

May 12, 1959

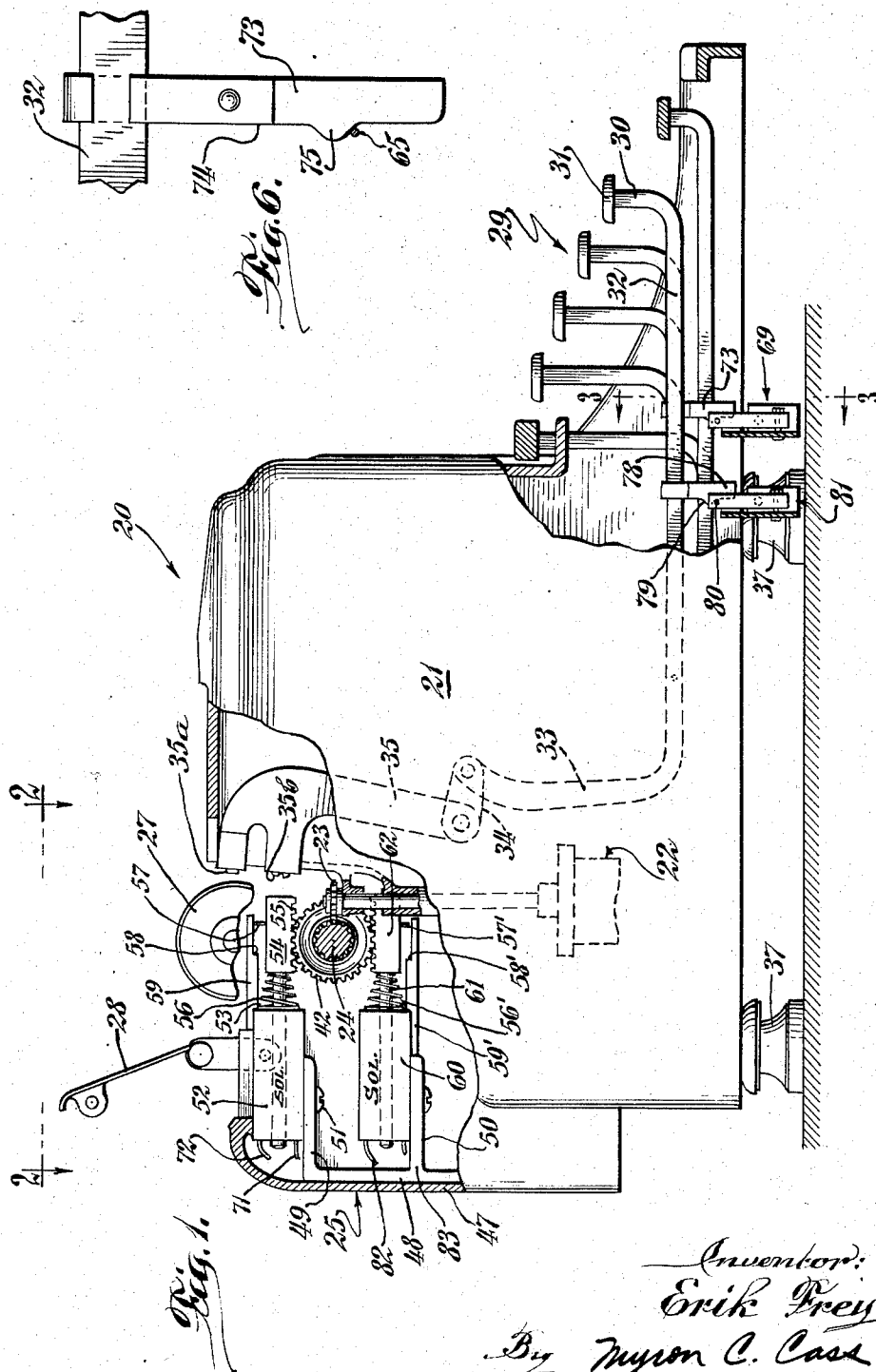
E. FREY

2,886,160

CARRIAGE MOVING APPARATUS FOR TYPEWRITERS

Filed June 13, 1956

4 Sheets-Sheet 1



Inventor:

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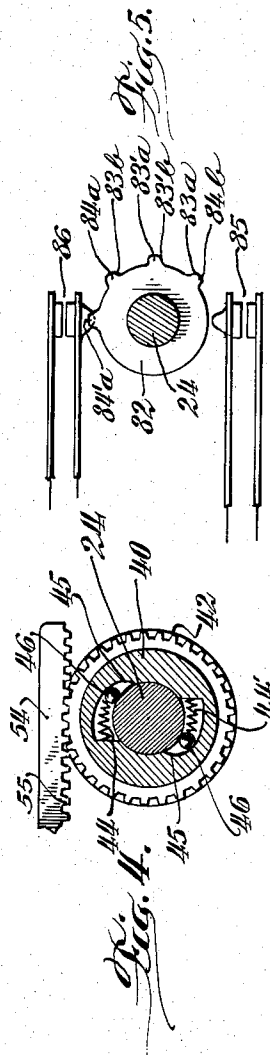
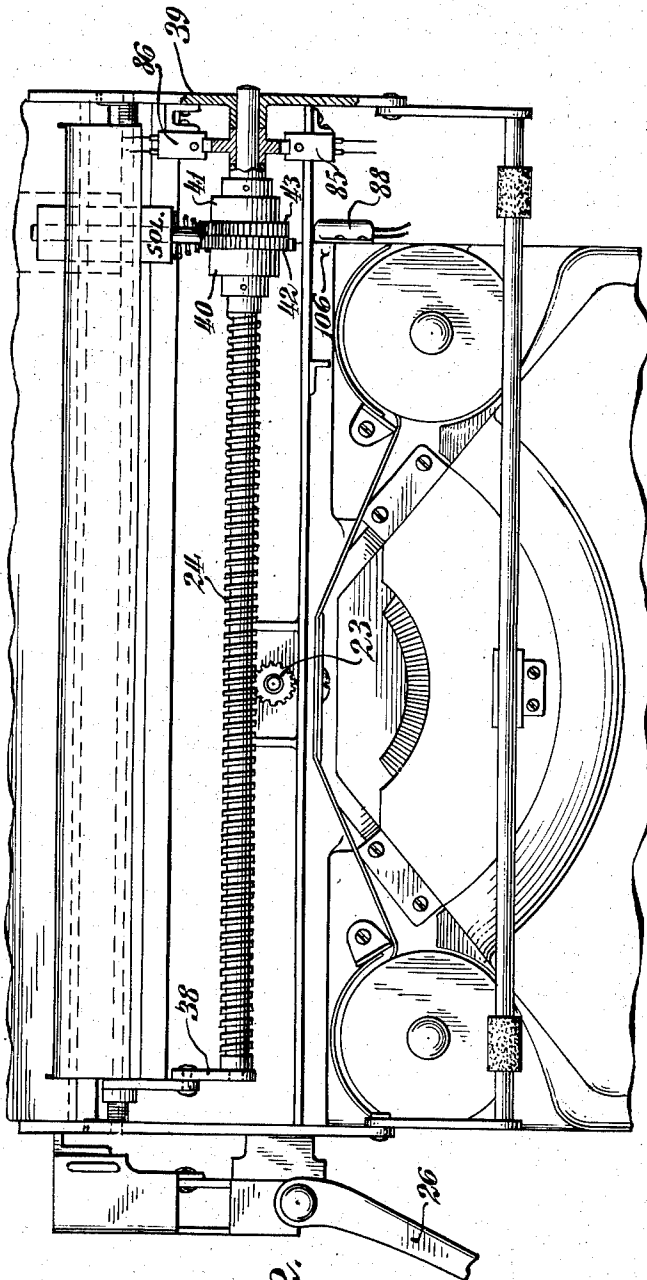
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4 Sheets-Sheet 2



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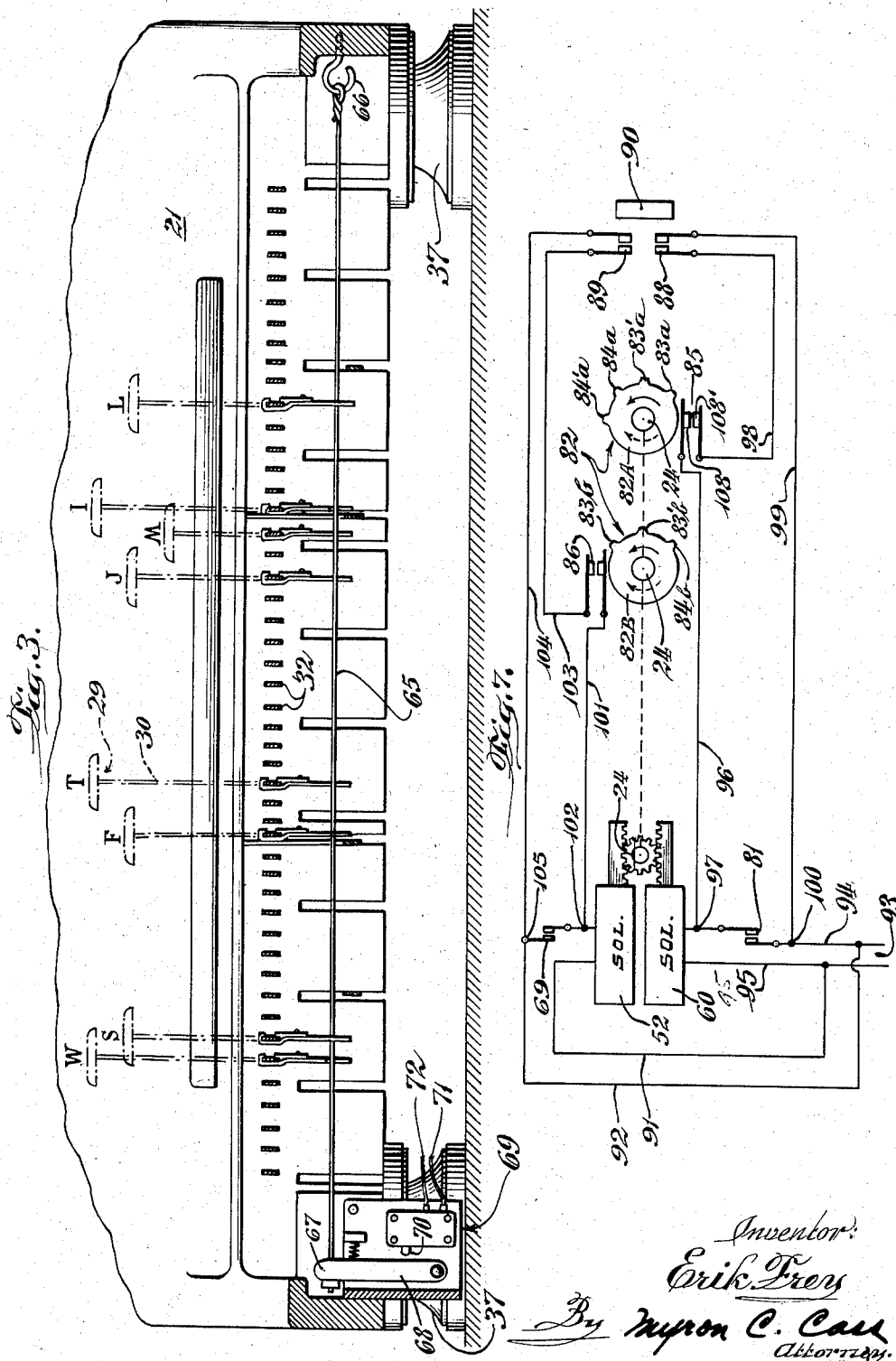
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CARRIAGE MOVING APPARATUS FOR TYPEWRITERS

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4 Sheets-Sheet 3



1

2,886,160

CARRIAGE MOVING APPARATUS FOR TYPEWRITERS

Erik Frey, Chicago, Ill.

Application June 13, 1956, Serial No. 591,107

17 Claims. (Cl. 197—84)

The present invention relates in general to typewriting machines, and has more particular reference to novel typewriter escapement mechanism.

The conventional fixed escapement typewriter, either manual or electrical, employs an escapement mechanism operably engaged with a rack which is stationary on the carriage. Depression of a character key lever initiates the escapement movement of the carriage through a predetermined fixed distance which is independent of the width of the letter to be imprinted. Hence, the escapement distance on a fixed spacing machine is the same for both upper and lower case letters, whether the same be of the centered or of the off-centered type. As a result, the spacing between adjacent letters will vary, where one letter is narrower than another, as with lower case letters "f," "i," "j," "t" and "j," which are narrower than other lower case letters. Non-uniform spacing between letters is also obtained in connection with upper case or capital letters, which are wider than their lower case counterparts. Such non-uniform spacing between the letters of printed material detracts from its appearance and wastes space. Also, by reason of the different widths of letters, both upper and lower case, uniform line ending margins are virtually impossible to achieve in conventional typewriters under ordinary circumstances of use.

One of the principal objects of the present invention is to provide novel typewriter escapement apparatus embodying a turnable, helically threaded escapement rack.

Another object of the invention is to provide typewriter escapement apparatus comprising a turnable screw forming an escapement rack in conjunction with means selectively operable to rotate the rack in either direction, to move the carriage through a predetermined escapement distance in response to the actuation of any type key, whereby normal escapement is accomplished by turning the rack forming screw through a predetermined angular displacement, such as one complete revolution of the screw.

Another important object is to provide improved means for achieving uniform spacing between typewritten letters, regardless of whether they are upper or lower case letters, and regardless of letter width variations.

Another object of the invention is to provide novel typewriter escapement apparatus of the character described which includes an escapement rack comprising a screw rotatably installed on the carriage and electromagnetically operated actuating members drivingly connected with the rack for selectively rotating the same to move the carriage forwardly or backwardly through adjusting distances in addition to the normal escapement movement, in order to achieve uniform spacing between letters regardless of the size or width of the letters imprinted.

Another object of the invention is to provide novel means associated with the proportional spacing apparatus embodying the invention for attaining uniform margins for printed matter, including tabulated printed matter.

Still a further object of the invention is to provide novel spacing apparatus which will permit selective spreading or shrinking of a line of typed copy.

2

Certain languages are written from right to left as distinguished from English, for instance, which is written from left to right. Typewriters of conventional design provide for typing in only one direction since conventional escapement apparatus is intended to accomplish only unidirectional escapement of the carriage. Such a typewriter can not be used for typewriting in the direction opposite to the normal escapement movement that is built into the machine. Specially constructed typewriters therefore are required for writing from right to left, even where conventional characters are used.

Another very important object of the invention, therefore, is to provide a typewriter which, by employing the principles of the invention, will provide for carriage escapement in either direction at the option of the user; a further object being to provide for proportional type spacing in either direction of carriage escapement movement.

Another important object is to provide a typewriter having means selectively operable to cause the machine to proportionally space successively imprinted letters to attain uniform spacing between successive letters, and alternately to operate as a conventional fixed escapement machine.

Other objects of the invention reside in the provision of a novel encoding apparatus for initiating carriage movement; to provide apparatus embodying the principles of the invention, which is simple, inexpensive, and well adapted for incorporation in conventional fixed spacing typewriters; and to enable achievement of these objects at substantial economy.

Since an important object of the invention is to provide apparatus which can be incorporated into conventional machines, the invention is in no way limited by reason of substantial variations in conventional parts of the machines not material to the successful operation of the invention.

The foregoing and numerous other important objects, advantages, and inherent functions of the invention will become apparent as the same is more fully understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

Referring to the drawings:

Fig. 1 is a side view of a typewriting machine having apparatus embodying the invention installed thereon, parts of the housing being broken away to show details of the invention;

Fig. 2 is a fragmentary top view of the typewriter as defined by the line 2—2 in Fig. 1, portions of the carriage having been removed to show the turnable rack forming screw of the invention;

Fig. 3 is a sectional view taken through the keyboard of the typewriter along the line 3—3 of Fig. 1 and illustrating the encoding apparatus of the invention;

Fig. 4 is a sectional view taken through a clutch mechanism drivingly associated with the rack screw for turning the same;

Fig. 5 is a diagrammatic view illustrating novel means provided in accordance with the invention for returning the rack screw to a predetermined zero position, when the carriage is at the end of a line, so as to achieve uniform margins when the carriage is returned to a line starting position;

Fig. 6 is a fragmentary elevational view of a portion of the encoding apparatus;

Fig. 7 is a diagrammatic illustration of an electrical circuit for operating the apparatus of the invention;

Fig. 8 is a fragmentary plan view of the carriage of a typewriter modified in accordance with the invention and showing the apparatus installed for achieving normal or uniform escapement movement in either direction;

3

Fig. 9 is a fragmentary elevation view of encoding apparatus for selectively initiating bi-directional escapement movement of the carriage; and

Fig. 10 is a sectional view taken along the line 10—10 of Fig. 8.

To illustrate the invention the drawings show a typewriter 20 which, for purposes of the present disclosure, may be either electrically or manually operable. In a manual machine, a separate electrical line will be required for connecting the apparatus of the invention to a suitable source of electrical power. In an electrical machine, the same power line by which the typewriter is energized for operation may be used to supply power for operating the apparatus of the invention. The typewriter 20, as shown, may include a housing 21, a conventional escapement mechanism 22 mounted in the housing, a pinion 23 coupled with the mechanism 22 and drivingly engaged with a rack carried on the carriage 25. In a conventional uniform shift escapement machine, the rack ordinarily is an elongate, rectangular member whose teeth are meshed with the pinion 23, the rack being stationary on the carriage. In place of the conventional stationary rack, the present invention utilizes a circular rack or helically threaded lead screw 24 which is rotatably mounted on the carriage and meshed with the pinion 23.

It will be appreciated that the conventional escapement mechanism may vary in different typewriters. As a consequence, it has been deemed unnecessary to illustrate a specific escapement mechanism in detail. In the illustrated typewriter, the carriage is translated by the mechanism 22 in one direction only, namely, from left to right. Return to the left hand margin position of the carriage is accomplished by means of the carriage release lever 26 which may function in conventional fashion to disconnect the escapement mechanism 22 from the rack 24. In the electric typewriter, carriage return movement is effected through a carriage return key or button on the keyboard of the machine. It should be understood, however, that the present invention is not limited to machines having uni-directional escapement from left to right, but applies equally to devices embodying right to left escapement as well as to typewriters selectively conditionable for escapement motion in either direction.

The carriage 25, as shown, mounts a conventional platen or roller 27, a paper bail 28 and various other conventional control members which have not been specifically illustrated since they have no bearing on the invention. The keyboard 29 has a plurality of character key levers, each of which may include a short vertical arm 30 supporting at its upper end a finger piece 31 and an elongate horizontal extension 32 which passes along the bottom of the housing and is upwardly bent at its forward end to provide an arm 33 which is pivotally connected in conventional fashion, as by the link 34, to a type bar 35. Type bar 35 mounts a pair of type characters 35a and 35b and is movable toward said roller 27 to make a type impression when the finger piece 31 of a key lever is depressed. The characters 35a and 35b respectively represent corresponding upper and lower case letters. A shift or capital letter key (not shown) may be provided on the keyboard 29 for selecting upper case letters desired to be imprinted.

An important feature of the invention comprises the elimination of the stationary rack found in conventional typewriters and, mounting, in its stead, a rotatable rack or helically threaded feed screw 24. The screw rack 24 is turnably journaled at its opposite ends in suitable bearings provided in a bracket 38 connected at one end of the carriage and in the end frame 39 of the carriage at its opposite end. The screw rack 24 meshes with the pinion 23 which is operated by the escapement mechanism 22 to translate the carriage uni-directionally through a predetermined normal escapement distance each time any of the keys 31 is depressed. Thus, the conventional

4

escapement apparatus in a typewriter may be utilized with the rack 24.

To achieve proportional spacing, it is necessary to adjust the distance moved by the carriage, during normal escapement, by either increasing or decreasing the same sufficiently to achieve uniform spacing of characters of unlike widths. This may be accomplished by means of apparatus adapted to rotate the rack 24 relative to the pinion 23 the necessary amount to move the carriage through the required adjustment distance, independently of carriage escapement movement effected by rotation of the pinion 23.

Secured on an unthreaded segment of the screw rack 24, spaced inwardly from the frame 39, are a pair of adjacently disposed collars 40 and 41, each carrying a circular gear, such as gear 42 on collar 40 and gear 43 on collar 41, said gears 42 and 43 being preferably identical. Referring to Fig. 4, there is shown a free wheeling clutch associated with the collar 40 adapted to drivingly rotate the screw rack 24 in a counterclockwise direction upon rotation of gear 42 in that direction. The second collar 41 has an identical clutch, albeit arranged to effect rotation of the rack 24 in the opposite or clockwise direction. The clutches may each comprise a pair of arcuate recesses 44 and 44' formed in the collar on opposite sides of the rack screw 24 and each curved toward said screw at its end 45. However, the ends 45 of the recesses 44 and 44' are arranged facing in opposite directions.

A spring pressed ball 46 is retained in each recess, with the ball normally urged toward said end 45. The diameter of the ball 46 is such as normally to clampingly engage between the wall of the recess and the rack 24, to thereby lock the collar 40 and said rack together, so that rotary movement of the gear 42 in one direction will result in rotary movement of the rack in the same direction. As seen in Fig. 4, rotary movement of the gear in one direction will maintain the ball 46 wedged into the tapered end 45, thus causing engagement of the clutch, whereas movement of the gear 42 in the opposite direction will free the balls 46 from such wedging engagement and permit the collar 40 to free-wheel relative to the rack. It will be understood that the collars 40 and 41 are arranged the one facing the other, but slightly spaced apart to permit one to rotate relative to the other. It will be understood that the clutch device of collar 41 will engage for rotating rack 24 clockwise, viewing Fig. 1, and to free-wheel in the opposite direction.

The means for rotating the collars 40 and 41 to accomplish incremental rotation of the rack 24 is illustrated in Figs. 1 and 2. Said means may comprise a pair of electromagnetically operated actuating members 54 and 62 which mesh with the gears 42 and 43 respectively. As seen in Fig. 1, secured to the rear wall 47 of the carriage is a supporting bracket 48 having a pair of vertically spaced shelves 49 and 50 extending within the housing 21. Secured on shelf 49, as by means of a bolt 51, is a solenoid 52 whose plunger 53 extends forwardly toward the rack screw 24. Secured to the forward end of plunger 53 is a rack bar 54 whose underside has teeth 55 adapted to mesh with the upper reach of gear wheel 42. The plunger 53 is maintained in a normally extended position by means of a coil spring 56 applied thereon between the solenoid housing and the bar 54.

Upstanding on the bar 54 is a stop pin 57 arranged to engage a shoulder 58 formed in a plate 59 supported on the solenoid 52. The stop member 57 and shoulder 58 are spaced apart linearly to limit movement of the plunger inwardly into the solenoid to a predetermined distance. Thus, when the solenoid 52 is energized, plunger 53 will be drawn into the solenoid, thereby moving the toothed rack bar 54 in a direction to rotate the gear wheel 42 counterclockwise, viewing Fig. 1, and thereby causing movement of the rack in a direction to advance the carriage to the left, viewing Fig. 2. The amount of rotary movement of the rack 24 will depend upon the linear distance moved

5

by the plunger 53, this being controlled by the linear distance between the stop pin 57 and shoulder 58.

Similar apparatus is provided for effecting rotation of the rack screw 24 in the opposite direction to move the carriage to the right, viewing Fig. 2. Mounted on shelf 50 is a second solenoid 60 whose plunger 61 actuates a toothed rack bar 62 which is drivingly engaged with the lower reach of gear wheel 43. A stop member 57' is provided which limits the linear distance traversable by plunger 61 when it engages against the shoulder 58' of plate 59'. A coil spring 56' on plunger 61 normally urges said bar 62 outwardly relative to the solenoid. When the solenoid 60 is energized, the gear wheel 43 will be moved in a direction to turn the rack screw 24 so as to cause carriage movement toward the right, viewing Fig. 2.

It will be understood that the clutch devices associated with collars 40 and 41 will permit free wheeling of the collars relative to the rack 24 upon return movement of the rack bars 54 or 62 under the normal bias of the springs 56 or 56', respectively, after the solenoid with which a said bar is associated is de-energized.

The linear distance between stop member 57 and the shoulder 58 or stop member 57' and shoulder 58' is calculated to effect a predetermined incremental rotary movement of the rack screw 24 which is equal for both clockwise and counterclockwise rotation thereof. For purposes of illustration, the normal escapement distance of the carriage, effected through the pinion 23, may be established at four units, which includes the width of the character plus the space between characters. A three unit character plus one unit of space for a total space of four units is the preferred norm, since the majority of characters are three units in width. The four units of space for normal escapement movement of the carriage may be effected by one complete revolution of the rack or screw 24. The linear distance between stop 57 and shoulder 58 and between stop 57' and shoulder 58' is calculated to effect one-eighth of a revolution of the rack, either clockwise or counterclockwise. Thus, depending upon which of the solenoids 52 or 60 is energized, the normal escapement distance of four units may be either increased or decreased a predetermined fractional amount of the total escapement distance for the purpose of accommodating carriage movement to the width of the character.

Referring to Figs. 1, 3 and 6, the manner in which the solenoids are selectively energized to initiate incremental movement of the carriage 25 in response to depression of a character key lever is illustrated. At the outset, it is desired to explain that energization of the solenoids 52 and 60 may be achieved through apparatus, other than as herein described, such as, for instance, the apparatus described in Patent No. 2,663,399, issued December 22, 1953, to Frey and Hattis, and in Patent No. 2,680,507, issued June 8, 1954, to Frey and Cooper.

Suspended within the housing 21 below the horizontal arms 32 of the character key levers is a control member, which may be in the form of a cord 65 or an elongate encoded bar or rod or a light beam. The cord 65 is retained in a normally taut condition, one end thereof being fastened to the hook 66 secured on the interior of the housing 21. The opposite end of said cord is attached to the free end 67 of the pivotally mounted switch arm 68 of a microswitch 69. Arm 68 is spring biased into a normal position spaced from the button 70 so that the switch is normally open. Upon movement of cord 65, the arm 68 will be pivoted to close the switch 69. It will be appreciated that the sensitivity of such switches will require only a slight movement of the cord 65 to close the switch. The leads 71 and 72 from switch 69 are connected to the solenoid 52.

Each of the arms 32 of the character key levers for lower case "f," "l," "i," "t" and "j" and for punctuations has secured thereto a depending elongate lug or bar 73, such as shown in Fig. 6. Each lug or bar 73 is substantially vertically arranged and along its inwardly fac-

6

ing edge 74 is provided a projection 75. The projection 75 is spaced from the bottom end of the lug 73 so as to overlie the cord 65. Upon depression of a said key lever, the projection will bear against the cord as it rides past and will move the same sufficiently to close the switch 69. Upon return of the depressed key lever, the projection 75 will again bear against the cord 65, causing the switch 69 to be closed again momentarily.

The projection 75 is positioned so as to close the switch 69 only after the normal escapement movement of four units for the carriage is completed, but before the character is printed. As previously explained, since each of the characters "f," "l," "i," "t," "j," et cetera, are narrower than the remaining letters of the alphabet, to achieve uniform proportional spacing it is necessary to reduce the spacing between such a letter and its adjacent letter or letters. By means of the apparatus described, if the character key 31 for letter "f" is initially depressed, the conventional escapement mechanism 22 will cause the carriage to move a distance of four units. As depression of the character key continues, the projection 75 will engage the cord 65, moving same to momentarily close switch 69 and energize solenoid 52. The plunger 53 will be drawn inwardly causing rotation of rack screw 24 one-eighth of a revolution, through an angular displacement of 45 degrees, thereby displacing the carriage 25 one-eighth of the normal escapement distance of four units, in a direction to reduce carriage travel by one-eighth of the distance moved during normal escapement, that is to say, by one-half of a unit.

This reduction of normal carriage escapement is accomplished before the letter "f" is imprinted, so that, upon imprinting, said letter will be one-half of a unit closer to the next preceding letter than would be attained by the normal escapement movement of the carriage. However, when the character key lever for "f" returns upwardly to its normal position, the cord 65 is again pulled, thus closing switch 69 a second time. The plunger 53, having in the meantime been returned to its normally extended position by action of the spring 56, will again be actuated to effect movement of the carriage another one-eighth of the normal escapement distance. The foregoing is the timing sequence required in machines fitted with centered type. In the case of left-sided offset type, the full reduction or increase of escapement movement would be accomplished after the character has been impressed, in a machine operating from left to right. In the case of right-sided offset type, the reduction or increase is applied before the character is impressed.

A complete stroke of a character key lever, where it is desired to reduce the distance between adjacent letters, will thus result in reduction of escapement movement by one-half a unit of the normal escapement distance both before and after the letter is imprinted. The escapement distance for these special lower case letters is thus, in effect, reduced to three units, whereas, in most other instances, the lower case letters will require four units of space, achieved through normal operation of the escapement mechanism 22 and pinion 23, without adjustment, since there are no depending lugs provided on these key levers to engage cord 65. It will be understood that the same principles may be employed to appropriately adjust the escapement distance in connection with certain of the punctuation marks.

Considering now the upper case or capital letters, where the same are of the center-type, all capitals usually require five units of space, including provision for inter-character spacing, with the possible exception of the letters "W" and "M" which may require six units. The letter "S" usually requires four units, while the letter "I" requires three units. The invention includes means for increasing the normal escapement distance for capital letters as necessary, including provision for avoiding such increase in the case of the letter "S" and reducing said

distance in the case of letter "I." Reference will be had to Fig. 1 for this portion of the disclosure.

There is provided, on each of the character key levers involved, a second depending lug 78 which in all respects is identical to the lug 73. A second cord or bar 80 is suspended in the same manner as cord 65 with one end of the cord 80 attached to the pivotal arm of a second microswitch 81. The switch 81 may be and preferably is identical to switch 69, with the leads 82 and 83 therefrom connected to the solenoid 60. The cord 80 and lug 78 are arranged to the rear of the cord 65 and lug 73.

Although not specifically shown, the shift or capital key on the typewriter may be connected to condition the switch 81 for operation, while at the same time disabling the switch 69. Thus, when a character key lever is actuated, the shift or capital key being depressed, only the switch 81 will operate. The pulling of the cord 80, by downward movement of the projection 79 thereagainst, will close switch 81 and actuate the solenoid 60. The plunger 61 will be moved thereby causing rotation of the rack screw 24 one-eighth of a revolution in a direction to shift the carriage 25 through a corresponding displacement distance of one-half a unit in a direction to increase the normal escapement distance. The return movement of the key lever will again close switch 81 momentarily to initiate another incremental movement of the carriage in the same manner as described supra in connection with the operation of the solenoid 52. The result will be to increase the escapement distance by a total of one unit. Since the switch 69 is dead at this time, nothing happens to solenoid 52 when cord 65 is pulled during the stroke of the character key lever.

The "S" character key is not provided with a lug, such as lug 78, and therefore the normal escapement distance of four units is obtained in response to character key operation for both lower and upper case letter "s." The lug 78 may also be omitted from the letter "I" character key, thus obtaining the normal four units of escapement distance when capital "I" is struck. However, a separate switch may be installed along the same principles discussed in connection with upper case "S" to achieve three units of spacing. For capitals "W" and "M," where six units of spacing may be desired, all that need be done is to provide a second projection on the lug 78 mounted on the key lever for these letters to pull the cord 80 twice during downward movement of the key and twice during the upward or return portion of the key lever stroke, thus increasing the total escapement distance to six units.

It is contemplated that the principles of the invention may encompass the use of only one cord and one switch instead of the two described. To accomplish this, it would be necessary only to incorporate with the shift or capital key a linkage which would shift the position of the single cord forwardly so as to be engaged by the projection 79 when typing capitals, while employing a double-pole switch connected to both solenoids 52 and 60. Action of the shift key would select the solenoid to be energized at the same time the cord is shifted in position. When typing lower case letters, the cord would be in position for engagement by projection 75 and only the solenoid 52 would be energized.

Many modifications may, of course, be made in the form of encoding apparatus employed to energize solenoids 52 and 60 selectively. For example, electronic switches may be substituted for switches 69 and 81, and the cords or bars may be replaced by a light beam and photoelectric cell or other light detecting units for closing such electronic switches, in response to actuation of the character keys.

It will be seen that the pitch of the thread of the rack screw 24 is preferably equal to the normal escapement distance of four units. Accordingly, in writing a four unit letter, which requires normal unmodified escapement, the rack will be in the "zero" position at the end

of the four unit letter writing operation, if it was in "zero" position at the start of the operation. If, however, a three unit letter is typed, starting with the rack in "zero" position, the rack, at the conclusion of the letter writing operation, will be turnably displaced backwardly from "zero" position through a rotated angle of adjustment corresponding with one spacement unit, that is to say, one-quarter of the normal escapement distance, such angle being one-quarter of a complete rotation of the rack or 90 angular degrees. The rack will be displaced backwardly through an angle of 180 degrees, from "zero" position, after imprinting a two unit character, such as a period or decimal point. Likewise, in writing a letter that is five units wide, starting from "zero" position, the rack will be displaced forwardly from "zero" position through a rotated adjustment angle of 90 degrees, and will be displaced through an angle of 180 degrees, from "zero" position, at the conclusion of the operation of imprinting a six unit letter. Accordingly, after imprinting a series of characters of various widths in a line of type, the threaded rack member 24 may be angularly displaced from "zero" position by 90 or 180 degrees in either direction.

It is desirable, however, to insure that the rack screw 24 will always return to a position such that the pinion 23 will engage the threads of the rack properly when the carriage is at the line starting margin position. To insure such return of the rack to what is referred to herein as the "zero" position of the rack screw, there is provided a cam or pilot wheel 82 fixed on the rack screw 24 between the collars and the end wall 39. The cam wheel 82 has two relatively offset parts 82A and 82B disposed in side-by-side relation. These parts respectively provide switch operating tines or projections 83a, 83'a, 84a and 84'a on the part 82A, and similar projections 83b, 83'b and 84b on the part 82B. The projections are angularly spaced apart 45 degrees on the periphery of the wheel, the tines 83a and 84b being disposed in alinement. The tines 83'a and 83'b are also alined and displaced 45 degrees from the tines 83a and 84b. The tines 83b and 84a likewise are alined and are displaced 45 degrees from the tines 83'a and 83'b, and 90 degrees from the tines 83a and 84b. The tine 84'a is displaced 45 degrees from tines 83b and 84a, 90 degrees from tines 83'a and 83'b, and 135 degrees from tines 83a and 84b. Mounted on the carriage on opposite sides of rack screw 24 are a pair of switches 85 and 86, the switch 85 being alined with the tines 83a, 83'a, 84a and 84'a, and the switch 86 being alined with tines 83b, 83'b and 84b. Installed on the interior of the housing is another pair of switches 88 and 89 in position to be intercepted and closed by the projection 90 secured on the carriage and adjustable in position by means of the margin selector of the typewriter.

Referring to the circuit illustration of Fig. 7, the entire operation of the apparatus described will be explained in conjunction with the manner of operation of the means for insuring uniform margin positions for the carriage. The solenoid 52 is connected by means of lead 91 and lead 92 across the line 93 to the source of electrical power. Switch 69 is connected in the lead 92 so that, when closed upon depression of a character key lever and the pulling of cord 65 as previously explained, the solenoid 52 is energized to effect incremental movement of the carriage in one direction. The solenoid 60 is connected by leads 94 and 95 across the line 93 and the switch 81 is connected in the lead 94 so that, when closed by pulling of cord 80, the solenoid 60 is energized to effect reverse incremental movement of the carriage. The operation of the solenoids 52 and 60 and the manner of achieving such incremental movements of the carriage has been described in detail heretofore, and the solenoids and the leads connecting same across the line 93 comprises one branch of the entire circuit of the invention.

The second branch of the circuit operates in connection

with cam wheel 82 and includes the lead 96 which connects a movable contact 108 of the switch 85 with solenoid 60 at the juncture 97. The stationary contact 108' of switch 85 is connected by lead 98 to one contact of switch 88, while the second contact of switch 88 is connected to the line 93 by lead 99 at juncture 100. The switch 86 is connected by lead 101 to the solenoid 52, at juncture 102, and to the switch 89 by means of lead 103. Switch 89 is connected across the line 93 by means of lead 104, at juncture 105.

In order to return the rack screw to "zero" position, the switches 88 and 89 may be closed by any suitable or preferred means operable immediately prior to or during return movement of the carriage to a line starting margin position. To this end, the switches 88 and 89 may be closed by the projection 90 when the carriage 25 shall have reached the end of a complete line of imprinted type, immediately prior to return of the carriage to the line starting margin position; and means may be provided for closing the switches 88 and 89 in response to operation of the carriage return and tabulating keys, thereby actuating the rack screw zeroizing means whenever the carriage is moved to a starting position, either for commencing a line of typing or for tabulating purposes.

Whenever the cam wheel 82 is turned from its normal or "zero" position in the counterclockwise direction, as shown by solid arrows in Fig. 7, the tines 83a, 83'a, 84a and 84'a will be brought successively into switch closing engagement with the switch 85, as the result of successive strokes of the solenoid 52. Additional strokes of the solenoid, after the tine 84'a engages switch 85, will successively engage tines 84b, 83'b and 83b with the switch 86. Likewise, when the wheel is turned from its "zero" position, in the clockwise direction, as shown by dotted arrows in Fig. 7, the tines 83b, 83'b, and 84b will be brought successively into switch closing engagement with the switch 86, and thereafter the tines 84'a, 84a, 83'a and 83a will successively engage switch 85, as the result of successive strokes of the solenoid 60. As a consequence, whenever the rack 24 is displaced from "zero" position, in any of seven possible angularly displaced positions, one of the tines 83a, 83'a, 83b, 83'b, 84a, 84'a and 84b corresponding with the displaced position of the rack will operate to close one of the switches 85 or 86.

Closure of switch 85 completes the circuit to solenoid 60 through lead 96, switch 85, lead 98, switch 88, lead 99 to the juncture 100 with the line 93. The solenoid 60 will be energized to draw its plunger inwardly, rotating the rack screw 24 in a clockwise direction the necessary amount to turn the rack 45 degrees. Thus, if the switch 85 is closed by the tine 83a, the rack will be returned to its "zero" position with respect to pinion 23, by one operating stroke of the solenoid 60. At the same time, the tine 83a will be rotated off the contact 108 where, as seen in its normal position in Fig. 7, the cam wheel has its tines removed from switches 85 or 86.

In the event tine 83b should come to rest on the movable contact of switch 86, a circuit would be completed through lead 101 to solenoid 52 at juncture 102, switch 86, lead 103, switch 89, lead 104 to juncture 105 across the line 93. The solenoid 52 accordingly would be energized to initiate counterclockwise movement of the rack 24 and return the cam wheel 82 to normal position released from the switches 85 and 86.

In either manner of operation, the return of the cam wheel and rack screw to normal or "zero" position released from switches 85 and 86 is automatic at the line end margin position of the carriage and upon operation of carriage return and tabulating keys. Where any of tines 83'a, 84a or 84'a are engaged with switch 85, or where the tines 83'b or 84b are engaged with switch 86, the rack screw 24 will be kicked over two or more times in succession in order to return the cam wheel to normal position. Thus, the line starting margin position of the

carriage will always be uniform by reason of this return to "zero" position of the rack screw with respect to pinion 23.

Referring now to Figs. 8 through 10, there is illustrated a preferred embodiment of apparatus employing the principles heretofore described for achieving the normal four unit escapement movement in either direction of carriage movement each time a character key lever is depressed, while at the same time achieving the advantages of proportional spacing. A modified form of typewriter is illustrated and designated 109. In this embodiment, the conventional escapement mechanism 22 and pinion 23 described in connection with the typewriter 20 may be retained, if desired, and provided with selectively operable means for disabling the mechanism 22 while the improved escapement mechanism now to be described is in operation. It will be understood that at least a pinion 23 or other suitable reaction member mounted on the typewriter in engagement with the rack will be employed to enable the carriage to be translated relative the typewriter frame upon rotation of the rack.

The typewriter 109 employs the same circular rack 24 as is used in the machine shown in Figs. 1-8, and solenoids 52 and 60 are employed as seen at the right hand side of the carriage. Instead of escapement mechanism 22 and pinion 23, there is provided a second pair of solenoids 110 and 111, the plunger 112 of solenoid 110 having a toothed bar 113 meshing with the upper reach of a gear wheel 114 carried on the collar 115 mounted on an unthreaded portion of rack 24. There is a coil spring 116 on the plunger 112 between the solenoid 110 and bar 113 normally urging said plunger to a position withdrawn from the solenoid. A stop member 117 upstanding on bar 113 limits the amount of linear movement of the plunger. However, in this case, the amount of linear movement of which plunger 112 is permitted is calculated to rotate the gear wheel 114 a complete revolution, thus effecting an escapement movement of four units. The solenoid 111 likewise is provided with a plunger, a toothed bar and stop member identical to that of solenoid 110, except that its toothed bar meshes with the lower reach of the gear wheel 118 on collar 119 juxtaposed the collar 115. Identical clutching devices such as described in connection with collars 40 and 41 are likewise provided for collars 115 and 119. Energization of the solenoid 110 results in counterclockwise rotation of rack 24 advancing the carriage 25, while energization of solenoid 111 results in clockwise rotation of the rack reversing the carriage. In each instance, the movement of the carriage is the normal escapement distance of four units.

Referring to Fig. 9, the solenoids 110 and 111 may be energized under the control of a pair of cords 120 and 123 suspended below the character key levers. The cord 120 may be connected to the switch arm 121 of a microswitch 122 which is electrically connected to the solenoid 110. The cord 123 may be attached at one end thereof to the switch arm 124 of a microswitch 125 which is electrically connected to solenoid 111. Each of the key arms of the character key levers is provided with a pair of spaced apart depending lugs 126 and 127 arranged to engage respectively against the cords 120 and 123. However, the projections provided on said lugs 126 and 127 are such as not to ride past the adjacent cord, and hence the closing of either switch 122 or 125 is effected on the downward stroke of the character key lever only. Further, the escapement apparatus is arranged to complete the normal escapement movement after the proportional spacing apparatus commences to operate.

Thus, when solenoid 110 is energized by closing of switch 122, the carriage is translated to the right. When solenoid 111 is energized, the carriage is translated to the left. In each instance, the resulting movement may be equivalent to four units of space. A control button or lever on the carriage (not shown) may be provided to enable the operator to select the switch (either 122 or

125) which will be operable upon depression of the character key lever. Indeed, it is feasible to employ but a single cord for the operation of the solenoids 110 and 111, such single cord being connected to close both solenoid switches 122 and 125 each time a key or space bar is depressed, a selector switch being provided for disconnecting one or other of the switches from its associated solenoid, whereby only one of the solenoids can be energized at a time. Novel apparatus is thus provided which permits the typewriter to be used either for writing from left to right or from right to left merely by controlling the direction of the escapement movement by selection of the switch 122 or 125 which can be activated. In either direction of movement, operation of the proportional spacing apparatus heretofore described can be concurrent. It will be understood that the same one-cord and double-pole switch arrangement may be used here as well.

It has been deemed unnecessary to show a specific electrical circuit diagram in connection with the solenoids 110 and 111 and switches 122 and 125 since this circuit will be very simple and may be powered from the same line 93 independently of the circuit shown in Fig. 7.

It may be pointed out that, in the event translating movement of the carriage by means of the apparatus is accomplished against spring tension associated with carriage, then upon release of the carriage from the normal escapement, the carriage will be automatically returned to its starting margin position.

Spreading or reducing a line may be accomplished by connecting the solenoids 52 and 60 also to separate switches on the keyboard. Where solenoids 110 and 111 are employed for normal escapement movement of the carriage, to employ also the proportional spacing apparatus when typing from right to left, the action of the solenoids 52 and 60 may be reversed.

It is believed that the principles of the invention have been described in sufficient detail to enable an understanding thereof commensurate with the requirements of the patent statutes. In its broadest scope, there is believed to have been provided novel and advantageous apparatus for effecting controlled movement of the carriage of a typewriter either for purposes of proportional spacing or for standard or uniform escapement movement, either from left to right or vice versa or for both concurrently. The apparatus may be installed in conventional typewriters, either electrical or manual, with very little modification and at extremely economical expense. Minor changes in the parts of the invention described are believed within the skill of the artisan without any material departure from the principles of the invention as set forth in the claims hereto.

I claim:

1. In a typewriter having a reciprocable carriage and character keys carrying associated type characters of unlike widths, the combination, with said carriage and keys, of escapement mechanism comprising a helically threaded member turnable on the carriage, escapement means operatively associated with said helically threaded member for shifting the carriage through a predetermined uniform escapement distance in response to actuation of any of said character keys, and proportional escapement means operable, in response to actuation of a said character key, to turn the threaded member through an angular displacement proportional to the width of the character corresponding with the actuated key, whereby to shift the carriage through an escapement adjusting distance corresponding to the angular displacement of the threaded member, said escapement mechanism comprising conventional mechanism cooperable with said threaded member as a rack to permit uniform escapement motion through a normal escapement distance corresponding with the thread pitch of said threaded member, additional escapement mechanism separate from and inde-

pendent of said conventional mechanism and operable in response to the actuation of a character key, to turn said threaded member through a predetermined normal displacement distance, whereby to shift the carriage through a corresponding uniform distance in response to actuation of any of said character keys, and selector means operable to condition one or the other of said conventional and additional escapement mechanisms for operation while simultaneously disabling the other.

2. In a typewriter having a reciprocable carriage and character keys carrying associated type characters of unlike widths, the combination, with said carriage and keys, of escapement mechanism comprising a helically threaded member turnable on the carriage, escapement means operatively associated with said helically threaded member for shifting the carriage through a predetermined uniform escapement distance in response to actuation of any of said character keys, and proportional escapement means operable, in response to actuation of a said character key, to turn the threaded member through an angular displacement proportional to the width of the character corresponding with the actuated key, whereby to shift the carriage through an escapement adjusting distance corresponding to the angular displacement of the threaded member, and zeroizing means operable to turn said helically threaded member to a selected zero position upon completion of a character line writing operation and before return of the carriage to line starting position, whereby to achieve a uniform line starting margin, said zeroizing means comprising switch means for actuating said proportional escapement means, switch actuating cam means on said threaded member and operable to actuate said switches in all positions of said threaded member except its zero position, and a control switch normally disabling said switch means and operable to activate said switch means after completion of a character line.

3. In a typewriter having a reciprocable carriage and character key levers for initiating escapement movement of the carriage, apparatus for selectively translating said carriage either forward or backward a predetermined linear distance of escapement movement during a complete stroke of a said key lever comprising, a helically threaded member rotatably mounted on the carriage, a pair of gear members mounted on the threaded member, actuating means meshed with each of said gear members to rotate one in one direction and the other in the opposite direction, clutch means associated with one of said gear members operable only when said gear member is rotated in said one direction to translate the carriage in one direction and clutch means associated with the other gear member and operable only when said other gear member is rotated in the opposite direction to translate the carriage in the other direction, and control means connected between said key levers and each of said actuating means for selectively initiating operation of a said actuating means to rotate its associated gear member in the direction in which so clutched to translate the carriage said escapement distance in one of said directions, upon depression of a said key lever.

4. Apparatus of the character described in claim 3 in which there is a second pair of gear members, actuating means and clutch means assembled in the same arrangement described for the first pair thereof, said second pair capable of selectively translating said carriage a predetermined normal escapement distance greater than said first escapement distance either forward or backward, independent of the width of the character printed, and second control means connected between said key levers and the second pair of actuating means for selectively operating one of the actuating means of the second pair to translate the carriage said normal escapement distance in one of said forward or backward directions, said first and second pairs being operable in sequence whereupon operation of said first pair is effective to selectively increase or decrease the normal escapement distance an

amount directly related to the character imprinted so as to achieve uniform proportional spacing between adjacent printed characters.

5. Apparatus of the character described in claim 3 which includes means for automatically rotating said threaded member to a predetermined zero position with respect to the said mechanism at the line end position of the carriage whereby to achieve a uniform margin for matter printed when the carriage is returned to its line starting position, said last mentioned means comprising a multi-pointed wheel fixed on the shaft, a pair of normally open electrical switches closeable upon engagement with a point of said wheel, normally open electrical switch means, means operable to close said switch means prior to the return of the carriage to line starting or tabulating position, said switch means and pair of switches cooperatively arranged in an electrical circuit to operate said actuating means to turn the rack to said zero position.

6. In a typewriter having a reciprocable carriage and character keys which initiate normal escapement movement of the carriage upon individual depression thereof, an escapement mechanism coupled with said keys, proportional spacing apparatus comprising a circular rack rotatably mounted on the carriage in operable association with the escapement mechanism of the typewriter for rotating the rack to effect said escapement of the carriage, means for selectively rotating the rack clockwise or counter-clockwise supplementary to rotational movement thereof to effect normal escapement movement, a plurality of control mechanisms for initiating operation of said first mentioned means and means carried on the keys for operating said control mechanisms individually to cause selective operation of said first mentioned means upon depression of said keys individually, whereby said carriage is translated rectilinearly a predetermined fractional portion of said normal escapement distance in a direction and amount related to the width of the character which would be imprinted by the individual key depressed whereby uniform spacing between adjacent characters is achieved.

7. In a typewriter having a reciprocable carriage and character keys which initiate normal escapement movement of the carriage upon individual depression thereof, an escapement mechanism coupled with said keys, proportional spacing apparatus comprising a circular rack rotatably mounted on the carriage in operable association with the escapement mechanism of the typewriter for rotating the rack to effect said escapement movement of the carriage, means for selectively rotating the rack clockwise or counter-clockwise supplementary to rotational movement thereof to effect normal escapement movement, a plurality of control mechanisms for initiating operation of said first mentioned means and means carried on the keys for operating said control mechanisms individually to cause selective operation of said first mentioned means upon depression of said keys individually, whereby said carriage is translated rectilinearly a predetermined fractional portion of said normal escapement distance in a direction and amount related to the width of the character which would be imprinted by the individual key depressed whereby uniform spacing between adjacent characters is achieved, and means fixedly mounted on said carriage operable automatically to effect rotation of the rack in a direction opposite to and in equal amount to rotation thereof by said first mentioned means immediately prior to the carriage reaching its extreme right hand margin position.

8. In a conventional typewriter having a reciprocable carriage and character key levers for initiating normal escapement movement unidirectionally of the carriage and a conventional escapement mechanism linked with the key levers, a threaded member rotatably mounted on the carriage in operable association with the mechanism, first and second gear members mounted on the threaded member, actuating means meshed with each of said gear mem-

bers to rotate same either clockwise or counter-clockwise, clutch means associated with the first gear member operable only when said first gear is rotated clockwise to translate said carriage in one of a forward or rearward directions, clutch means associated with the second gear member operable only when the second gear is rotated counter-clockwise to translate the carriage in the other of said directions, and means cooperating with said key levers and connected to said actuating means for initiating operation thereof, individual depression of key levers arranged to effect selective operating of one of said actuating means whereby the carriage is translated a predetermined fractional portion of said escapement distance in one of said two directions directly related to the width of the letter imprinted whereby uniform spacing is achieved with all characters.

9. Apparatus as described in claim 8 in which said actuating means each comprise a solenoid operated plunger meshed with a said gear member, said plungers disposed on opposite sides of the threaded member and capable of limited linear movement an amount sufficient to effect said fractional translation of the carriage.

10. In a typewriter having a reciprocable carriage and character key levers for initiating escapement movement of the carriage, apparatus for translating said carriage a predetermined escapement distance either forward or backward during a complete stroke of a key lever comprising, a circular rack rotatably mounted on the carriage, gear means mounted on the rack, actuating means connected to the gear means to rotate same in either a clockwise or counter-clockwise direction, clutch means associated with the gear means operable only when the gear means is rotated in one of said two directions, and control means connected between said key levers and said actuating means for initiating operation of the actuating means to rotate the gear means in said one direction an angular distance sufficient to translate the carriage said escapement distance in one of said forward or backward directions when a key lever is depressed.

11. Apparatus of the character described in claim 10 in which said actuating means comprises a solenoid operated plunger meshed with said gear means and an electrical circuit including a connector for connecting the circuit to a source of electrical power and a normally open switch between said source and solenoid, said control means connected to close said switch to energize the solenoid.

12. Apparatus of the character described in claim 10 in which said control means comprises an elongate member suspended in the path of movement of said key levers and connected to close said switch when the key lever intercepts said elongate member during its stroke.

13. The structure as described in claim 10 in which said machine has a conventional escapement mechanism connected with said key levers and coupled with said rack to translate said rack a predetermined normal escapement distance uni-directionally independent of the character imprinted and greater than said first mentioned escapement distance, said apparatus arranged to operate either to increase or decrease said normal escapement distance of the carriage an amount related to the width of a character imprinted to achieve uniform proportional spacing.

14. In a typewriter having a reciprocable carriage and character key levers for initiating escapement movement of the carriage, apparatus for selectively translating said carriage either forward or backward a predetermined linear distance of escapement movement during a complete stroke of a said key lever comprising, a circular rack rotatably mounted on the carriage, a pair of gear members mounted on the rack, actuating means meshed with each of said gear members to rotate same in either a clockwise or counter-clockwise direction, clutch means associated with one of said gear members operable only when said gear member is rotated clockwise to translate the carriage in one direction and clutch means associated

15

with the other gear member operable only when said other gear member is rotated counter-clockwise to translate the carriage in the other direction, and control means connected between said key levers and each of said actuating means for selectively initiating operation of a said actuating means to rotate its associated gear member in the direction in which so clutched to translate the carriage said escapement distance in one of said forward or backward directions upon depression of a key lever.

15. Apparatus of the character described in claim 14 in which said typewriter has a conventional escapement mechanism coupled with said rack to move the carriage a normal escapement distance uni-directionally independent of the character imprinted and greater than said first mentioned distance.

16. Apparatus of the character described in claim 14 in which there is a second pair of gear members, actuating means and clutch means operably assembled in the same arrangement described for the first pair thereof, said second pair capable of selectively translating said carriage a predetermined normal escapement distance greater than said first escapement distance either forward or backward independent of the width of the character printed, and second control means connected between said key

16

levers and the second pair of actuating means for selectively operating one of the actuating means of the second pair to translate the carriage said normal escapement distance in one of said forward or backward directions, said first and second pairs being operable in sequence whereupon operation of said first pair is effective to selectively increase or decrease the normal escapement distance an amount directly related to the character imprinted so as to achieve uniform proportional spacing between adjacent printed characters.

17. Apparatus of the character described in claim 16 in which each of the actuating means of said first and second pair comprises an electrical circuit including a solenoid operated plunger movable linearly upon energization of the solenoid, and stop means associated with the plunger for limiting the amount of linear movement thereof related to the distance the carriage is desired to be translated by the apparatus.

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