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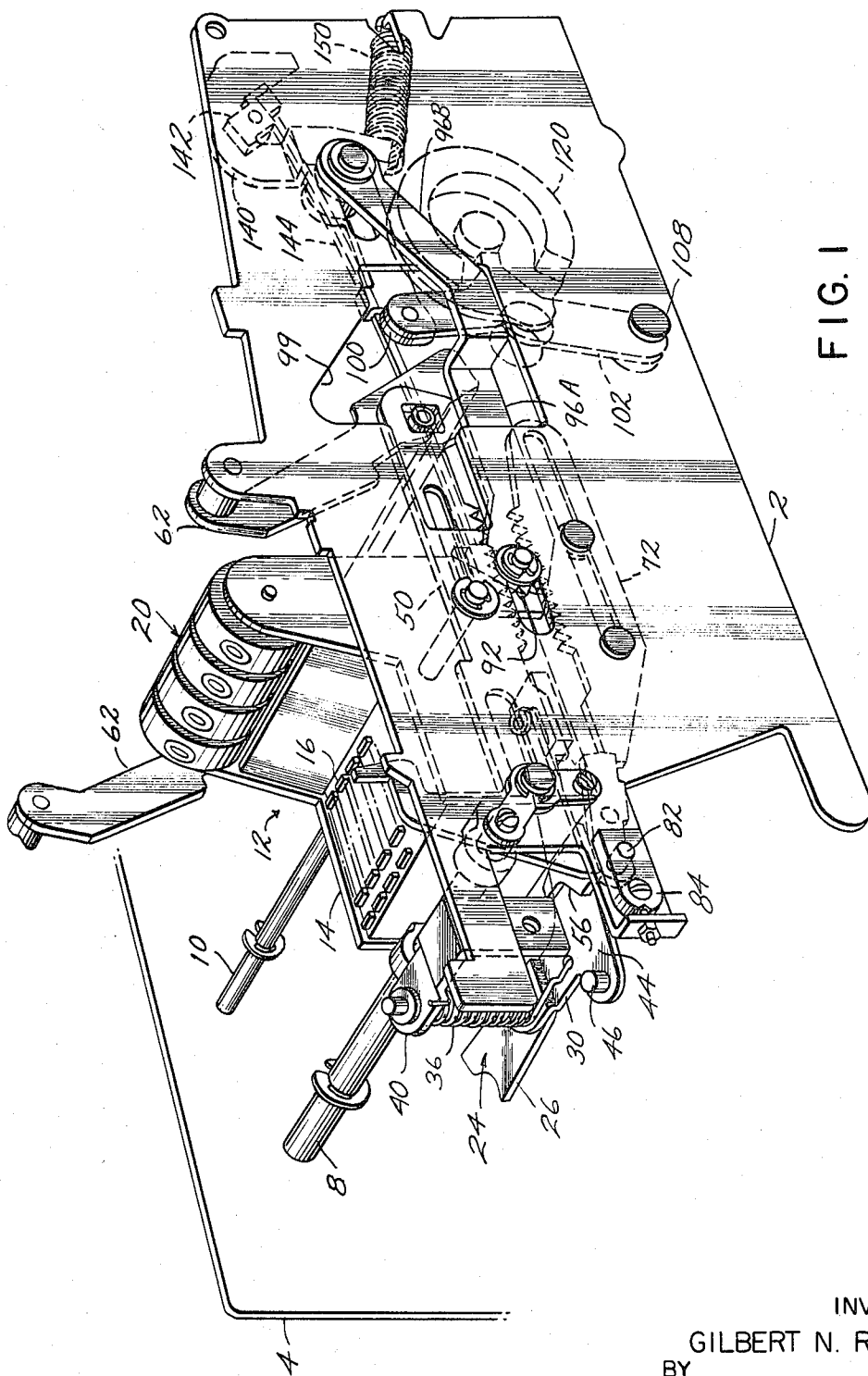
G. N. RILEY

3,384,302

CARRIAGE RESTORING MECHANISM

Filed Feb. 16, 1966

3 Sheets-Sheet 1



INVENTOR.

GILBERT N. RILEY

BY

Nicholas A. Pandiscio

ATTORNEY

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G. N. RILEY

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5 Sheets-Sheet 2

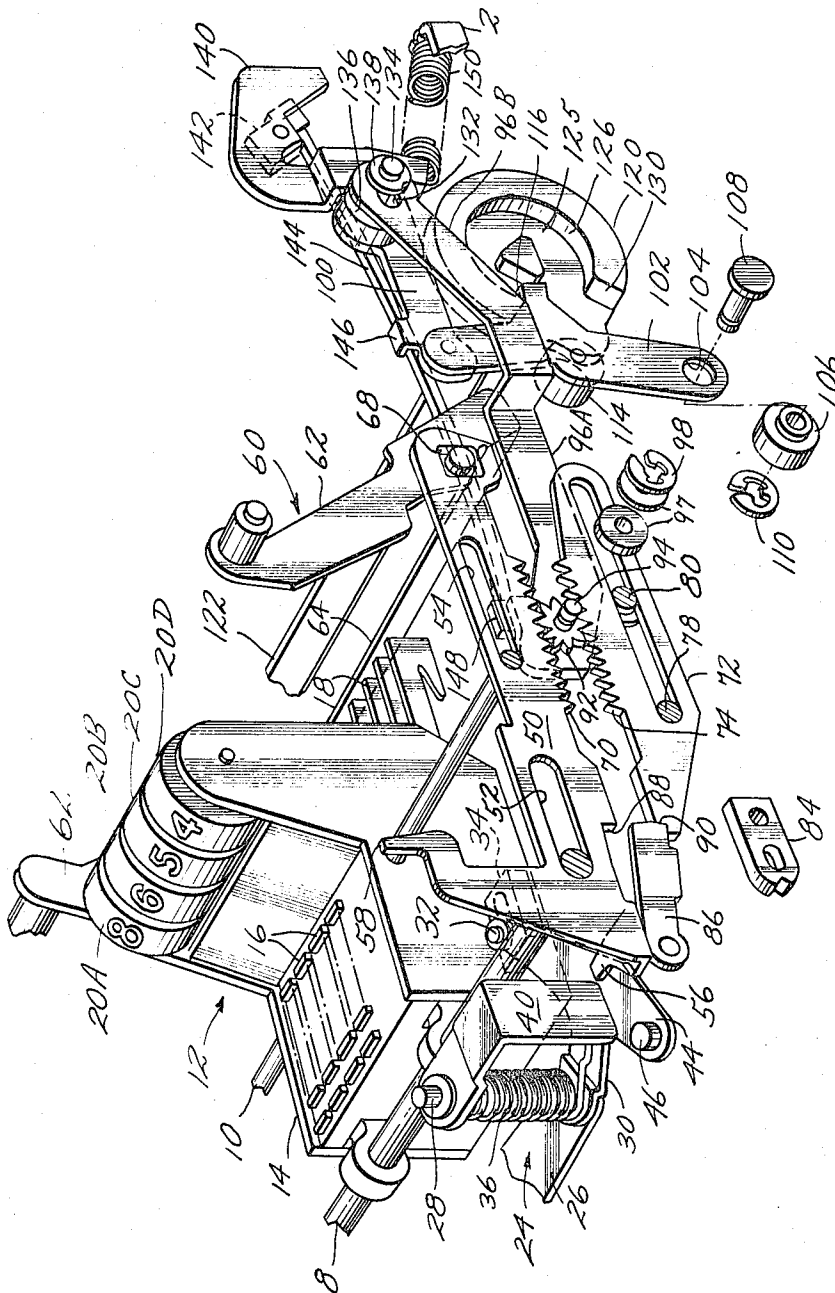


FIG. 2

INVENTOR.

GILBERT N. RILEY

BY

Nicholas A. Pandolico

ATTORNEY

May 21, 1968

G. N. RILEY

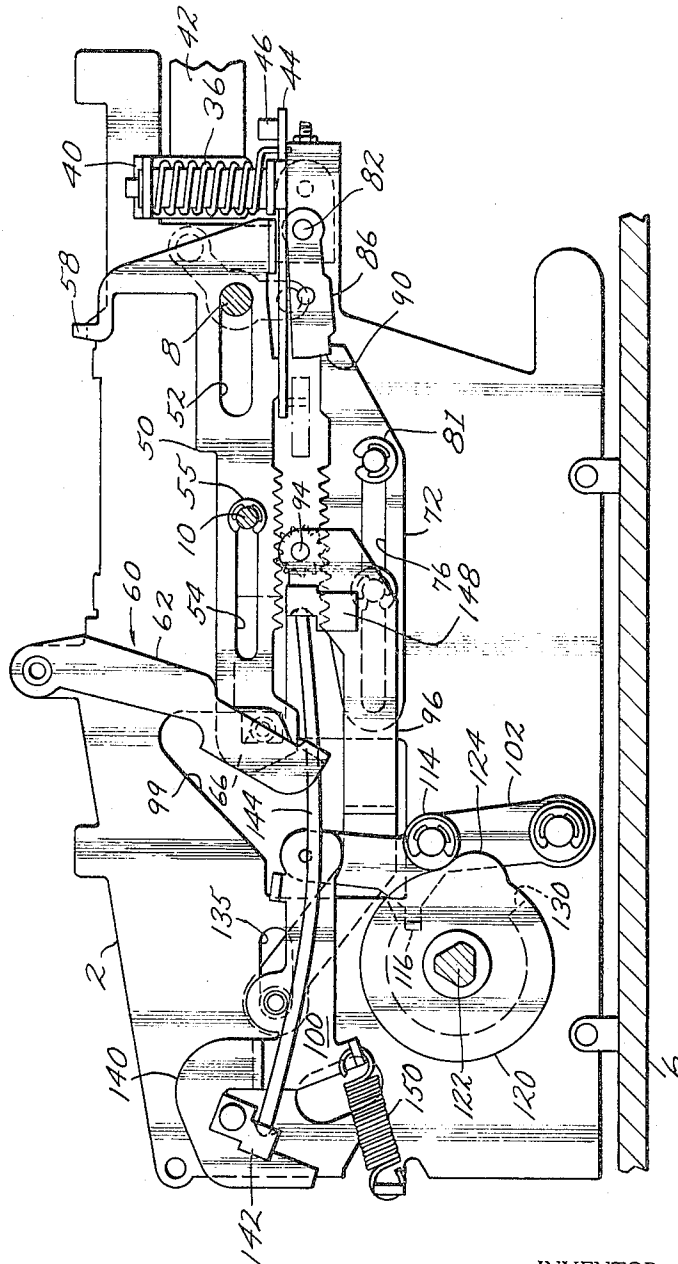
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CARRIAGE RESTORING MECHANISM

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3 Sheets-Sheet 3

FIG. 3



INVENTOR.

GILBERT N. RILEY

BY

Nicholas A. Pandasio

ATTORNEY

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3,384,302

CARRIAGE RESTORING MECHANISM

Gilbert N. Riley, Norwalk, Conn., assignor to Pitney-Bowes, Inc., Stamford, Conn., a corporation of Delaware

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28 Claims. (Cl. 235—60.41)

This invention relates to keyboard actuated mechanisms for entering values into value-indicating means as are commonly used in adding machines, and the like, and more particularly to means for restoring to home position a value-indicating mechanism of the type that indexes from one denominational order to a higher denominational order each time a key is depressed.

A conventional keyboard actuated mechanism of the type to which the invention relates generally comprises a carriage adapted for movement from one to the other of a number of predetermined index positions each corresponding to a different denominational order, the carriage carrying a plurality of value-indicating means each representing a different denominational order, a like plurality of value-setting control elements each for entering values into a different one of said value-indicating means, and means operable by the keyboard for operating a different value setting control element at different index positions of said carriage. Each time a key of this type of conventional keyboard mechanism is operated to enter the designated value of that key, that designated value is indexed into the higher denominational order and the designated value of any previously operated key is indexed from whatever denominational order it occupied into the next higher denominational order. After a particular value has been set by operation of one or more keys and the whole number values in the respective denominational orders have been entered into appropriate value-registering means, the mechanism is reset for entry of a new value. This resetting operation includes resetting the value-setting control elements and the value-indicating means and returning the carriage to its original home position so that the next time a key is operated to enter a designated value, that designated value will be entered into the lowest denominational order. The mechanism for restoring the carriage to home position must be operative regardless of whether the carriage is in the index position corresponding to the highest denominational order or in any other index position removed from the home position.

In practice the carriage restoring mechanism must meet several other requirements in addition to being operative at any random position of the carriage. For one thing, in an electrically powered machine having a timing cam shaft, the operating cycle is fixed and the time available for restoring the carriage to home position is generally limited to a brief period at the end of the cycle. Typically the operating cycle is less than 1 second with the carriage restoring operation required to be completed within an interval commencing at about the 285° position and ending at or slightly before the 330° position of the timing cam shaft. Hence there is insufficient time to permit slow acceleration of the carriage at the beginning of the resetting operation and slow deceleration of the carriage as it approaches home position. Instead the carriage must attain maximum velocity almost immediately and then decelerate rapidly to a suitable minimum velocity at the end of the restoring operation. The restoration force that is required to be applied to achieve maximum carriage velocity is a function of the mass of the carriage and the acceleration to be imparted. The almost zero rise time for attaining maximum velocity necessitates maximum acceleration almost immediately and this involves a restoration force of such magnitude as to produce a substantial impact on the carriage and mecha-

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nism associated therewith. At its worst such an impact will result in destruction of parts; at its very least it will tend to produce undue wear and excessive noise. Accordingly a further requirement is that the restoring mechanism be able to return the carriage to home position within its allotted time without subjecting it or any of the mechanisms associated therewith (including the restoring mechanism) to excessive shock force. Where an electrically operated business machine embodies means for manually clearing it of entered values, it is a further requirement that the carriage restoring mechanism be adapted for operation by the manual clearing means independently of the machine's drive system. Still another requirement is provision of means for preventing operation of the carriage restoring mechanism when it is desired to repeat the operating cycle without clearing the machine of entered values.

Accordingly the primary object of the present invention is to provide a novel carriage restoring mechanism that meets the foregoing requirements and also offers other advantages over other mechanisms in the prior art.

The present invention contemplates that the initial velocity required to achieve carriage restoration within the allotted time will vary with different index positions of the carriage. Accordingly a more specific object of the invention is to provide a carriage restoring mechanism that is designed to apply a predetermined maximum restoring force or different amount of restoring energy to the carriage at different index positions.

It is appreciated that the driving force available for operating the carriage restoring mechanism in an electrically operated machine is substantially constant. Accordingly a further specific object of the invention is to provide a carriage restoring mechanism involving a force translating means that is designed to absorb a portion of the energy of said driving force and to transmit the remainder to the carriage as a restoring force, the relative proportions of absorbed and transmitted energy varying in accordance with the index position of the carriage.

Briefly a carriage restoring system of the character described involves a force translating mechanism comprising a column spring, means supporting the column spring in pre-stressed condition between two members of the force translating mechanism, means for applying a driving force to one member at one end of the spring, and means for bringing the other member into position for restoring the carriage to home position in response to movement of the spring by the driving force through the first member. The system also includes a differential mechanism for selectively preventing operation of said last-mentioned means in response to movement of the spring, plus means for operating said last-mentioned means independently of the spring.

Other objects and many of the attendant advantages of the present invention will become more readily apparent from the following detailed specification when considered together with the accompanying drawings, wherein:

FIG. 1 is a fragmentary perspective view of a portion of a business machine embodying a preferred form of the invention, with the carriage in the home position;

FIG. 2 is an exploded perspective view of the apparatus of FIG. 1 but with the side plates omitted and the carriage shifted to an index position corresponding to a higher denominational order; and

FIG. 3 is a sectional view in side elevation looking at the inner surface of the side plate that is foremost in FIG. 1.

Referring now to FIGS. 1, 2 and 3, the illustrated apparatus comprises two vertical side plates 2 and 4 that are attached to and supported by a horizontal base 6. Supported by and extending between the two side plates are two horizontally disposed parallel spaced rods 8 and

10. The foregoing structure acts as a support for a carriage unit 12 which is slidably mounted on rods 8 and 10. The carriage unit is conventional in the art and preferably corresponds generally in construction and mode of operation to the carriage unit 11 described and illustrated in U.S. Patent No. 3,156,411, issued Nov. 10, 1964, to J. E. McEvoy for "Value Entering Device Useful For Mixed Numbers."

The carriage unit 12, also commonly called a "pin basket," is related to and forms a part of the present invention only to the extent that it is returned to home position by the mechanism hereinafter described. Accordingly its details of construction are not pertinent to the present invention and it may be modified in various ways as taught by McEvoy and the prior art without affecting the construction or mode of operation of the present invention. For this application it suffices to state that the illustrated carriage unit 12 comprises a box-like support 14 that carries four rows of vertically slidable pins or rack stop bars 16. In the usual case each row includes ten control elements 16, one for each of the digits "0" through "9." These vertically slidable stop bars are settable by keys supported by a keyboard (not shown) that generally is mounted above the carriage. Also carried by the carriage unit are four indicator setting control elements in the form of toothed racks 18, one for each row of rack stop bars 16.

By appropriate means (not shown) illustrated and described in said U.S. Patent 3,156,411, each rack 18 is adapted to be moved longitudinally in response to setting of individual rack stop bars 16, each row of stop bars operating a different rack with the length of the operating movement of the rack varying by predetermined increments according to which of the ten stop bars is set. No rack movement occurs when a stop bar 16 that corresponds to the digit "0" is set. Thus, setting a rack stop bar 16 corresponding to the digit "1" will cause the rack 18 to move one increment while depressing the rack stop bar 16 corresponding to the digit "9" will cause the rack 18 to advance nine increments. The carriage unit 12 also carries four value indicators 20 each carrying the whole numbers "0" through "9," plus means (not shown) for actuating each indicator from a different rack. Each indicator indexes one whole number for each of the nine increments of movement of the rack with which it is associated. Four value indicating windows (not shown) are provided by the casing of the machine and when an indicator is actuated the value displayed in a window by that particular indicator corresponds to the value of the key used to initiate movement of the rack 18 that caused it to be actuated. Thus the whole number 9 is positioned for display when a rack has moved to its maximum extended position.

The carriage is constantly urged to the left away from its home position (FIG. 1) by a torsion spring mechanism identified generally by numeral 24 and an indexing means in the form of a keyboard operated escapement mechanism (not shown) is provided for permitting the carriage to move under the influence of the torsion spring mechanism to a number of index positions corresponding to successively higher denominational orders. The torsion spring mechanism comprises a rigid horizontally extending support bar 26 to which is affixed a vertical pivot pin 28. Pivotaly mounted on pin 28 is a lever 30, one end of which is pivotally connected by pin 32 to bracket 34 (FIG. 2) attached to carriage 12. Bracket 34 has a slot to permit relative sliding movement of pin 32. Also mounted on pivot pin 28 is a torsion spring 36. The upper end of pivot pin 28 is held by a bracket 40 which is attached to a rigid member 42 (FIG. 3) that is connected (by means not shown) to the base plate 6. Although not shown, support bar 26 also is secured to rigid member 42. The torsion spring 36 is connected at one end to lever 30 and at the other end to bracket 40 and is arranged

so as to urge lever 30 counterclockwise (as seen in FIGS. 1 and 2) about pivot pin 28.

The keyboard (not shown) is stationary and its keys are adapted to operate a different row of stop bars 16 in each index position of the carriage. Thus, let it be assumed that the carriage unit 12 is in its home position and that the value "8654" is to be entered. The whole number key representing the value "8" is depressed to set the ninth rack stop bar 16 of the first row of stop bars (viewed from left to right in FIGS. 1 and 2). This causes the associated rack 18 to operate the corresponding indicator 20A by an amount sufficient to display the whole number "8." Thereafter the carriage unit is indexed one space to the left (as viewed in FIGS. 1 and 2) to shift indicator 20A to a display position representing the lowest denominational order of values. Depressing the "6" key causes the seventh stop rack bar in the second row of stop bars to be actuated, thereby causing indicator 20B to operate by an amount to display the whole number "6." The carriage then is indexed to place the indicator 20A in the next highest denominational order display position and indicator 20B in the lowest denominational order display position. Successive operation of the "5" and "4" keys cause similar operation and indexing of indicator 20C and 20D, so that on completion of entry of the full value an "8" is displayed in the highest denominational order position, a "6" is displayed in the next lower denominational order position, a "5" is displayed in the next lower denomination order position, and a "4" is displayed in the lowest denominational order position.

Racks 18 may be reset before or after the carriage is returned to home position. Preferably, as in the present case, they are reset while the carriage is restored. Resetting of racks 18 causes resetting of the indicator means 20. Rack stop bars 16 are reset during restoration of the carriage by cam means not shown. Although not shown, it is to be appreciated that the machine may also include value registering means that are operated by or in response to racks 18, as taught by said McEvoy Patent No. 3,156,411.

To the extent already described the apparatus illustrated in the drawings is conventional and further elaboration is not believed necessary. The mechanism for restoring the carriage 12 will now be described.

The carriage-restoring mechanism acts through lever 30 to restore the carriage to its home position. For this purpose lever 30 has an extension 44 that is provided with a vertically extending abutment in the form of a stud 46. The carriage-restoring mechanism acts on stud 46 to pivot lever 30 clockwise to shift the carriage back to its home position.

The carriage-restoring mechanism comprises a lever 50 located adjacent to the inner surface of side plate 2 and supported by rods 8 and 10. Lever 50 is provided with two elongated slots 52 and 54 which enable it to be moved back and forth along a path extending at right angles to rods 8 and 10. Snap rings such as shown at 55 prevent the lever from moving away from the adjacent side plate. Lever 50 is provided at its forward end with a lateral extension in the form of a finger 56 disposed so as to engage stud 46 when the rack is moved forward to the extent permitted by slots 52 and 54. Lever 50 also has a vertical extension 58 that is in contact with a mechanism, not shown, so that the lever may be moved manually.

At its rear end lever 50 is coupled to a U-shaped bail 60 that is adapted to clear the carriage, that is, restore racks 18 to their original position. Bail 60 comprises two vertically extending arm portions 62 that are pivotally attached to side plates 2 and 4 and a center portion 64 that extends horizontally behind the carriage in position to engage the ends of racks 18 and force them back to their original position when the bail is pivoted toward the carriage. The coupling between the bail 60 and lever 50 comprises a stud 66 attached to the nearest arm 62

of the bail and positioned in a rectangular hole 68 formed in the rear end of the lever. The bail is actuated to restore racks 18 to their original position either by manually operating the lever 50 through its vertical extension 58 or through mechanism hereinafter described that is controlled by the drive system of the machine.

Lever 50 is provided with gear rack 70 on its lower edge. Disposed below lever 50 in parallel spaced relation thereto is a second lever 72 having a gear rack 74 on its upper edge. Lever 72 is provided with an elongated slot 76 to accommodate two supporting studs 78 and 80 that are attached to side plate 2. Snap rings 81 (FIG. 3) prevent lever 72 from moving away from the adjacent side plate. Also attached to side plate 2 by means of a pivot pin 82 (FIG. 3) and a pivot pin bearing plate 84 is a latch 86. Latch 86 is adapted to selectively lock lever 50 or lever 72 against forward movement. For this purpose lever 50 is formed with a shoulder 88 on its bottom edge in position to be locked by latch 86 when the latter is pivoted upwardly, and lever 72 is notched to form a second shoulder 90 for engagement by latch 86 when the latter is moved downwardly. In FIGS. 1-3 latch lever 86 is in its down position, so that lever 72 is locked and lever 50 is free to be moved.

Operatively associated with the racks 70 and 74 of levers 50 and 72 is a pinion gear 92 that is rotatably mounted on a stud 94 that is carried by the front end of a lever 92. Pinion gear 92 is held on stud 94 by a plurality of spacer members 97 and a snap ring 98. Lever 96 is offset, having a forward portion 96A located on the inner side of side plate 2 and a rear portion 96B located on the outer side of side plate 2. A suitable aperture 99 is provided in side plate 2 to accommodate the offset portion of lever 96 and to permit the lever to move back and forth along a path extending at right angles to the carriage support rods 8 and 10.

The rear end 96B of lever 96 is coupled through a limited lost motion connection to one end of a link 100, which is pivotally connected to a cam follower lever 102 disposed adjacent the inner surface of side plate 2. The bottom end of lever 102 is pivotally secured to side plate 2. For this purpose the bottom end of the cam follower lever is provided with an aperture 104 to accommodate a bearing sleeve 106 having a central aperture for a stud 108 that extends through side plate 2. Bearing sleeve 106 is locked to stud 108 by means of a conventional snap ring 110. Cam follower lever 102 is provided with a cam follower in the form of a roller 114 and a cam guide in the form of a lateral extension 116, both of which are operatively associated with a cam 120. The latter is mounted on and is rotatable with a cam shaft 122 that extends parallel to rods 8 and 10 and is operatively connected to and driven by the drive mechanism (not shown) of the machine. At this point it is to be understood that during one cycle of operation of the machine, cam shaft 122 and cam 120 undergo one complete revolution.

The periphery of cam 120 is of circular configuration except for a cam lobe 124 that encompasses approximately 70° of arc. The end face of the cam also is provided with a circular cavity 125 so as to leave an internal circular surface 126 along which rides the laterally extending cam guide 116. The cam is also provided with a radial slot 130 that serves as an entrance way to cavity 125 for cam guide 116. Cam 120 is shown in its home position, with slot 130 located so that cam guide 116 (and thus cam follower lever 102) is free to move forward away from the cam. However, on rotation of cam 120, slot 130 moves out of registration with the cam guide, trapping the cam guide in cavity 125 and thus preventing the cam follower lever from being pivoted away from the cam.

The pivotal connection between the rear section 96B of lever 96 and link 100 is effected by an elongated slot 132 in lever 96 and a pin 134 attached to link 100. Pivot pin 134 projects through side plate 2, an elongated slot

135 being provided in the side plate to permit displacement of the pivot pin. A spacer 136 is disposed between link 100 and side plate 2 and a snap ring 138 maintains lever 96 on pivot pin 134. Slot 132 permits a limited amount of lost motion between lever 96 and link 100. With the mechanism in its at rest position, pin 134 is at the rear end of slot 132, as shown in FIG. 2.

Link 100 is provided with an extension 140 at its rear end. This extension rigidly supports a small block 142 which serves as an anchor for the rear end of a column spring 144. The latter extends forwardly alongside link 100 beneath the stud 66 connecting bail 60 and lever 50. A lateral extension 146 on link 100 projects over column spring 144 and prevents the latter from moving into contact with stud 66. The forward end of column spring 144 is anchored in a second block 148 that is secured to the end of the forward portion 96A of lever 96. The length of column spring 144 and the location of blocks 142 and 148 is such that the column spring is in a pre-stressed condition with the carriage restoring mechanism at rest, substantially as shown in FIGS. 1-3. Link 100 is further provided with a depending extension to which is connected one end of a tension spring 150. The opposite end of tension spring 150 is secured to side plate 2. Tension spring 150 acts through arm 100 to urge cam follower lever 102 clockwise (as seen in FIG. 2) so as to maintain its roller 114 in engagement with the peripheral surface 120 of the cam; this same action of spring 150 urges lever 50 rearwardly, i.e., to the right as seen in FIG. 2, to the limit permitted by slots 52 and 54.

Operation of the carriage restoring mechanism will now be described starting with the carriage out of home position and lever 72 locked against movement by latch 86. With the carriage in an index position corresponding to a higher denominational order, the abutment 46 will be displaced from the position shown in FIG. 1 and will be closer to the finger 56 of lever 50 as illustrated in FIG. 2. Upon initiation of the cycle of operation of the machine, the cam shaft 122 will rotate counterclockwise (as seen in FIG. 2). The immediate effect of rotation of cam 120 is to captivate cam guide 116 so that the cam follower lever 102 cannot be moved forwardly away from the cam by manual operation of lever 50. During the major portion of the cycle of operation the cam follower lever 102 will remain stationary. However, as cam lobe 124 moves into engagement with roller 114, the cam follower 102 will begin to pivot forwardly, that is, counterclockwise as seen in FIGS. 1 and 2. This forward movement of the cam follower 102 will cause link 100 to move forward. This forward movement of link 100 drives spring 144 forward and thereby (due to the fact that spring 144 is connected to the front end of lever 96) causes movement in the same direction of lever 96. The net effect is to force pinion gear 92 to move along rack 74. This movement of gear 92 in turn causes lever 50 to move forward. During the initial portion of its forward stroke, lever 50 pivots bail 60, causing the latter to engage and reset the racks 18 of carriage 12. As lever 50 continues to move forward it engages abutment 46, causing the lever 30 to pivot clockwise (as seen in FIG. 2) and restoring the carriage to home position. The lost motion connection between lever 96 and link 100 permits the column spring 144 to deform and store energy and give up its stored energy and return to its original prestressed condition. Thus the impact energy is taken up and released during the initial portion of the period after lever 50 engages abutment 46 and causes restoration of the carriage to home position. Since column spring 144 has a substantially uniform spring constant, the energy is absorbed and given up at a uniform rate so that there is a minimal shock force on the mechanism at contact of lever 50 and abutment 46. Lever 50 reaches its forward limit of motion as roller 114 reaches the tip of cam lobe 124. As lobe 124 passes by roller 114, spring 150 urges link 100 rearwardly to its original position. This rear-

ward movement of link 100 is transmitted to lever 96 by the pivot pin connection, causing the latter to move in the same direction and thus forcing pinion gear 92 to move back along rack 74. This latter movement of pinion gear 92 causes lever 50 to reverse its motion and return to its original home position. Rearward movement of lever 50 restores bail 60 to its original at rest position.

With the latch 86 in position to prevent movement of lever 72, it is possible to manually clear the carriage 12, that is, to reset racks 18 and restore the carriage to home position, without initiating operation of cam shaft 122. This is achieved by manually operating mechanism, not shown, which moves lever 50 forward by means of its vertical extension 58. The initial forward movement of lever 50 will cause bail 60 to reset racks 18 in the manner previously described; on further movement of lever 50 its finger 56 will engage the abutment 46 and thereby force lever 30 to shift the carriage back to its home position. Manual movement of lever 50 will cause rotation of pinion gear 92 and consequent forward movement of lever 96 and link 100. Cam follower 102 is free to follow movement of lever 96 since slot 130 is in a position to permit withdrawal of cam guide 116 from cam 120. At this point it is to be noted that if lever 50 is moved forward to its forward limit while the carriage is in home position, finger 56 will not engage abutment 46.

The differential mechanism comprising levers 50 and 72 and pinion gear 92 also permits the machine to repeat a cycle of operation without clearing the carriage, that is, without resetting racks 18 and restoring the carriage to its home position. This mode of operation is achieved by pivoting the latch 86 from the position shown in FIG. 2 to a position where it engages the shoulder 88 of lever 50. This change in position of latch 86 locks lever 50 against forward movement and frees lever 72 and has the net result of preventing the carriage from being cleared either manually or by operation of cam 120. Instead, when the machine undergoes another cycle of operation, cam 120 will pivot cam follower 102, drawing link 100 forward and thereby causing corresponding movement of lever 96 in the manner previously described. Pinion gear 92 will move relative to the now stationary lever 50 and thereby cause lever 72 to move forward. This movement of lever 72 allows the cam to undergo its complete cycle of operation without impediment. Since lever 50 is held stationary, neither bail 60 nor lever 30 is operated on and, therefore, racks 18 and carriage 12 remain in their previously set positions corresponding to the value previously entered. When repeat operation is no longer desired, latch 86 is pivoted back to its original position in engagement with lever 72, freeing lever 50 for movement either manually or automatically in the manner described above.

The force necessary to restore the carriage is dependent upon the acceleration it is subject to ($F=MA$). Additionally there will be an impact force when lever 30 is set under motion by abutment 46 being contacted by finger 56 which always travels at a finite velocity as prescribed by cam 124. However, regardless of the position occupied by the carriage, it will be restored to home position within the time allotted and without subjecting either the carriage or the carriage restoring mechanism to excessive shock forces. The desirable mode of operation is achieved by use of the column spring 144 which is based upon the following considerations. The force supplied by the torsion spring 36 on the carriage is substantially linear as the carriage is restored to its home position. Necessarily this spring cannot be too strong because it would frustrate manual clearance. It is appreciated that the motion imparted to the carriage cannot be such as to cause the abutment 46 to separate or move out of engagement with lever 50. It is also appreciated that the initial impact force cannot be so great as to cause destruction or premature wearing of parts. Accordingly it is necessary to control the initial velocity and also the deceleration of the

carriage when it is being restored to home position. Ideally the deceleration of the carriage should conform to a rectangular waveform since with this mode of deceleration the carriage velocity will be maximum almost instantaneously with commencement of movement of the carriage and then drop off linearly as the carriage progresses to home position. Moreover with this deceleration characteristic, the initial velocity (and hence the restoring force) required to return the carriage from an intermediate index position to home position at the same time in the operating cycle is less than the initial velocity required when the carriage is in the furthest index position. However, this mode of operation still poses a problem in that attainment of maximum velocity at the outset results in an impact which is felt not only by the carriage but also by the carriage restoring mechanism. Accordingly it is necessary to control the shock force by building a spring action into the carriage restoring mechanism, such that the spring absorbs the impact energy and supplies a force of such magnitude to accelerate the carriage to the velocity being demanded by input cam motions in the allotted time.

This acceleration is represented by

$$\frac{A}{M}=F$$

where F is the maximum impact force limitation and M is the mass of the carriage. If a spring action is built into the system, the acceleration is represented by the expression

$$A=V\sqrt{\frac{K}{M}}$$

where V is the maximum velocity demanded of the carriage, M is the mass of the carriage, and K is the spring constant of the carriage restoring mechanism (predominantly influenced by the added spring).

Therefore the necessary spring constant is determined by re-writing the above equations to

$$K=\frac{F^2}{MV^2}$$

The necessary spring constant is determined by the magnitude of the force required to restore the carriage from its highest denominational index position within the allotted time and yet not exceed the prescribed maximum impact force. Typically a force of about 25 lbs. is required to restore a carriage. However, the spring constant required to achieve the maximum input force limitation and desired deceleration within the allotted time cannot be obtained with a conventional compression spring sized to fit in the available space. This difficulty is overcome by using a column spring pre-stressed in the manner of column spring 144. The column spring is pre-stressed to where its force is equivalent to the maximum impact force limitations and where its rate of displacement is substantially flat. Accordingly as cam 120 commences to drive the carriage by means of the restoring mechanism, the column spring begins to bow at a uniform rate. The amount of bowing experienced by spring 144 and hence the proportion of the energy which it absorbs from the impact of abutment 46 imparted to it by operation of cam 120 varies with the position of lever 30. When the carriage is in its higher denominational order index position, lever 50 will encounter lever 30 almost immediately and will impart to it a maximum velocity. On the other hand, when the carriage is in a lower denominational order index position, lever 50 will encounter lever 30 a little later in the operation cycle and will impart to lever 30 and the carriage 12 an initial velocity that is less than the initial velocity applied when the carriage is in its highest index position. However, regardless of the index position occupied by the carriage when lever 50 engages lever 30, the initial impact force is controlled and the amount of im-

fact energy absorbed by the spring is gradually released back to the carriage as it decelerates to zero velocity.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts specifically described or illustrated, and within the scope of the appended claims, it may be practiced otherwise than as specifically described or illustrated.

I claim:

1. In a value registering device having a carriage mounted for movement between a predetermined home position and a selected number of index positions and pivotally mounted spring biased means urging said carriage away from said home position in the direction of said index positions, mechanism for restoring said carriage to said home position, said mechanism comprising a first moveable lever operative to engage said spring biased means and pivot it in a direction to restore said carriage to said home position, a second lever, means providing a motion translating connection between said second lever and said first lever, a link, means providing a limited lost motion connection between said link and said second lever, means moveably supporting said link, and a shock-absorbing column spring connected between said link and said second lever to cushion said mechanism against shock from the carriage restoring force applied to said spring-biased means by said first lever.

2. In a value registering device having a carriage mounted for movement to any one of a plurality of index positions from a predetermined home position and pivotally mounted spring biased means urging said carriage away from said home position in the direction of said index positions, mechanism for restoring said carriage to said home position, said mechanism comprising a first moveable lever operative to engage said spring-biased means and pivot it in a direction to restore said carriage to said home position, a pivoted cam follower lever with a cam follower, a link pivotally connected to said cam follower lever, a second lever, means providing a limited lost-motion connection between said second lever and said link, means providing a motion translating connection between said second lever and said first lever so that movement of said second lever will operate said first lever, a spring element connected between said link and said second lever to cushion said mechanism against shock from the carriage-restoring force applied to said spring-biased means by said first lever, a rotatable cam shaft, and a cam mounted for rotation with said cam shaft, said cam having a curved cam surface with a predetermined portion of said surface defining a cam lobe, said cam positioned so that said cam follower rides on said cam surface, and said lobe shaped to cause pivotal movement of said cam follower lever to an extent sufficient to operate said first lever by way of said link and said second lever.

3. The apparatus defined by claim 2 wherein said carriage includes a plurality of value setting control elements and further wherein said apparatus includes means operable to reset said control elements, said last-mentioned means connected to and operable by said first lever.

4. The apparatus defined by claim 2 further including means for selectively locking said first lever against movement, and by means operative when said first lever is locked to passivate the motion translating connection between said first and second levers so that said cam is ineffective to operate said first lever.

5. The apparatus defined by claim 2 wherein said means providing a motion translating connection between said first and second levers comprise a rack on said first lever, a pinion gear carried by said second lever in position to engage said rack, and means in engagement with said pinion gear for causing said pinion gear to move said rack on operation of said second lever in response to rotation of said cam.

6. The apparatus of claim 5 wherein said last-mentioned means comprises a second gear rack.

7. The apparatus of claim 6 wherein said second gear rack is supported for rectilinear movement by said pinion gear, and further including means for locking said second rack against rectilinear movement.

8. The apparatus of claim 7 wherein said locking means is operable to unlock said second rack and lock said first lever so that operation of said second lever produces movement of said second rack instead of said first lever.

9. Apparatus according to claim 2 wherein said spring element is a column spring.

10. Apparatus according to claim 9 wherein said column spring is prestressed to a load equivalent to the maximum permissible force to be imparted to said carriage by said carriage-restoring mechanism.

11. Apparatus comprising a carriage provided with key-settable control elements for entering values in a plurality of denominational orders, means supporting said carriage for movement along a selected plane from a home position to a number of different index positions each corresponding to a different denominational order, a lever arm, means pivotally supporting said lever arm for pivotal movement in a plane parallel to said selected plane, means pivotally connecting said lever arm to said carriage, a spring urging said lever arm to pivot in a direction to move said carriage away from said home position toward said index positions, a first lever mounted for rectilinear motion between first and second limits in a plane at right angles to said selected plane, a first gear rack carried by said first lever, a second lever also mounted for rectilinear motions in a plane at right angles to said selected plane, a second gear rack carried by said second lever, locking means for selectively locking said second lever, a third lever provided with a pinion gear disposed between and meshing with said first and second gear racks, a link, means pivotally connecting said link to said third lever at a point on said third lever remote from said pinion gear, a column spring supported at its ends in pre-stressed condition by said link and said third lever, a cam follower lever with a cam follower element thereon, means pivotally supporting said cam follower lever, means pivotally connecting said cam follower lever to said link, a rotatable cam shaft, a cam mounted on said shaft for rotation therewith, said cam having a curved cam surface in engagement with said cam follower element, said cam surface defining a cam lobe adapted on rotation of said cam to pivot said cam follower in a direction to cause movement of said first lever from its first limit towards its second limit, and means on said first lever operative on movement toward said second limit to engage said lever arm and pivot it in a direction to restore said carriage to said home position.

12. Apparatus as defined by claim 11 further including means connected to said first lever for resetting said control elements when said first lever is moved toward said second limit.

13. Apparatus as defined by claim 11 further including means for manually moving said first lever toward said second limit to restore said carriage to said home position while said cam is stationary.

14. Apparatus as defined by claim 13 further including means for preventing manual movement of said first lever while said cam is rotating.

15. Apparatus as defined by claim 11 wherein said locking means is operative to unlock said second lever and lock said first lever.

16. Apparatus comprising a carriage provided with value entering mechanism including a plurality of settable control elements, means supporting said carriage for movement from a predetermined home position to a plurality of index positions each corresponding to a higher denominational order, spring biased means urging said carriage away from said home position toward said index positions, and means for restoring said carriage to said home position, said spring biased means comprising a lever arm, means pivotally supporting said lever arm, means

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pivotally connecting said lever arm to said carriage, and a spring urging said lever arm to pivot in a direction to move said carriage away from said home position toward said index positions, said carriage restoring means comprising a carriage restoring lever supported for rectilinear motion between first and second positions, said carriage restoring lever normally being in said first position where it is out of engagement with said lever arm, means on said carriage restoring lever operative to forceably engage said lever arm and pivot it in a direction to shift said carriage back to said home position when said carriage restoring lever is moved from said first position to said second position, first cam-operated means for moving said carriage restoring lever to said second position, second manually operated means for moving said carriage restoring lever to said second position, tension spring means for returning said carriage restoring lever to said first position from said second position, and selectively operable means for preventing operation of said carriage restoring lever by said first cam-operated means and also said second-manually operated means.

17. Apparatus defined by claim 16 wherein when said carriage restoring lever is in said first position it is displaced from said lever arm by an amount inversely proportional to the distance of said carriage from said home position.

18. Apparatus as defined by claim 16 further including means operable by said carriage restoring lever to reset said control elements when said carriage restoring lever is moved toward said second position.

19. Apparatus according to claim 16 wherein said carriage restoring lever remains stationary when said carriage moves from said home position in the direction of said index positions.

20. Apparatus comprising guide means; a carriage mounted for reciprocative movement along said guide means between a first position and a plurality of other positions; a first mechanism urging said carriage away from said first position toward said other positions; said first mechanism including a first lever pivotally secured to a fixed support, means connecting said first lever to said carriage, and a spring biasing said first lever in a direction to urge said carriage away from said first position; and a second mechanism for restoring said carriage to said first position from any of said other positions, said second mechanism comprising a rotary drive mechanism, a second lever mounted for reciprocal movement between a first retracted position and a second extended position, coupling means connected to said second lever for forcibly engaging said first lever and thereby causing movement of said carriage back to said first position when said second lever moves from said first retracted position to said second extended position, said coupling means and said first lever being disengaged when said second lever is in its first retracted position, said coupling means disposed so as to be spaced from said first lever a variable distance according to the position of said carriage when said second lever is in its first retracted position, and motion transmitting means connected between said drive mechanism and said second lever for causing said second lever to move to its second extended position in response to rotation of said drive mechanism.

21. Apparatus as defined by claim 20 wherein said motion-transmitting means includes a resilient structure for absorbing the energy of impact of said coupling means on said first lever, said resilient structure including an elongate member adapted to undergo displacement as it absorbs said energy and to absorb said energy at a constant rate with respect to its displacement as said carriage is moved toward its said first position.

22. Apparatus as defined by claim 20 wherein said sec-

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ond lever embodies a gear rack and further wherein said motion transmitting means comprises a third lever, means including a shock absorbing column spring mounting said third lever for movement in response to said rotary drive mechanism, a pinion gear on said third lever disposed in engagement with said gear rack, and means for causing said pinion gear to drive said rack in a direction to move said second lever to said second extended position in response to rotation of said drive mechanism.

23. In combination, a carriage adapted to be indexed under biasing force and to be returned within an allotted time cycle, means to provide a returning force, and force-transmitting means for coupling said return force to said carriage, said force-transmitting means including a resilient force-transmitting link adapted to absorb shock energy at a constant rate during said time cycle.

24. The combination of claim 23 wherein said force-transmitting means also includes a plurality of pivotally connected levers with said resilient link having one end thereof connected to one of said levers and the other end thereof connected to another of said levers.

25. The combination of claim 23 wherein said resilient link is prestressed to a predetermined load and has a relatively small displacement in the direction of the line of force.

26. A combination according to claim 23 wherein said resilient link comprises a column spring.

27. In combination, a carriage adapted to be indexed under biasing force and to be returned, a driving means, means adapted to return said carriage under the influence of said driving means, said last-mentioned means including a resilient coupling prestressed to a load equivalent to the maximum permissible force to be imparted by said last-mentioned means, said resilient coupling having a substantially constant spring rate.

28. Apparatus comprising a carriage provided with value entering mechanism including a plurality of settable control elements, means supporting said carriage for movement from a predetermined home position to a plurality of index positions each corresponding to a higher denominational order, spring biased means urging said carriage away from said home position toward said index positions, and means for restoring said carriage to said home position, said carriage restoring means comprising a carriage restoring lever supported for rectilinear motion along a predetermined path, means on said lever operative to shift said carriage back to said home position when said lever is moved in a first direction along said path, first cam operated means for operating said lever, said cam-operated means comprising a cam follower and a linkage connected between said cam follower and said carriage restoring lever, said linkage including a column spring for absorbing the shock of the restoring force applied to said carriage by said lever, second manually operated means for operating said lever, and selectively operable means for preventing operation of said lever by said first cam-operated means and also said second manually operated means.

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STEPHEN J. TOMSKY, *Primary Examiner*.