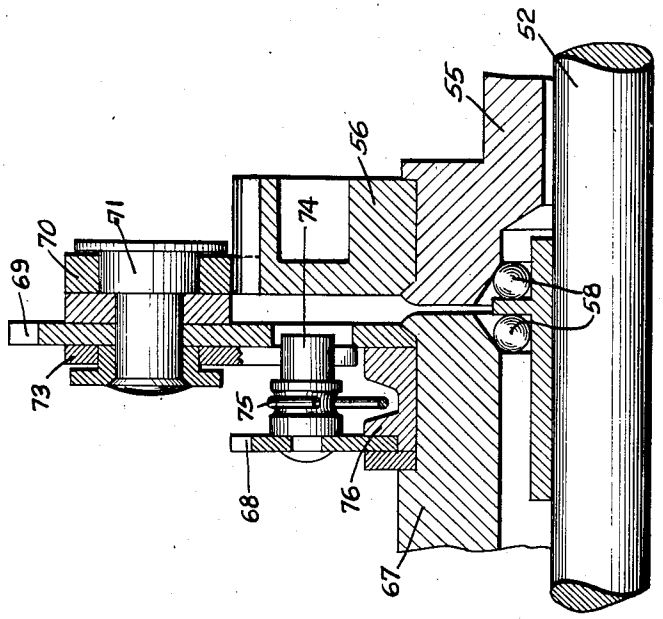


FIG. 13.



INVENTOR
Ronald D. Dodge
BY
W. M. Gibson
ATTORNEY

Patented Oct. 8, 1940

2,217,159

UNITED STATES PATENT OFFICE

2,217,159

TYPEWRITING MACHINE

Ronald D. Dodge, Rochester, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application July 2, 1938, Serial No. 217,204

11 Claims. (Cl. 197—84)

This invention relates to typewriting machines and more particularly to improvements in variable spacing typewriters such as the machine disclosed in application Serial No. 148,270, filed June 15, 1937 by Ronald D. Dodge.

In the foregoing Dodge application there is disclosed and claimed a power-operated typewriting machine having variable spacing mechanism by means of which the carriage of the machine is spaced distances proportional to the widths of the characters typed. There is provided a multiple escapement mechanism and selector mechanism for controlling the multiple escapement mechanism to vary the feed of the carriage in accordance with the widths of the upper case characters as well as the lower case characters whereby capital letters and other characters printed by means of a shift movement of the type basket are spaced commensurately with the widths. An indicator is also disclosed in said application to facilitate the production of justified copy, i. e., copy in which the right hand margin is even. This machine was designed primarily for use in the photo-offset and similar processes of lithography wherein printing plates are made from typewritten copy by employing photography.

In the preparation of typewritten copy for the photo-offset and other lithographic process there are occasions when it is desirable to space the printed characters of certain words somewhat more than the bulk of an article or other printed matter. For instance, it is often desirable at the head of a column to capitalize and expand one or more of the opening words for purposes of emphasis or display. In the case of titles, subtitles, headlines, and sub-headlines, and so on, it is often desirable to expand the words either for purposes of emphasis or to expand sub-titles or headlines to make the lines more uniform, hence, more attractive. This result, of course, can be obtained in a crude way in an ordinary typewriting machine by operating the space bar after each character is printed but this produces an inartistic effect as the letters are then spaced too far apart for good appearance.

The present invention has for its primary object to provide an improvement in typewriting machines of the variable spacing type, in which the characters are spaced according to their widths, to permit increasing the spacing of the characters at will for the purpose of extending a word or line for purposes of artisticness, emphasis, justification, or to make a word or line conform as close as possible to some standard of length.

An object is to provide a variable spacing typewriter with a manual device for controlling the escapement or carriage feed mechanism in such fashion as to modify the normal spacing, as for example, to expand a word or line.

While the invention described hereinafter has been designed to cause an increase in the spacing of characters, that is, to effect expansion of words or lines, it may, by merely rearranging the lugs on the selector bars, be adapted to condensing lines, or to either expanding or condensing lines at will.

Further objects of the instant invention reside in any novel feature of construction or operation or novel combination of parts present in the embodiment of the invention described and shown in the accompanying drawings whether within or without the scope of the appended claims and irrespective of other specific statements as to the scope of the invention contained herein.

In the drawings:

Fig. 1 is a vertical section of a power operated typewriter embodying the present invention.

Fig. 2 is a large scale vertical section showing the shift mechanism.

Fig. 3 is a large scale plan view of the escapement mechanism.

Fig. 4 is a large scale vertical section on the line 4—4 in Fig. 2.

Fig. 5 is a large scale view of the selector mechanism and shows the position of the parts for normal spacing of upper case characters.

Fig. 6 is a view similar to Fig. 5 but shows the position of the parts when lower case characters are to be typed with increased spacing.

Fig. 7 is a view similar to Fig. 5 but with the parts in position to cause the upper case characters to be typed with expanded spacing.

Fig. 8 is a plan view of the indicator mechanism.

Fig. 9 is a front elevation of the indicator.

Fig. 10 is a vertical section on the line 10—10 in Fig. 9.

Fig. 11 is a detail view of the right hand marginal stop.

Fig. 12 is a large scale detail view of part of the carriage release mechanism.

Fig. 13 is a section on the line 13—13 in Fig. 12.

Fig. 14 is a view of the lever to adjust the spacing mechanism.

The drawings illustrate the present invention as applied to the "International" electric writing machine formerly known as the "Electromatic." However, it will be understood that the invention is not limited in application to the specific ma-

chine selected for purposes of illustration but may be applied to other typewriters equally as well, whether manually or power operated. Since the "International" electric writing machine is now well known in the art and fully described in patents covering the various mechanisms comprising this machine, only a very brief general description will be given of the machine such as will enable the present invention to be readily understood.

The numeral 10 (Fig. 1) designates the usual character keys on key levers 11 pivoted on a rod 12 which is supported by a cross frame 13 rigidly mounted in the base 14. Rotatably mounted in the base 14 is the power roller 15 which is rotated in the direction of the arrow (Fig. 1) by means of a suitable motor, not shown. When the machine is in use the power roller 15 rotates continually.

Cooperating with the power roller 15 are the cam units 16 which are pivotally mounted on rods 17 extending parallel with the power roller 15. There is a cam unit 16 associated with each of the key levers 11 and each cam unit is connected by a link 18 with a sub-lever 19 pivoted on rod 12. The sub-levers 19 are connected by links 20 to type bars 21 through the medium of toggles 22. The type bars 21 are pivoted in the usual wire segment 23 provided with a type guide 24 located in front of the platen 25. The platen is, as usual, rotatably mounted in the carriage 26 which is supported on front and rear rails 27 and 28, respectively, by means of suitable anti-friction roller trucks. Springs 29 connected to a curved spring anchoring member 30 and to toggles 22 provide means for restoring the toggles and type bars to the normal position shown in Fig. 1.

When any character key 10 (Fig. 1) is depressed, its cam unit 16 is caused to operatively engage the power roller 15 in a well known way thereby rocking the cam unit 16 clockwise or counterclockwise, according to whether the operative cam unit is pivoted on the left hand or right hand rod 17, respectively. The rocking of the cam unit causes its link 18 to be drawn downwardly, thereby rocking the corresponding sub-lever 19 in a clockwise direction. This movement of the sub-lever 19, through the corresponding link 20 and toggle 22, causes the type bar 21 associated with the selected key to rock in a counterclockwise direction to effect the impression of the type upon a work sheet wrapped around the platen 25. The type bar, near the end of its operative stroke, engages the usual universal bar 31 and causes the universal bar to move rearwardly and downwardly in Fig. 1.

The segment 23 is mounted in a frame 32 which forms part of the type basket. The type basket is movably mounted in the framework of the machine for case shifting movement in a well known way and normally occupies an elevated position shown in Figs. 1 and 2 for the typing of the lower case characters. The shift mechanism for drawing the type basket 32 downwardly to permit the printing of capital letters is described in Patent No. 1,945,097 and is partly shown in Fig. 2.

Secured to the back of the type backet frame 32 (Fig. 2) is a pair of brackets like 33 connected by toggle links 34 to the arms of toggle levers 35 secured on the ends of a shaft 36 journalled in the framework of the machine. Pivoted on a stud 37 is a three-armed lever 38 having two pins 38a, 38b engageable by the short arms of a T-shaped lever 39 which is pivotally connected at 40 to one arm of a three-armed lever 41. The latter is pivoted on a stud 41a carried by a fixed part of the framework and a spring 41b holds a bent-over lug on one arm of the lever against a stud 41c carried by the framework acting as a stop. The lever 38 is connected by a link 42 to one arm of one of the toggle levers 35. The T lever 39 has a stud 43 projecting into a slot formed in an arm 44 formed as an extension of one of the shift key levers. One arm of lever 41 has a link connection 45 to a cam unit, not shown, which is controlled by one of the shift keys, also not shown.

When the shift key is depressed the left hand end of the T lever 39 is elevated to bring one of the short arms thereof to a position to the left of the pin 38a, this movement taking place before the cam unit controlled by the shift key is operatively connected to the power roller 15. When the cam unit controlled by the shift key is operated by the power roller 15, the link 45 is drawn downwardly thereby rocking lever 41 in a clockwise direction on stud 41a against the tension of spring 41b. This draws the T-lever 39 to the right in Fig. 2, thereby, through the engagement of said T-lever with the pin 38a, rocking the lever 38 clockwise. Through the link connection 42, the toggle levers 35 and shaft 36 are rocked in a counterclockwise direction, thereby bending the toggles comprising the links 34 and the arms of levers 35 and causing the type basket to be drawn downwardly.

The mechanism briefly described above is old and well known in the art.

The escapement mechanism is mounted in a frame casting 46 which is secured to the undersides of the front and rear rails 27, 28 (Figs. 1 to 4). The frame 46 is formed with two parallel struts 46a (see Fig. 3) which support the escapement ratchets which are designated 48, 49, and 50. Externally threaded sleeves like 51 are loose in aligned holes in the struts 46a and support the rod 52 on which the ratchets 48, 49, and 50 are rotatably mounted. Abutting the end of each sleeve 51 is a thrust washer 53 alongside of which are located the balls 54 of a combination axial and radial thrust bearing of which the outer ball race 55a is integral with a helical pinion 55 secured to a ratchet 56. The pinion 55 meshes constantly with a rack 57 (Figs. 1 and 3) which is secured to the underside of the carriage 26.

The rear end of the pinion 55 is formed as a ball race (see Fig. 13) in cooperation with balls 58 whereby the pinion 55 and ratchet 56 rotate freely on the rod 52. The latter is relatively fixed in the framework by means of a set screw 59 (Fig. 3) which projects through a slot in the rear sleeve 51. A similar thrust washer like 53 abuts the end of the rear sleeve 51 to retain balls which freely rotatably mount one end of the hub of ratchet 48 for rotation on the rod 52.

The hub of ratchet 48 is integral with a pinion 60 (Figs. 1 and 3) located adjacent the hub of the ratchet 49. The pinion 60 meshes with one of a pair of intermeshing pinions 61 rotatably mounted on brackets 62 carried by the ratchet wheel 49 while the other pinion 61 meshes with a pinion 63 which is secured to a pinion 64. The latter meshes with one of a pair of intermeshing pinions 65 like pinions 61 and mounted on brackets 66 carried by ratchet wheel 50, while the other pinion 65 meshes with a pinion 67.

Rotatably mounted on the pinion 67 is a ratchet wheel 68 (Figs. 3 and 13) which is of

the same diameter as the ratchet 56 while secured to the pinion 67 is a ratchet 69 which is considerably larger in diameter than the ratchets 56, 68. The ratchets 56 and 69 are normally connected for driving purposes by means best shown in Figs. 12 and 13 comprising a dog 70 pivoted on a stud 71 fixedly mounted on the ratchet wheel 69. The dog 70 normally engages the teeth of the ratchet wheel 56 whereby the ratchet wheel 69 will be rotated in a counterclockwise direction (Fig. 12) whenever the ratchet wheel 56 is similarly rotated by letter spacing movement of the carriage. The dog 70 is slotted to embrace a stud 72 carried by a member 73 also pivotally mounted on the stud 71. The member 73 has a lug engaging a stud 74 secured to the side of ratchet wheel 68. A torsion spring 75, hooked over the end of stud 74 and lying in a groove formed in a collar 76 on the pinion 67 and also anchored to a stud 77 on ratchet 69, normally tends to rotate the ratchet 68 in a counterclockwise direction (Fig. 12). A spring 75a, anchored to studs 72 and 77, holds the end of dog 70 in engagement with the teeth of ratchet 56.

Movement of the carriage is effected, as usual in typewriting machines, by means of a spring drum 78 partly shown in Fig. 3 on which drum is wound the tape 79. The latter passes over a pulley 80 mounted on the rear rail 28 and thence to the right hand end of the rack 57 at which point the tape 79 is secured to the rack. Due to the constant tension produced in the tape 79 by the spring drum 78, the carriage 26 tends to move to the left with reference to Fig. 3. Thus the ratchet 56 always tends to rotate the ratchet 69 and pinion 67 in a counterclockwise direction (Fig. 12). This rotational tendency of the pinion 67 is communicated to the ratchet wheels 48, 49, and 50 (Fig. 3) through the train of connections comprising the pinions 60, 61, 63, 64, 65. Normally, however, this rotational tendency has no effect so far as movement of the carriage is concerned, because the ratchet wheels 48, 49, and 50 are restrained from rotation by means of the loose dogs 81 (Fig. 4) of the escapement mechanism.

Reverse rotation of the ratchet 69 and pinion 67 is prevented by means of a dog 82 (Fig. 3) pivoted on a stud 83 carried by a plate 84 which is adjustably secured to the rear rail 28. The dog 82 is normally held in engagement with ratchet 69 by a spring 86.

The ratchet wheels 48, 49, and 50 have 27, 36, and 27 teeth, respectively, whereby the amount of feeding movement imparted to the carriage may be varied. Due to the method of interconnecting the ratchet wheels by means of intermeshing pinions, the ratchet wheels 48 and 50 rotate in a direction opposite to the ratchet 49. Assuming for the moment that the ratchet wheels 48 and 49 (Fig. 3) are fixed and immovable, the pinion 64 will be locked against rotation, therefore, if ratchet wheel 50 is now permitted to rotate one tooth space, one of the pinions 65 will roll around said pinion 64 and, by rotating the other pinion 65, will permit the pinion 67 to rotate in the same direction as the ratchet wheel 50 but twice as much as ratchet wheel 50. Similarly, if the ratchet wheels 48 and 50 are locked and the ratchet wheel 49 is permitted to move, one of the pinions 61 will roll around the pinion 60 and cause pinions 63, 64 to be rotated. The rotation of pinion 64 is communicated to pinion 67 through the intermeshing pinions 65. As in the case of ratchet wheel 50, pinion 67 rotates twice as much as ratchet wheel 49. However, when the ratchet wheels 49 and 50 are held and ratchet wheel 48 rotates, the same amount of movement will be communicated from the ratchet wheel 48 to the ratchet wheel 67 through the pinions 61, 63, 64, 65 acting as idlers. It is possible, however, to permit the ratchet wheels 48, 49, and 50 to rotate in combinations to produce an accumulative effect upon the pinion 55 which, of course, will permit the carriage to move correspondingly.

Since the ratchet wheel 48 has twenty-seven teeth, the pinion 67, and hence the pinion 55, will be rotated $\frac{1}{27}$ of a revolution whenever the ratchet wheel 48 rotates one tooth space. On the other hand, since the movement of the pinion 67 is twice that of the ratchet wheel 49 and the latter has thirty-six teeth, the pinions 67 and 55 will be rotated the equivalent of $\frac{1}{18}$ of a revolution of the ratchet wheel 49. Likewise, the ratchet wheel 50 having twenty-seven teeth, pinions 67 and 55 will be rotated $\frac{2}{27}$ of a revolution of the ratchet wheel 50. Reducing these fractions to a common denominator of 54, it will be seen that the movements of pinions 67 and 55 produced by the ratchet wheels 48, 49, 50 are $\frac{2}{54}$, $\frac{3}{54}$ and $\frac{4}{54}$ of a revolution, respectively, per tooth space on the respective ratchet wheels. The gearing is so designed and the spacing of the teeth on their ratchet wheels has been so selected that ratchet wheel 48 causes the carriage to move two units of spacing, ratchet wheel 49 three units of spacing, and ratchet wheel 50 four units of spacing.

It is thus possible to secure 7 different spacings of the carriage which, in terms to units of carriage spacing, are as follows: 2, 3, 4, 5, 6, 7, 9. Thus the spacing of the carriage can be accommodated to seven different widths of letters if necessary. The means by which the escapement wheels 48, 49, 50 are selectively controlled will be described in the following paragraphs.

The rotation of the escapement ratchet wheels 48, 49, 50 is controlled by means of three dog rocker mechanisms which are selectively controlled by power operated selecting mechanism. Fig. 4 shows the dog rocker mechanism for the ratchet wheel 49. Each dog rocker mechanism includes a dog rocker plate 106 which is pivotally mounted on vertically aligned conical studs 107 screwed into threaded holes in two parallel and horizontal portions 46b of the frame 46. The conical points of the studs are seated in conical holes in lugs formed in the dog rocker plate 106. Pivoted on a shoulder on a stud 108 carried by the rocker plate 106 is the usual loose escapement dog 81, mentioned hereinbefore, which is actuated by a spring 109 so as to be urged in a counterclockwise direction (Fig. 4). The left hand end of the dog 81, engaging one of the teeth of the ratchet 49, however, is held in the position of Fig. 4 owing to the tension of the spring drum 78 (Fig. 3) being greater than the tension of the spring 109 (Fig. 4) whereby the dog 81 is forced against a resilient stop 110a mounted on an arm 111 which is rotatably secured to the side of the rocker plate 106 by means of the stud 108. The shoulder on stud 108, on which the dog 81 is loose, permits the arm 111 to be secured to the plate 106 without binding the dog. The upper left hand portion of the arm 111 is provided with a bent-over lug against which bears an adjusting screw 112 carried by a lug formed in the rocker plate 106. By turning the screw 112 in one direction or an-

other, the arm 111 may be rotatably adjusted about the stud 108 as a pivot. The dog rocker plate 106 (Fig. 3) is provided with a lug 106a which is substantially in horizontal alignment with the left end of the dog 81 but does not normally engage the teeth of the ratchet wheel 49.

When the rocker plate 106 is rocked in a counterclockwise direction (Fig. 3), the lug 106a is moved into the tooth space occupied by the dog 81 before said dog is moved free of the ratchet wheel 49 whereby when the dog ultimately clears the teeth of the ratchet wheel 49, the latter is permitted to rotate counterclockwise a fraction of a tooth space in Fig. 4. The spring 109 then rocks the dog 81 in a counterclockwise direction until said dog strikes a resilient stop 110b mounted on the arm 111. The stops 110a, 110b on arm 111 are so spaced that the end of dog 81 assumes a position in horizontal alignment with the next lower tooth space of ratchet wheel 49.

When the plate 106 is restored to the position of Fig. 3, the end of dog 81 is moved into the path of the next lower tooth on ratchet wheel 49 before the lug 106a clears the teeth in ratchet 49. When the lug 106a finally clears the teeth in the ratchet 49, the latter will be permitted to rotate in a counterclockwise direction (Fig. 4) the remainder of a tooth space, thereby bringing the end of dog 81 back against the resilient stop 110a. Thus, by giving the plate 106 one complete oscillation the escapement ratchet 49 is permitted to turn one full tooth space.

The rocker plate 106 (Figs. 3 and 4) is formed with a lug 114 which extends between two resilient stops 115a, 115b mounted on arms 116a, 116b, respectively, which arms are adjustably pivoted in scissors fashion on one of the conical studs 107. The stops 115a, 115b, being located on opposite sides of the lug 114, adjustably limit the oscillatory movements of the plate 106 on the studs 107 as pivots. Plates 116a, 116b are secured to frame 46 by means of bolts 116c.

Similar mechanism is provided for the other two ratchet wheels 48, 50 but, owing to the fact that these two ratchet wheels rotate in a direction opposite to the ratchet wheel 49, the rocker plates 106 for the ratchet wheels 48, 50 are in effect inverted. Normally, the plates 106 are held by springs 117 with their lugs 114 abutting the stops 115a, as best shown in Fig. 3, with all of the dogs 81 engaging the teeth of their respective ratchets. Springs 117 are anchored to lugs formed in plates 106 and to a bracket secured to frame 46.

The rocker plates 106 are selectively and combinationally operated through power operated mechanism controlled by the keys 10 which selecting mechanism now will be described.

Rigidly mounted on brackets 118 (Figs. 1 and 2) secured to the lower edges of the sides of the base 14 is a rod 119 which is steadied at its midpoint by extending through a slot in a bracket 120 secured to the frame 121 which supports the case shift mechanism and the type basket by means not shown. Pivotally mounted on the rod 119 are selector bars 122 which extend forwardly and horizontally to points underneath the cam units 16. There is a selector bar 122 for each cam unit 16 and its key. Since the cam units 16 are arranged in two rows on opposite sides of the power roller 15, the bars 122 are made in two lengths which alternate on the rod 119, the shorter bars 122 being interspersed with the longer bars. Each of the selector bars 122 has a link connection 123 with an extension 124 formed as part of one of the side frames supporting the cams and release mechanism of the cam units 16. Thus, whenever a cam unit is operated in consequence of the depression of any key 10, one of the selector bars 122 (Figs. 1 and 4) is rocked in a counterclockwise direction.

The selector bars 122 are provided with one or more lugs like 122a in one or more of twelve possible positions as shown in Figs. 2 and 5 to 7, inclusive. Each lug is designed to be engageable under certain circumstances with one of three bails which selectively control the operation of the escapement mechanism. Each bail comprises a tube 125 mounted on side arms 126 (Figs. 1, 2, and 5 to 7) which are pivotally mounted on studs 127. These studs are carried by arms 128 the hubs of which are rigidly mounted on and near the ends of a shaft 129. This shaft is rotatably mounted on arms 130a secured to a shaft 130 (Figs. 2 and 5 to 7). The shaft 130 is rotatably mounted in the base 14 of the machine. The lugs 122a are so disposed along the length of the selector bars 122 that one or more of the bails comprising tubes 125 and arms 126 will be rocked counterclockwise about studs 127 as a pivot whenever the bars 122 are operated in consequence of the depression of a key 10.

The bars 122 are guided near the mid-points of the longer bars and adjacent the ends of the shorter bars by means of a comb 131 which is secured to the lower edges of the base 14. Adjacent the rod 119, the bars 122 are guided by a comb 132 which is formed with side arms 132a attached to hubs fixedly mounted on the rod 119. Pivotally mounted on the rod 119 near the center of the machine are three levers 133, 134, 135 which extend forwardly or to the right (Figs. 2 and 5 to 7) to overlie the tubes 125. The levers 134, 135 are curved downwardly at their forward ends whereby lever 134 may be operated only by the central tube 125 and the lever 135 only by the right hand tube 125. The right hand end of the lever 133 is straight and is operated only by the left hand rod tube. It will be seen that each time one of the selector bars 122 is rocked in a counterclockwise direction (Fig. 2) one or more of the levers 133, 134, 135 will be similarly rocked about rod 119 as a pivot.

The clockwise restoring movement of the bails including the tubes 125 and arms 126 is limited by means of two brackets like 136 (Figs. 1, 2, and 5) secured to the inside faces of the base 14. Each bracket 136 extends horizontally underneath the arms 126 and is provided with a resilient facing 138 of material such as leather and each of the arms 126 rests on the top surface of the adjacent resilient facing 138. The tubes 125 are held upwardly slightly clear of the lugs 122a by the resilient facings 138 whereby the clicking noise which would result if arms 126 were to directly strike the brackets 136 is silenced.

Each of the levers 133, 134, 135 (Fig. 2) extends rearwardly or to the left of the rod 119 and these levers support arms 139, 140, 141 (see Fig. 4 also) which are pivoted on studs 142 carried by the levers 133, 134, 135, respectively. Each of the arms 139, 140, 141 has a bent-over lug 143 which cooperates with the upper edge of the rear end of the corresponding lever 133, 134, 135 and these lugs are normally held in contact with said levers by means of torsion springs 144 interposed between pins carried by the arms 139, 140, 141 and pins carried by the levers 133, 134, 135. The levers are urged in a clockwise direction by means of springs 145 anchored to pins carried by said

levers and ear formed in bracket 120. The arms 139, 140, 141 have link connections 146 to arms 147, 148, 149, respectively, (Figs. 3 and 4) which are pivotally mounted on the front sides of the rocker plates 106 of the several escapements. It is evident that when one or more of the levers 134, 135, 136 is rocked in a counterclockwise direction (Fig. 2) one or more of the links 146 will be drawn downwardly thereby rocking the corresponding arms 147, 148, 149 downwardly, or clockwise in Fig. 4, which shows only the arm 148 for the middle escapement mechanism.

Secured to the rear end of frame 46 (Figs. 2 and 3) is a bracket 150 having a horizontal slot into which extends a stud 151 on a bar 152. This bar at its forward end is pivotally connected to one arm of a bell crank 153 pivotally mounted on a bracket 153a secured to frame 46. The bell crank 153 has a link connection 154 to the movable frame including the universal bar 31. A spring 155, anchored to a pin carried by the bar 152 and to a pin carried by the bracket 150 holds the bar 152 in the rearward or retracted position shown in Figs. 2 and 3. In order to permit the bar 152 to move to the right in Fig. 2, or forwardly in Fig. 3, independently of the universal bar 31, the link 154 has a slotted connection to the universal bar frame. The bar 152 through most of its length is L-shaped in vertical section and on the top surface of the horizontal portion of said bar there is secured three screw studs 156 located in the rear of and slightly below (see Fig. 4 also) the ends of the arms 147, 148, 149, respectively, whereby the bar 152, if operated alone, will not affect any of the arms 147, 148, 149.

With the bails comprising tubes 125 and arms 126 in the position shown in Figs. 1 and 2, depression of any key 10 causes the corresponding cam unit 16 to be rocked by the power roller 15 in a clockwise or counterclockwise direction, according to whether the operative cam unit is in the left hand or right hand row, respectively, thereby rocking the corresponding bar 122 in a counterclockwise direction and at the same time operating the corresponding type bar 21. Through the intermediary of one or more of the lugs 122a in positions 3, 7, and 11, the bar 122 which corresponds to the key depressed will be rocked in a counterclockwise direction thereby similarly rotating one or more of the bails comprising the tubes 125 and arms 126. One or more of the levers 133, 134, 135 and their corresponding arms 139, 140, 141 will be rocked in the same direction thereby, through links 146, rocking the corresponding arms 147, 148, 149 downwardly or clockwise in Fig. 4. The operated arms 147, 148 or 149 are then brought into the path of movement of the studs 156, this operation taking place before the operated type bar strikes the universal bar 31. For example, the bar 122 for the "A" key 10, shown in front in Fig. 2, has a lug 122a in position 11 whereby only the lever 133, arm 139, and arm 147 are operated with the parts in the positions shown in Fig. 2.

When the type bar ultimately strikes the universal bar 31, the latter is moved rearwardly or to the left in Fig. 2 thereby, through the link 154, rocking the bell crank 153 clockwise. This results in the bar 152 moving forwardly (Fig. 3) or to the right (Fig. 2). Those of the arms 147, 148, 149 which have been drawn downwardly will be engaged by the corresponding studs 156 and, as a result, the rocker plates 106 connected to said arms will be rocked counterclockwise in Fig. 3.

Upon the restoration of the type bar, the bar 152 is restored by spring 155 to the position of Figs. 2 and 3, this operation taking place during the first part of the restoring movement of the type bar and is completed by the time the type bar has receded a short distance from the printing point. With continued restoring movement of the type bar, the bails comprising tubes 125 and arms 126 and the operated levers and arms 133, 134, 135 and 139, 140, 141, respectively, will be restored to the position of Fig. 2 thereby restoring the operated arms 147, 148, 149 to the position shown in Fig. 4. It will thus be seen that one or more of the escapement ratchets 148, 149, 150 will be operated each time a type bar 21 is operated with the result that the carriage will be permitted to move a distance depending upon the spacing of the teeth in the operative escapement ratchets 48, 49, 50.

The description up to the present time has assumed that the type basket is in elevated position to cause the lower case characters to be printed. Many of the upper case letters of the alphabet are considerably wider than the corresponding lower case letters, particularly when type faces like those used in the printing of newspapers and books is employed. Thus, the upper case "L" is considerably wider than the lower case "l." In order to take care of these differences in width between the upper and lower case characters, means is provided to shift the bails comprising the tubes 125 and arms 126 rearwardly of the machine or to the left in Figs. 1 and 2 to cause the tubes 125 to register with such lugs 122a as may be in positions 1, 5, and 9 on selector bars 122 as shown in Fig. 5.

An arm 157 (Fig. 2) is secured to the shaft 129 and has a link connection 158 to an arm 159 secured to the shaft 36 which it will be recalled is rocked counterclockwise each time the type basket 32 is drawn downwardly to the upper case position. Whenever the type basket is shifted to the upper case position, arm 159 is rocked counterclockwise thereby, through the link 158, rocking arm 157, the shaft 129, and the arms 128 in a clockwise direction. The bails comprising tubes 125 and arms 126 are thus drawn rearwardly, or to the left in Fig. 2, to re-position the rods to register with lugs 122a, 122c, 122e. In most cases the spacing of the characters is increased when the upper case characters are printed. However, this may not be invariably the case as the extreme left hand or rear row of keys (Fig. 1) often contains combinations of characters such as parentheses and numerals which may require that the spacing be reduced for the characters printed with an accompanying upper case shift movement.

The space bar 10b controls a cam unit 16b (Fig. 1). This cam unit, through a link like 18a, operates a lever like 160 and a link like 161 (Figs. 3 and 4) connected to an arm 171 secured to a shaft 172 (see Fig. 2 also) which is rotatably mounted in frame 121. The lever 160 and link 161 shown in Fig. 1 actually operates the back space mechanism (not shown) controlled by the back space key 10a. The connections for the space cam unit 16b are the same. Also secured to shaft 172 is an arm 173 (see Fig. 4 also) which extends upwardly to one side of the plane of the lever 153 and has a pin 174 extending into the plane of lever 153. A spring 175 connected to the arm 173 and to a fixed part of the frame-

work, holds the lever 173 in the position of Fig. 2. When the space bar 10b is depressed, its cam unit 16b causes the lever 160 to which the link 161 is connected to rotate in a clockwise direction, thereby drawing link 161 toward the front of the machine in consequence of which the arm 173 is rocked counterclockwise in Fig. 2 to first bring pin 174 in engagement with lever 153 and thereafter rock said lever in a clockwise direction. This causes the bar 152 to move to the right (Fig. 4). There is a selector bar 122b (Fig. 2) associated with the space bar cam unit 16b and this selector bar operates the bail 125—126 which controls the arm 147 causing the latter to be drawn downwardly. It will be noted in Fig. 2 that the pin 174 under normal conditions is located far enough away from the lever 153 to allow ample time for the arm 147 to be drawn downwardly into the path of the associated stud 156 before bar 152 moves.

In order to effect the expansion of words, there is secured upon the shaft 130 an arm 176 (Figs. 2 and 14) by means of which said shaft may be rotated in a counter-clockwise direction (Fig. 2). The shaft 130 extends through a hole in the base 14 on the right side thereof, as one faces the keyboard, whereby the lever 176 will be easily within reach of the operator's right hand. Secured to the side of the base 14 is a plate 177 having two bent-over lugs 177a, 177b, which limit the rocking movements of lever 176 and shaft 130. A toggle spring 178, hooked around pins carried by lever 176 and the plate 177, respectively, is operative to hold the lever 176 in engagement with one or the other of lugs 177a, 177b. The alternate positions of the lever 176 are designated in Fig. 14 by the captions "Normal" and "Expand."

When the lever 176 is in engagement with lugs 177a, the bails comprising tubes 125 and arms 126 will take the position shown in Fig. 2 in which the tubes 125 are in registry with the lugs 122a in the positons 3, 7, and 11 for the lower case characters. The tubes 125 will be brought into cooperation with the lugs in positions 1, 5, and 9 when the type basket is shifted to upper case position as shown in Fig. 5. When the machine is operated with lever 176 in the "Normal" position, the characters will be variably spaced on the work sheet exactly as in the case of the machine disclosed in the Dodge application, i. e., the characters will be printed as close together as is consistent with good appearance and legibility.

When the lever 176 is shifted to the "Expand" position (Fig. 14) so as to engage lug 177b, shaft 130 will be rocked counterclockwise (Fig. 2) approximately 30° thereby re-positioning the bails comprising tubes 125 and arms 126 to cooperate with lugs in the positions 4, 8, and 12, as in Fig. 6, or the positions 2, 6, and 10, as in Fig. 7, on the selector bars 122 according to whether the type basket is positioned to print the lower case characters or the upper case characters. The lugs on the selector bails 122 are so disposed that every character will receive an additional spacing when the lever 176 is set in the "Expand" position. For instance, the letter "A," instead of receiving the normal four units of spacing in the lower case, will receive five units of spacing. When the upper case "A" is printed, instead of being spaced five units, the normal spacing, it would be spaced six units. Similarly, the other characters may be expanded by one or more units according to their widths. This relatively small increase of spacing is not enough to make the words look unnatural yet is enough for purposes of emphasis or display.

In order to permit justification to be accomplished, an improved justification indicator is provided for measuring and indicating the amount each line is typed short of or beyond the right hand margin. This indicator is shown in Figs. 8 to 11, inclusive. Secured to the front cover plate 190 (Figs. 1, 8 to 10) is a semi-circular dial plate 191 which is spaced from the cover plate by means of blocks 192. The dial plate 191 has its outer edge graduated at intervals equivalent to one unit of spacing, i. e., the theoretical unit of the carriage. In the machine disclosed herein the unit of feed movement of the carriage is .022" although the smallest feed which it is possible to obtain is two units or .044". The dial 191 has an arbitrary zero mark which corresponds to the desired right hand marginal position of the carriage. Secured in a hole in the dial plate 191 is a ball race 193 in which is rotatably mounted on bails 194 a stub shaft 195. A washer 195a and lock nut 195b on a threaded portion of shaft 195 hold the stub shaft and balls 194 in their proper relation.

Integral with the stub shaft 195 is a pointer 196 and a gear 197. The pointer 196 is located behind the dial plate 191 in the space between the dial plate and front cover plate 190. When the carriage is in the right hand marginal position the pointer extends directly upwardly to a point above the upper edge of the dial printing where the pointer is bent U-shaped so as to have a downwardly projecting portion 196a in the plane of the dial plate, but not quite touching the edge thereof. In this position the pointer coincides with the zero mark on the dial. By constructing the dial plate and pointer in this fashion the effect of parallax is avoided.

Secured on the front plate 190 is a stud 198 on which is rotatably mounted, by means of balls 199, a hub 200 constructed somewhat similarly to the ball race 193. The stud 198 has a shoulder 198a which retains the right hand row of balls 199, while a washer 201 on the stud 198 retains the left hand row of balls 199. Two lock nuts 202, on a threaded portion of the stud 198, in cooperation with the washer 201, prevents the hub 200 from slipping off the end of stud 198. Secured to the hub 200 is a gear sector 203 meshing with the gear 197.

The gear sector 203 is operated by the carriage in its movement through a train of connections to the right hand marginal stop which is designated 204 in Figs. 1, 8, and 11. The marginal stop 204 is adjustably mounted on the marginal stop rack 205 which is secured in the carriage end plates 26.

A square rod 206 (Figs. 1, 8, and 11) is slidably mounted in square holes in brackets 207 secured to the rear rail 28. Rigidly mounted on the right hand end of the rod 206 is a plate 208 projecting upwardly into the path of the right hand marginal stop 204. The left hand end of the rod 206 is flattened at 206a to provide a relatively broad, but thin, bearing shaped like the blade of a hatchet, engaging a pin 209a on an arm 209 secured to a shaft 210. This shaft is journaled in brackets 211, 212 secured to the underside of the rear rail 28 and the frame 13, respectively. Secured to the forward end of the shaft 210 is an arm 213 connected by a link 214 to the gear sector 203.

With reference to Fig. 8, it is evident that during the movement of the carriage to the left to

type a line, the right hand marginal stop **204** will strike plate **208** and move rod **206** to the left with the carriage. Through the train of connections including arm **209**, shaft **210**, arm **213**, and link **214**, the gear sector **203** will be rocked counterclockwise (Fig. 9) thereby rotating the indicator pointer **196** clockwise in that figure. The pointer starts to turn when the carriage is thirty units short of the right hand marginal position, that is, within .66" of the right hand marginal position. This is, of course, arbitrary as the unit of spacing, the point of becoming operative of the indicator, and the number of scale divisions may be changed as desired.

Clockwise rotation of the pointer **196** by the carriage in its letter spacing movement is resisted by a spiral spring **215** (see Figs. 8 and 10 also) anchored to the gear **197** to a bracket **216** secured to the rear face of plate **190**. This spring restores the pointer when the carriage is returned and holds the pointer **196** against the left hand spacer block **191** (Fig. 9) when the carriage is more than thirty units away from the position denoted by the "0" mark on dial **191**. Spring **215** also restores the train of mechanism between the marginal stop **204** and the pointer **196**.

The typist will, in making the preliminary draft of the matter to be justified, set the marginal stops so that the left hand marginal stop is exactly in the left hand marginal position, while the right hand stop is set as near to ten units of spacing to the right of the desired right hand marginal position as the relatively coarse teeth on the marginal stop rack will permit. The typist now types the first line, taking pains to terminate the first line as close as possible to the position of the carriage corresponding to the zero mark on dial **191**. At the end of the line, the typist notes the reading of the indicator and types on the same line the number of units the carriage is short of, or typed beyond, the marginal position. The same procedure is followed for subsequent lines, in each case the typist taking pains to terminate the line as close as possible to the margin. The numbers typed at the end of each line are subsequently used to justify the lines by increasing the spacing between words if the line is short, or decreasing the spacing if the line is too long.

The space bar **10b**, through its selector bar **122**, causes the carriage to be spaced four units or .088" for each depression thereof. The back space mechanism, not here described, causes the carriage to be back spaced only one unit, as in the Dodge application. This makes it possible to vary the spacing between words by small amounts, more or less, than the normal amount of four spaces, by manipulating the space bar **10b** and the back space key **10a** (Fig. 1) in various combinations. Thus, if a line is found to terminate three units short of the margin, a unit can be added to the three spaces between the first four words, in retyping the draft, by operating the space bar twice and the back space key three times for each original space. This causes the first four words to be spaced from each other by five units instead of four. The remainder of the line is typed with normal spacing, thereby producing a justified line which terminates at the desired marginal position, namely, the zero position of scale **191**.

While the primary purpose of the control effected by the lever **176** is to expand words for display, or decorative purposes, this control may be used for the purpose of producing justified copy, since the effect produced by the selecting mechanism controlled by the keys is to increase the spacing of each character by one unit when the lever is in "Expand" position. All the operator has to do is to note at the end of each line, in writing the first draft, the number of units each typed line is short of the marginal position. In retyping the draft, the lever **176** may be set to "Expand" and the first few words of the line retyped with increased spacing until as many key operations have been made as the number of units of spacing the line is short. Thus, if the original draft shows the line to be ten units short, in retyping the draft, the first ten key operations may be made with lever **176** in "Expand" position. Preferably this should be done near the middle of a line in order that the increased spacing of certain words will be less noticeable.

This method of justification is superior to the practice of increasing the spacing of uniformly spaced characters, now commonly found in commercial justifying typewriters as the characters are still spaced proportionately to their widths and the spacing of most characters will still be less in the aggregate than in the more common method of justifying lines of evenly spaced characters because, in a typewriter spacing the characters according to their widths, the spacing of most characters is very considerably less than the standards of one tenth of an inch for a pica machine and one twelfth for an elite machine. Thus the small letter "i" is spaced .044" or two units by the machine described herein and the addition of a unit brings this spacing to .066" which is still only two thirds of the standard pica spacing of one tenth of an inch. The letter "A," upper case, is spaced four units or .088" and the addition of a unit makes the spacing only .110" only slightly greater than pica spacing.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In a variable spacing typewriter, variable escapement mechanism, key controlled selector mechanism for selectively controlling the escapement mechanism in accordance with the widths of the lower case characters corresponding to the several keys, shift mechanism, means controlled by the shift mechanism for controlling the selector mechanism to modify the control exercised by the selector mechanism on the escapement mechanism according to the widths of the upper case characters corresponding to the several keys, and a supplemental control device for further controlling the selector mechanism to change the effect on the escapement mechanism of the selector mechanism for both the lower and upper case characters.

2. In a variable spacing typewriter, character keys, variable escapement mechanism, a series of selector bars, one for each character key, means to actuate the selector bars under control of their respective keys, escapement controlling means cooperating with the selector bars and combinationally selectively controlled by the selector bars, shift mechanism, means connected to the shift mechanism for changing the cooper-

ative relation between the selector bars and the escapement controlling means whereby to change the combinational selective control exercised by the selector bars on the escapement controlling means upon a shift operation, and separate manually controlled shifting means for further changing the combinational selective control of the escapement controlling means by the selector bars.

3. In a variable spacing typewriter, character keys, multiple escapement mechanisms, each for effecting a different value of escapement, a series of selector bars, each corresponding to and controlled by one of the character keys, each selector bar having one or more lugs in one or more of a series of positions, a series of bails cooperating with the selector bars whereby one or more of the bails is operated by each selector bar when the corresponding key is operated, connections between the bails and escapement mechanisms whereby each bail controls one of the escapement mechanisms, shift mechanism, means connected to the shift mechanism for displacing the bails relative to the bars to change the effect of the selector bars on the bails upon a shift operation, and a supplemental shift control for said bails to shift the bails into cooperation with either of two different sets of lugs on said bars according to the initial position of the bails as determined by the shift mechanism.

4. In a variable spacing typewriter, variable escapement mechanism, character keys, a type basket, case shift mechanism for the type basket; selecting mechanism controlled by the keys for selectively controlling the operation of the variable escapement mechanism, including selector bars associated with and controlled by the keys and a plurality of elements cooperating with said bars and selectively shiftable to a plurality of positions relative to the selector bars, and two escapement shift mechanisms for effecting such relative shifting movement, one of said escapement shift mechanisms being automatic and controlled by the type basket shift mechanism, the other escapement shift mechanism being manually preset and modifying the effect of the first-named escapement shift mechanism.

5. In a variable spacing typewriter, selectively operable escapement mechanism, typing means, character keys, means controlled by the keys for operating the typing means; selector means operated by the type bar operating means for selectively controlling the escapement mechanism, said selector means including a series of selector bars and a series of members extending transversely of the selector bars so as to be responsive to movement of the selector bars, each of said selector bars being adapted to operate said members singly or in combination, said bars and said members being relatively shiftable to change the effect of said bars on said members, case shift mechanism having connections to effect said relative shifting movement, and a second and separate shift mechanism for changing the relation of the bars to said members.

6. In a variable spacing typewriter, a carriage, typing means, keys for controlling the typing means, selectively operable carriage feed mechanism for feeding the carriage variable extents according to the widths of the characters typed, selecting means controlled by the keys for selectively operating the carriage feed mechanism, said selecting means being selectively settable to effect four different degrees of feed of the carriage, each degree of feed being variable according to the widths of characters typed, case shift mechanism operative to select two of the degrees of feed, and a manual control device for selecting one or the other of the remaining two degrees of feed according to the selection effected by the case shift mechanism.

7. In a variable spacing typewriter, a plurality of escapement mechanisms, each for a different spacing; character keys, selector elements controlled by the keys, a series of members cooperating with the selector elements and operable thereby in various combinations, each member having a connection to one of the escapement mechanisms to render the associated escapement mechanism operative, manual means for shifting said elements and members relative to each other to change the effect of the selector elements on said members, case shift mechanism, and means whereby the selector elements are further shifted relative to said members automatically as an incident to a case shift operation.

8. In a machine of the class described, the combination of a carriage, typing means comprising a series of type bars, a continually operating power roller common to all the type bars, cam units each connected to a type bar and adapted to be selectively engaged with the power roller to operate the type bar, keys for selectively engaging the cam units with the power roller, a series of selector bars each associated with a key and having a connection to the corresponding cam unit whereby the selector bars are operated each time the corresponding cam unit is operated, a series of escapement mechanisms with means interconnecting said escapement mechanisms and said carriage, means common to the escapement mechanisms and normally disengaged therefrom for operating said escapement mechanisms, means individual to each escapement mechanism for coupling the escapement mechanisms to the operating means, means whereby the selector bars operate the coupling means combinationally, and manual means for changing the effect of the selector bars on the coupling means.

9. In a machine of the class described, typing means, power mechanism for operating the typing means, keys for selectively controlling the power means, selector bars one for each key and having an operative connection to the power means whereby one of the selector bars is operated whenever a corresponding key is operated, multiple escapement mechanisms connected to the carriage, means operated by said selector bars for operating the multiple escapement mechanisms combinationally to vary the feed of the carriage in proportion to the width of the character corresponding to a selected key, and manual means for changing the effect of the selector bars on the last named means.

10. In a machine of the class described, the combination with a carriage, multiple escapement mechanisms operative to feed the carriage variable extents, typing means, means to operate the typing means, means to selectively control the operation of the typing means, means common to the multiple escapement mechanisms for operating said escapement mechanisms, a plurality of interponents each associated with one of the escapement mechanisms for connecting said mechanism to the common operating means, and selecting mechanism controlled by the first named selecting means for operating the interponents combinationally, and separate control

means for changing the effect of the selecting mechanism.

11. In a machine of the class described, the combination with a carriage, a series of escapement ratchets, differential gearing interconnecting said ratchets in said carriage, a plurality of dog rockers each associated with one of said ratchets and having escapement dogs, typing means, keys for controlling the typing means, a universal bar operated by the typing means, a slide common to the dog rockers and having a connection to the universal bar whereby said slide is moved longitudinally each time a character is typed; interponents, each pivotally mounted on one of said rockers and movable into engagement with said slide; selector mechanism for moving said interponents into engagement with said slide for operation thereby, power means controlled by said keys for operating the selector means each time the character is typed, and manual means for varying the effect of the selector mechanism.

RONALD D. DODGE.