June 20, 1961 C. DORMAN 2,989,232

CALCULATING MACHINE CARRIAGE SHIFT MECHANISM

Filed March 31, 1958 3 Sheets-Sheet 1

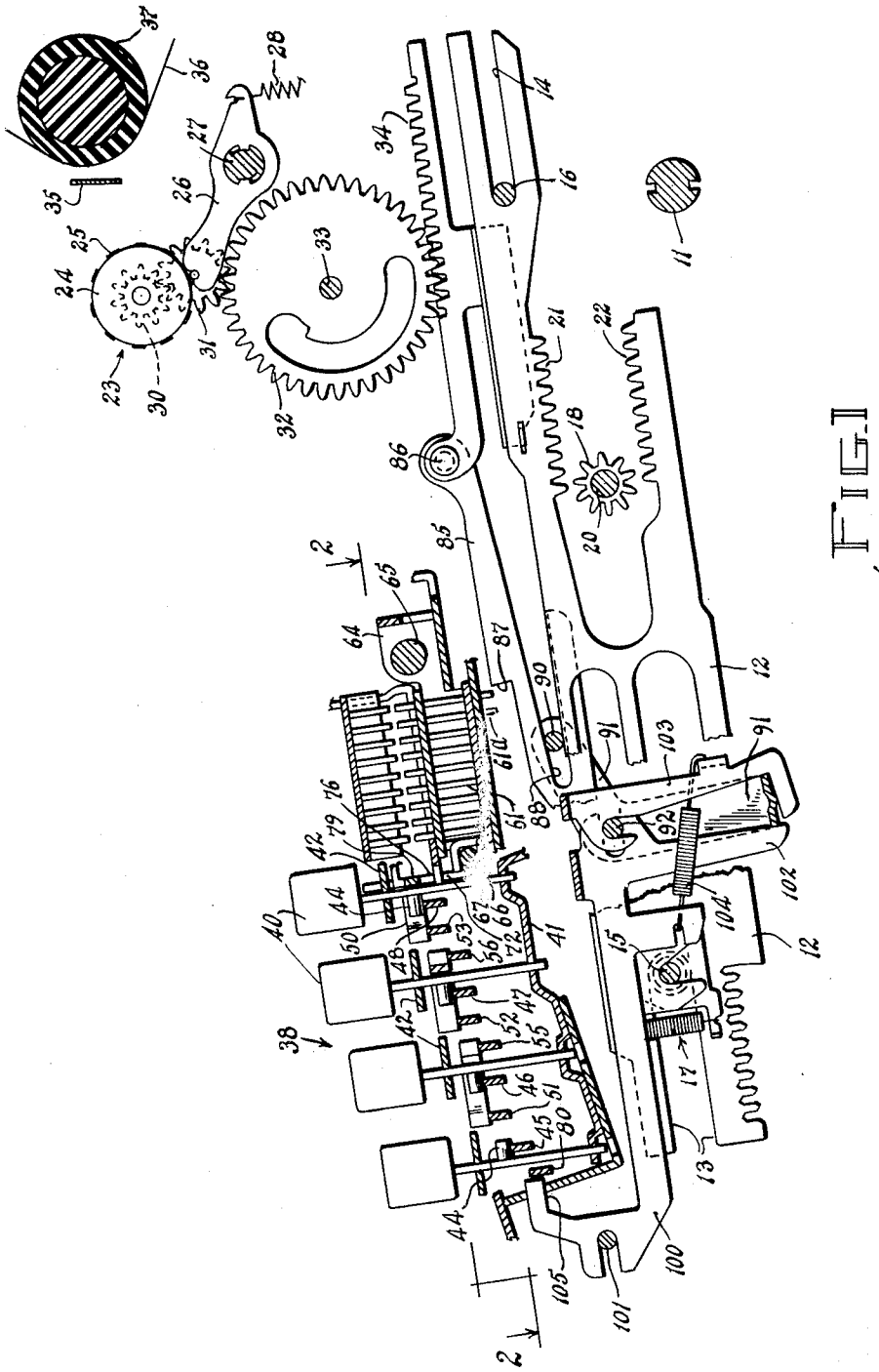

FIG. 1

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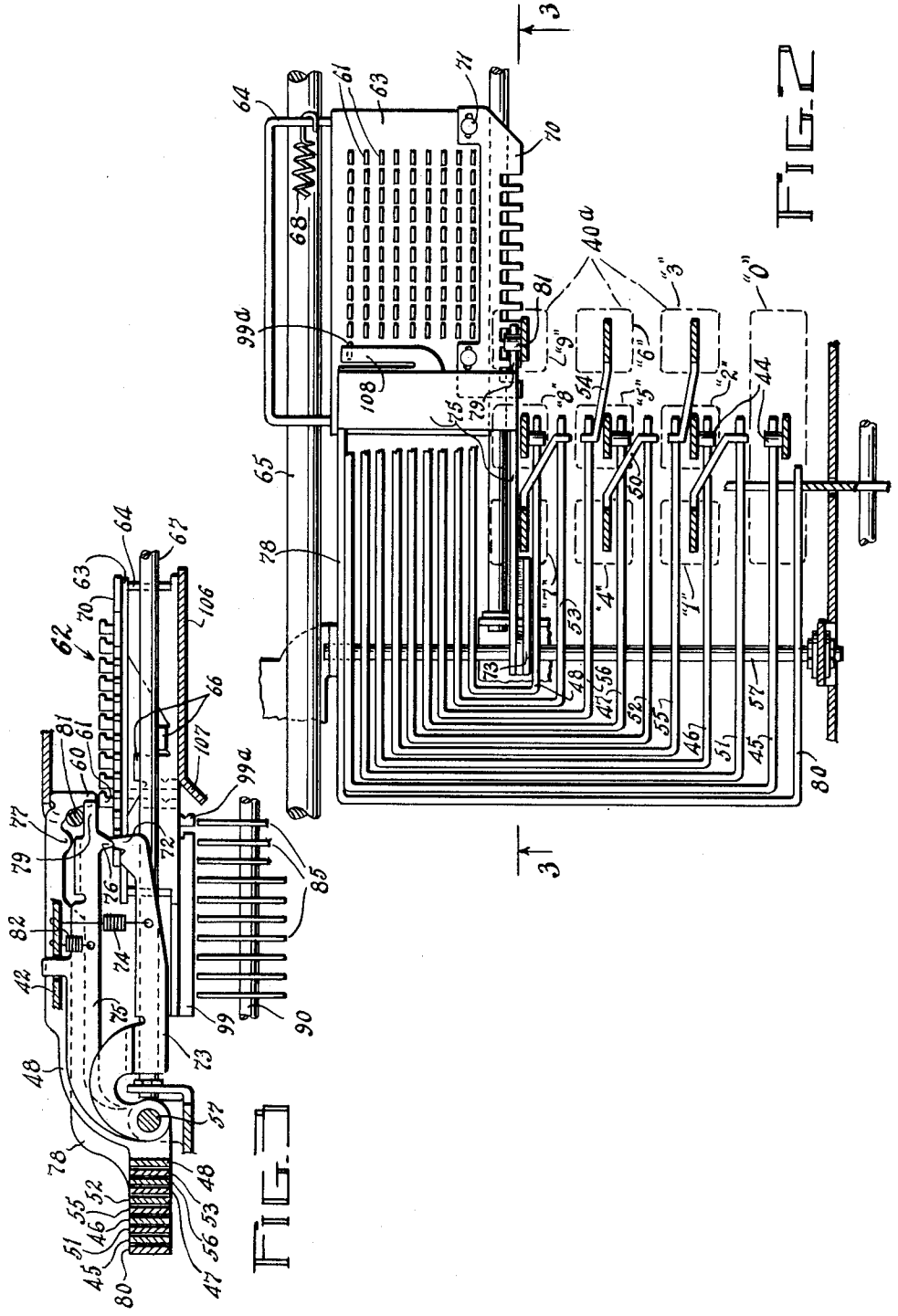

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CALCULATING MACHINE CARRIAGE SHIFT MECHANISM

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FIG. 5

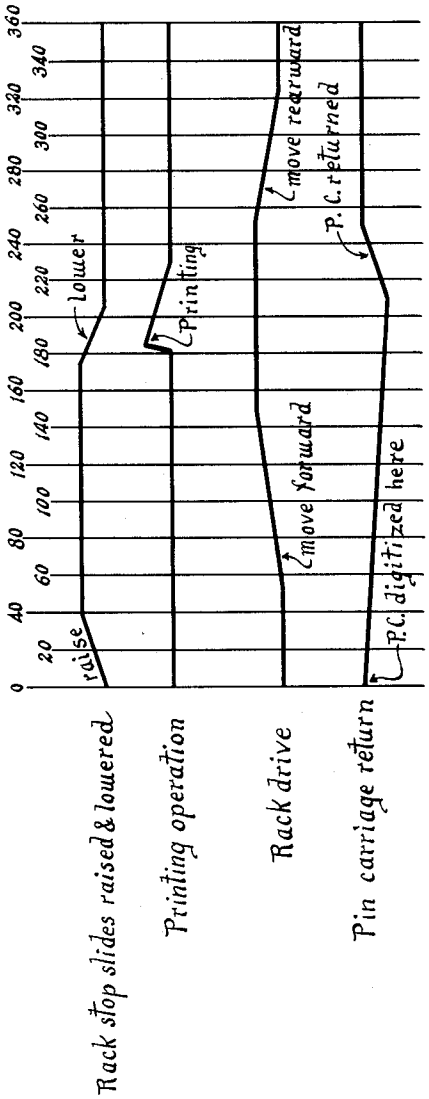
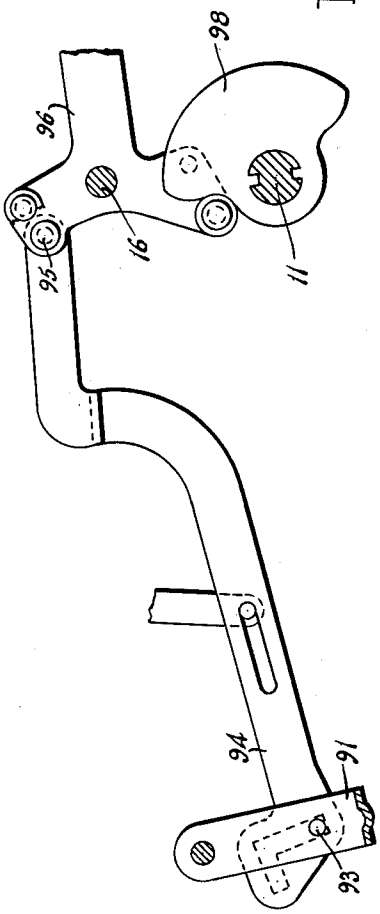


FIG. 4



United States Patent Office 2,989,232 Patented June 20, 1961

2,989,232

CALCULATING MACHINE CARRIAGE SHIFT MECHANISM

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Filed Mar. 31, 1958, Ser. No. 725,034
4 Claims. (Cl. 235—60)

This invention relates to calculating machines and has particular reference to calculating machines of the ten key type.

Such ten key machines usually comprise a stop pin carriage which carries a plurality of actuator stop pins and which is spring urged to travel in one direction across the differential actuators. The pin carriage is stepped in such direction from one denominational position or order to the next as an incident to depression of each of a series of ten amount keys (including a zero key) and consequent setting of an appropriate stop pin in a position to arrest an aligned differential actuator.

In order to effect proper denominational advancement of the pin carriage, under control of the amount keys, an escapement mechanism is generally provided which is actuated by a universal member operable by any of the amount keys. The escapement mechanism, which may take any of a number of different forms, is effective when any amount key is depressed to advance the pin carriage a short distance and, when the key is released, to advance the pin carriage a remaining distance from one denominational position to the next.

Although ten key machines of the above type are generally satisfactory, a relatively fast machine operator can operate "ahead of the machine." That is, after initiating a machine cycle, she may attempt to depress the amount keys to enter the factor of a new problem before the current cycle is completed.

In order to overcome the above problem, machines have been constructed to remove the pin carriage from control or possible interference with the actuators after the latter have been differentially arrested by the stop pins during the first half of the machine cycle, thus permitting depression of amount keys after substantially the mid point in the cycle has been reached. In most cases, a key lock is provided to prevent depression of a key until the mid-portion of the cycle has been reached or until the actuators have been differentially arrested and the pin carriage removed from interference with the actuators. However, operators are known to operate even ahead of this feature so that if depression of an amount key is attempted while the machine is in the early stages of a current cycle wherein the actuators are traveling toward the set stop pins, the operator must wait until the key lock is released or until the pin carriage has been removed from cooperative relation with the actuators. Although such a wait is only momentary and extends over only a fraction of a second, it may be enough to break the rhythm of operation of a relatively fast operator.

This problem shows up particularly in controlling a ten key machine to perform multiplication. In certain modern ten key machines, i.e. in the commercially available Clary ten key adding machine which is disclosed and claimed in the copending patent application of Richard S. Mark et al., Serial No. 506.486, filed May 6, 1955, the operator may effect multiplication by merely entering the multiplicand in the keyboard and thereafter holding both the zero key and the motorized repeat bar depressed until a number of cycles corresponding to the value of the units order digit of the multiplier factor has been reached. The zero key is then momentarily released while the repeat bar is held depressed to step the

pin carriage into its next higher denominational position whereupon, the machine will continue cycling so as to build up a number of cycles equal to the value of the tens order digit of the multiplier factor, etc. Since this multiplying operation is simplified in the above machine to the point where the operator need only release and redepress the zero key in order to multiply by the different digits of the multiplier factor, it may be readily seen that she may attempt to work ahead of the machine.

It therefore becomes a principal object of the present invention to prevent the entry of new amounts for the next cycle in a ten key keyboard machine from interfering with the operation of the machine through a current cycle then in progress.

Another object of the invention is to obviate the necessity of locking the keyboard of a machine of the above type against depression of any keys thereof for the next cycle too early in a current cycle.

Another object is to enable trouble-free depression of an amount key for the next cycle of a ten key type machine before the actuators have completed their differential advancing movement in a current cycle.

The manner in which the above and other objects of the invention are accomplished will be readily understood on reference to the following specification when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a longitudinal section view through a ten key machine embodying a preferred form of the present invention.

FIG. 2 is a sectional plan view taken along the line 2—2 of FIG. 1, illustrating the keyboard, pin carriage and interrelated controls.

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 2, illustrating the pin carriage escapement mechanism.

FIG. 4 is a longitudinal sectional view illustrating the machine controls for raising and lowering the rack stop slides.

FIG. 5 is a timing diagram showing the operation of different components of the machine.

The mechanism of the present invention accomplishes the above objects by permitting the zero key (or any other key) to be depressed for a subsequent cycle at any time while the macnine is in a current cycle while timing the release of such key from depressed position so that it is not released until after the differential actuators have been fully advanced to digitized positions in the current cycle. This feature eliminates any critical timing required on the part of the operator in depressing and releasing the zero key in order to set the carriage from each denominational position to the next during the multiplication operation.

The ten key machine in which the present invention is incorporated is disclosed in the aforementioned application, Serial No. 506,486. Other details of the machine are disclosed in the Robert E. Boyden Patent No. 2,583,810, issued on January 29, 1952, and the Edward P. Drake Patent No. 2,472,696, issued on June 7, 1949. Therefore, for the sake of brevity, only those portions of the machine which embody the present invention or cooperate therewith will be illustrated and described herein. It should be understood, however, that the invention may be equally well applied to other types of ten key adding and calculating machines.

In general, the machine comprises a drive shaft 11 which is rotatable through one revolution during each cycle of operation of the machine, the shaft having various drive instrumentalities thereon effective to operate various units of the machine in proper timed relation.

A plurality of denominationally arranged differentially operable actuator racks 12 are provided, each having slots 13 and 14 at opposite ends thereof which embrace shafts

15 and 16, respectively. The shaft 16 is stationary, but the shaft 15 is advanced to the left in FIGURE 1 to the left and then retracted during each machine cycle, whereby to differentially advance the racks until arrested by set stop pins 61, as will be described later. A yieldable drive device, generally indicated at 17, is provided between the drive shaft 15 and each rack 12 in order to yieldably advance the racks.

As shown in the timing diagram of FIG. 5, the racks are advanced forwardly, to the left of FIG. 1, during a period extending approximately from 50° to 150° in the machine cycle and are returned during the period extending approximately from 250° to 330°.

An accumulator is provided in cooperation with the vairous racks. The accumulator comprises a plurality of accumulator gears 18, one associated with each rack 12 and all independently rotatable on an accumulator shaft 20. During additive operations, the accumulator is raised at the start of a machine cycle to mesh the accumulator gears with upper rack gear sections 21 whereby the gears will be rotated in a counterclockwise direction during subsequent forward rack movements. During subtractive operations, the accumulator is lowered at the start of a machine cycle to mesh the accumulator gears with lower rack gear sections 22 so as to drive the accumulator gears in a clockwise direction.

At approximately 180° in the cycle, and before the racks are returned (during item entry operations), the accumulator is returned to its neutral illustrated position. During the latter half of the cycle, and while the racks are being returned, a tens transfer operation is effected.

The printer, generally indicated at 23, comprises a plurality of printing wheels 24, each of which has formed around the periphery thereof a series of type characters 25, ranging in value from "0" to "9," and these wheels are so entrained with respective ones of the racks 12 that they will each print a digit corresponding to the value of a set stop pin in the associated denominational order, to a numerical position to which the rack is moved in its forward stroke. Each wheel is rotatably mounted on a separate arm 26 which is loosely keyed on a printer control shaft 27 and is urged clockwise by a tension spring 28. Each printer wheel 24 is integral with a gear 30 which meshes with a gear 31 also rotatably mounted on the arm 26.

The shaft 27 is normally held in a position to maintain the gears 31 in mesh with idlers 32 which are rotatably mounted on a stationary rod 33 and are maintained in continual mesh with offset rack extensions 34 integrally connected to associated ones of the racks 12. At approximately 180° in the machine cycle, and after the racks have been differentially advanced, means (not shown) controlled by the drive shaft 11 becomes effective to rock the printer control shaft 27 clockwise and thus allow the springs 28 to carry the various type wheels 24 into printing contact with a printing ribbon 35 and a paper tape 36 which is guided around a platen 37. Thereafter, and before the racks are returned from their forwardly advanced positions, the shaft 27 is returned counterclockwise to return the various type wheel arms 26 to their illustrated positions wherein the gears 31 again mesh with the idlers 32.

The keyboard, generally indicated at 38, comprises a group of ten amount keys whose keytops 40 are arranged in a pattern shown by the dot-dash lines 40*a* of FIG. 2. The amount keys represent different values progressing from "0" to "9."

The stem of each key is slideably mounted in a slot formed in a bottom key frame 41 and top frame strips 42.

As seen in FIGS. 1 and 2, the stems of the "0," "2," "5" and "8" keys have secured thereto studs 44 which overlie extending arms of bails 45, 46, 47 and 48, respectively. The stems of the amount keys "1," "4" and "7" have arms 50 extending to the right thereof which overlie bails 51, 52 and 53, respectively. Also, the stems of the amount keys "3" and "6" have arms 54 extending to the left thereof and overlying bails 55 and 56, respectively.

The various bails 45, etc., are nested together and pivotally mounted on a cross rod 57 suitably supported at its ends by upward extensions of the keyboard frame 41.

Each of the various bails is normally spring held in a counterclockwise rocked position (as viewed in FIG. 3) by an individual spring (not shown) whereby to normally hold the associated amount keys in raised positions. However, upon depression of an amount key, its respective bail will be rocked clockwise about rod 57 causing a hammer portion 60 (FIG. 3) thereon to depress an aligned stop pin 61 carried in a pin carriage, generally indicated at 62.

The pin carriage 62 comprises a box frame 63, the top and bottom walls of which are provided with a field of coordinately aligned slots in which are slideably fitted the various stop pins 61. These pins are located in rows extending longitudinally of the machine, each row comprising nine pins spaced apart distances equal to the increments of advancement of the racks.

Spring means (not shown) are provided to hold the pins either in their normal raised position shown in FIG. 3, or in positions to which they are lowered by the hammer portions 60 of the respective bails, as shown by the dotted lines 61*a* (FIG. 1).

The pin carriage 62 is movable laterally of the machine into cooperative relation with different ones of rack stop slides 85 operatively connected to respective ones of the racks as will be described later on. For this purpose, the side walls 64 of the pin carriage are provided with bearing holes therein slideable along a support shaft 65. At its forward end, the pin carriage is provided with a pair of spaced ears 66 which embrace a second support shaft 67.

An escapement mechanism is provided to enable the pin carriage to be stepped laterally from one denominational order leftward to the next under the urge of a tension spring 68 (FIG. 2), extending between the pin carriage and an anchor point (not shown) on the frame, as an incident to depression of any amount key including the "9" key. For this purpose, a toothed plate 70 is attached by screws 71 to the pin carriage 63, the teeth of which plate are engageable by a tooth 72 of an escapement lever 73 (FIG. 3). The latter is pivoted on the aforementioned pivot rod 57 and is urged upwardly in engagement with the rack plate 70 by a tension spring 74 extending between the same and one of the key frame strips 42.

An auxiliary escapement bail 75, also pivoted on the rod 57, is provided with a tooth 76 lying directly above the tooth 72, but spaced slightly to the left thereof, as seen in FIG. 3.

The bail 75 extends under depending humps 77 formed on the various amount-key-actuated bails, e.g., 45, and as seen in FIG. 2, the second leg 78 of such bail 75 is lengthened and bent back upon itself forming an extension 80 which is also pivoted on the rod 57.

No bail is provided for the "9" amount key. However, a stud 81 extends therefrom to overlie a projection 79 extending from the auxiliary escapement bail 75, whereby depression of this key will lower the bail 75 in the same manner as will the remaining amount keys.

Upon depression of any of the amount keys (except the "9" key), and as the hammer portion of its associated key bail depresses the corresponding pin 61 of the pin carriage, the escapement bail 75 will be rocked downwardly causing the tooth 76 thereon to depress and disengage the escapement tooth 72 from engagement with one of the teeth of the toothed plate 70 on the pin carriage, and in its place presenting the tooth 76. Accordingly, the spring 68 will become effective to advance the pin carriage to the left a slight amount. When the key is thereafter allowed to rise, a spring 82 will return the escapement bail 75 upward to its normal position, removing the tooth 76 from engage-

ment with the toothed plate **70**, and the spring **74** will urge the tooth **72** to raise into the path of the next succeeding tooth of plate **70** whereby the pin carriage will have advanced from one denominational position to the next relative to the racks.

It should be noted at this point that the teeth **72** and **76** are spaced relatively close together so that the pin carriage will escape leftward only a very small portion of its total travel between two adjacent denominational positions during the depression of any amount key, the greater amount of such travel occurring as an incident to raising of the key. Thus, as seen in FIG. 3, a stop pin **61**, upon being set by depression of an amount key, will not move into cooperative relation the right most rack stop slide **85** until the key is released to raised position.

As seen in FIG. 1, each rack has pivoted to the offset rack extension **34** thereof, at **86**, one of the rack stop slides **85**. The latter have stop shoulders **87** which normally, when the machine is in its full cycle position, lay directly below and to the rear of any depressed "0" stop pins **61**. When the pin carriage is in its home position shown in FIG. 3, the shoulders **87** lay below and behind a zero stop ledge **99** integral with the pin carriage and with a dummy zero stop pin **99***a* to be described later.

The various stop slides **85** have slots **88** therein which slideably embrace a bail rod **90** carried by a bail **91** fulcrummed on a pivot rod **92**. Normally, during item entry operations, the bail **91** is coupled through a pin and slot connection **93** (FIG. 4) to a link **94** which is pivotally connected at **95** to a cam follower **96**. The latter is fulcrummed on the shaft **16** and is urged by a spring (not shown) into engagement with a cam **98** keyed on the drive shaft **11**.

At the start of a machine cycle, as indicated in the top line of the timing diagram of FIG. 5, the cam **98** is effective to rock the bail **91** counterclockwise, raising the rack stop slides **85** so that they will be located behind any depressed stop pins **61** of the pin carriage, in positions to be differentially arrested by such pins. At approximately 180°, and prior to return of the racks to their illustrated home positions, the cam **98** permits the cam follower **96** to rock counterclockwise under the urge of a spring (not shown), rocking the bail **91** clockwise to lower the rack stop slides **85** below the level of the bottom edges of any set stop pins. Thus, the pin carriage may be laterally advanced to successively higher orders or may be returned to its home position after the 180° point in the cycle has been reached. Actually, the pin carriage is returned during the period extending approximately from 210° to 250°.

During repeat operations pin **93** does not engage the horizontal portion of the inverted L-slot in the link **94**. During repeat operations the link **94** remains coupled to bail **91**. The pin **93** enters the idle position in the L-slot only during total and sub-total operations, as explained in the co-pending Mark et al. application Serial No. 506,486, filed May 6, 1955, which is referred to in the present application.

Since the pin **93** continues to couple the link **94** to the bail **91**, during repeat operations the bail **91** is restored to its initial position (i.e. rotated clockwise) by a leftward movement of link **94** (see FIGS. 1 and 4). This leftward motion of link **94** is caused by the return of cam follower **96** to its illustrated position (FIG. 4) at mid-cycle by a spring (not shown).

It will be appreciated that when bail **91** is rotated clockwise in the manner described, the lower crossmember of bail **91** (seen in section in FIG. 1) exerts a positive driving force against extension **102** to move the latch slide **100** to the left for release of the shoulder **105** from engagement with bail extension **80**. Spring **104** and retainer lever **103** do not serve to release the latch; their function is to yieldably drive the latch slide **100** to the right for latching purposes when the bail **91** is rotated counter-clockwise.

Referring to FIG. 3, the stop pins **61** are returned to their raised positions during return of the pin carriage to its right hand home position by a stationary cam plate **106** which extends the length of the various rows of pins and is suitably secured, in a manner not shown, to the framework of the keyboard. The cam plate has a deflecting portion **107** against which depressed ones of the stop pins engage and are deflected upward during return of the pin carriage.

In the home position of the pin carriage, as indicated in FIG. 3, the leftmost row of stop pins **61** are located over the lower edge of the deflecting portion. By the time the pin reaches its lowermost position, the escapement tooth **72** of the escapement lever **73** has been removed from engagement with the adjacent tooth of the toothed plate **70** on the pin carriage, permitting the same to move through the initial portion of its escapement movement to carry the depressed pin past such deflecting portion.

It will be appreciated that during the return of the pin carriage to its home position, the latter must overtravel somewhat beyond its position shown in FIG. 3 to cause the left most row of pins **61** to pass completely over the deflecting portion **107** so as to cam any depressed pin in that row into its upper position. However, in order to prevent the zero stop ledge **99** from striking the deflecting portion **107** during such overtravel, the dummy zero stop pin **99***a* is yieldable upward in its slots, acting against a leaf spring **108** (FIG. 2) attached to the upper surface of the pin carriage frame. The spring **108** will normally hold the zero pin **99***a* in its lower position illustrated in FIG. 3.

According to the present invention, a latch slide **100** (FIG. 1) is provided having slots embracing at one end the rod **92** and at its opposite end a stationary rod **101**. A retainer lever **103** is pivotally supported on rod **92** in juxtaposition with slide **100**, and a tension spring **104** is extended between the slide and retainer lever to hold a depending projection **102** of the slide normally against the lower edge of the bail **91**. When the bail is in its normal position shown in FIG. 1, a latching shoulder **105** on the latch slide lies directly in front of, but out of engagement with, the extension **80** of the escapement bail **75**, permitting depression and raising of the escapement bail by any of the amount keys. However, upon initiation of a machine cycle, the bail **91** will be rocked counterclockwise, as described heretofore, causing the spring **104** to urge the latching slide **100** to the right in FIG. 1 whereupon, if no amount key is in depressed position, the latching shoulder **105** will abut against the side of the escapement bail extension **80**, causing the spring **104** to yield. If, during the first half of a cycle, the zero or any other amount key is depressed, the extension **80** is lowered permitting the slide **100** to snap its locking shoulder **105** over the extension, thus preventing return of the escapement bail to its upper position. Accordingly, the pin carriage can only escape a very short distance, insufficient to move any set stop pins from complete alignment with their rack stop slides. Accordingly, the zero or any other amount key may be depressed while the machine is in the early part of an amount entry cycle, but will be prevented from effecting advance of the pin carriage to its next higher order until the midportion of the cycle has been reached.

In performing multiplication by means of the disclosed machine, a convenient manner of controlling the same is to simultaneously depress a motorized repeat bar (not shown) and the zero or any other amount key, keeping them depressed after the multiplicand has been entered into the pin carriage. The repeat bar and zero key are held depressed until the requisite number of cycles corresponding to the value of the units order of the multiplier digit have been completed, at which time the zero or other amount key is allowed to raise momentarily, enabling the pin carriage to advance to the next higher denominational order.

Since the latch slide **100** will prevent the pin carriage from advancing until the 180° point has been reached, i.e. until the pin carriage is otherwise free to advance, it will be seen that downward pressure on the zero or other amount key may be released at any time after the start of the cycle. Therefore, no critical timing is required of the operator since he may release pressure on the zero or other amount key at any time during the cycle.

Although I have described my invention in detail and have therefore used certain terms and language herein, it is to be understood that the present disclosure is illustrative rather than restrictive, and that changes and modifications may be made without departing from the spirit or scope of the invention as set forth in the claims appended hereto.

Having thus described the invention, what I desire to secure by United States Letters Patent is:

1. In a calculating machine, differentially moveable actuators, drive means for advancing and thereafter retracting said actuators, a carriage including settable elements for differentially limiting the extent of movement of said actuators; a depressible zero key, a carriage shift control member depressible by said zero key upon depression thereof, means responsive to release of said shift control member from depressed position for advancing said carriage laterally to move said elements from alignment with certain of said actuators into alignment with adjacent actuators, and means preventing release of said shift control member from depressed position during advancement of said actuators and for enabling release of said shift control member during retraction of said actuators.

2. In a calculating machine, differentially moveable actuators, cyclically operable drive means for advancing and thereafter retracting said actuators, a carriage including settable elements for differentially limiting the extent of movement of said actuators; a depressible zero key, a carriage shift control member depressible by said zero key upon depression thereof, yieldable means for returning said shift control member from depressed position, means responsive to return of said shift control member from depressed position by said yieldable means for advancing said carriage laterally to move said elements from alignment with certain of said actuators into alignment with adjacent actuators, and means operable by said drive means for preventing return of said shift control member by said yieldable means during a first predetermined portion of a cycle of said drive means and for

thereafter enabling return of said shift control member by said yieldable means.

3. In a calculating machine, differentially moveable actuators, cyclically operable drive means for advancing and thereafter retracting said actuators, a carriage including settable elements for differentially limiting the extent of movement of said actuators; a depressible zero key, a carriage shift control member depressible by said zero key upon depression thereof, spring means for returning said shift control member from depressed position, means responsive to return of said shift control member from depressed position by said spring means for advancing said carriage laterally to move said elements from alignment with certain of said actuators into alignment with adjacent actuators, a normally ineffective latch for latching said shift control member in depressed position, and means operable by said drive means during a first predetermined portion of a cycle for rendering said latch means effective, said last mentioned means being operable by said drive means during a second predetermined portion of said cycle for rendering said latch means ineffective.

4. In a calculating machine, differentially moveable actuators, drive means for advancing and thereafter retracting said actuators, a carriage including settable elements for differentially limiting the extent of movement of said actuators; a depressible zero key, a carriage shift control member depressible by said zero key upon depression thereof, spring means for returning said shift control member from depressed position for advancing said carriage laterally to move said elements from alignment with certain of said actuators into alignment with adjacent actuators, a normally ineffective latch for latching said shift control member in depressed position, and means operable by said drive means upon advancement of said actuators to render said latch means effective, said last mentioned means being operable by said drive means upon return of said actuators to render said latch means ineffective.

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