

April 29, 1958

H. J. CHALL ET AL

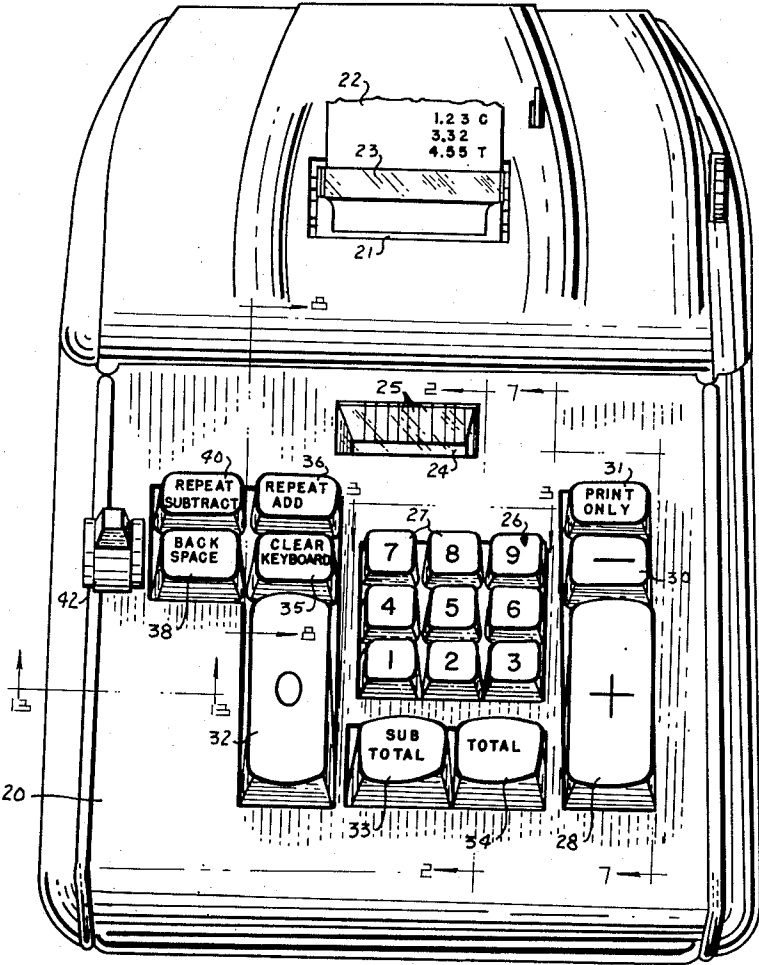
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TEN-KEY CALCULATING MACHINE WITH BACKSPACING MECHANISM

Filed Oct. 21, 1955

11 Sheets-Sheet 1

FIG. 1



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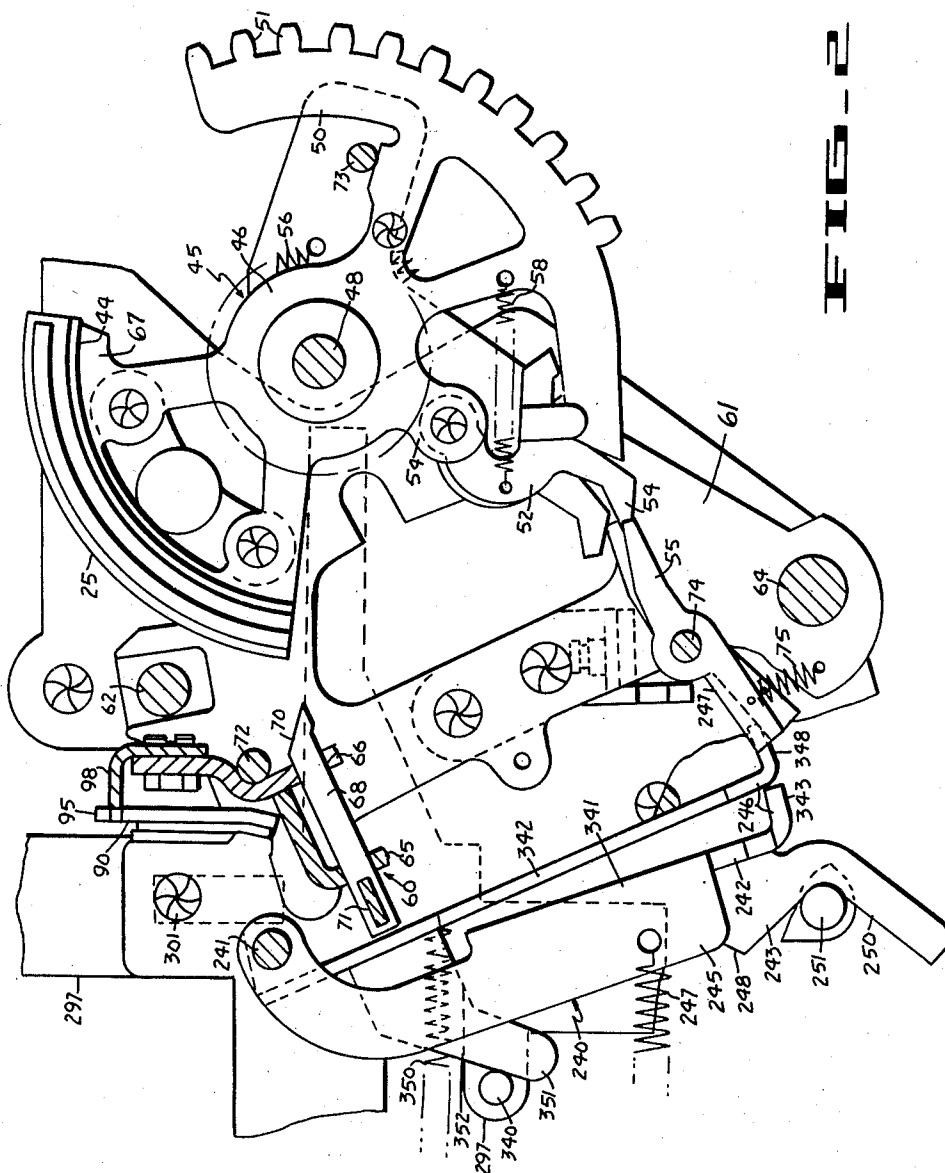


FIG. 2

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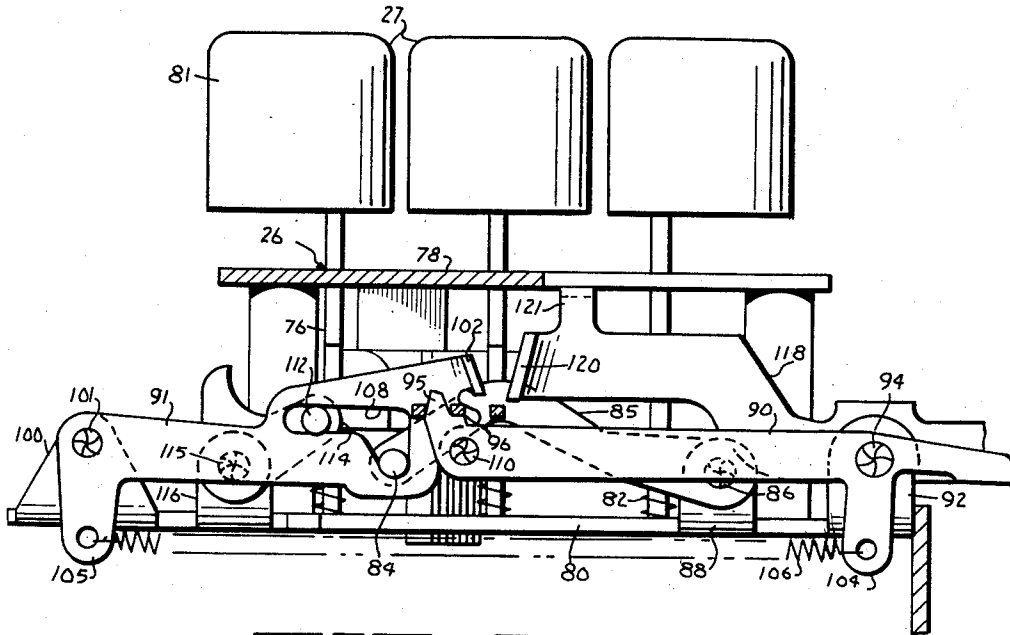


FIG. 3

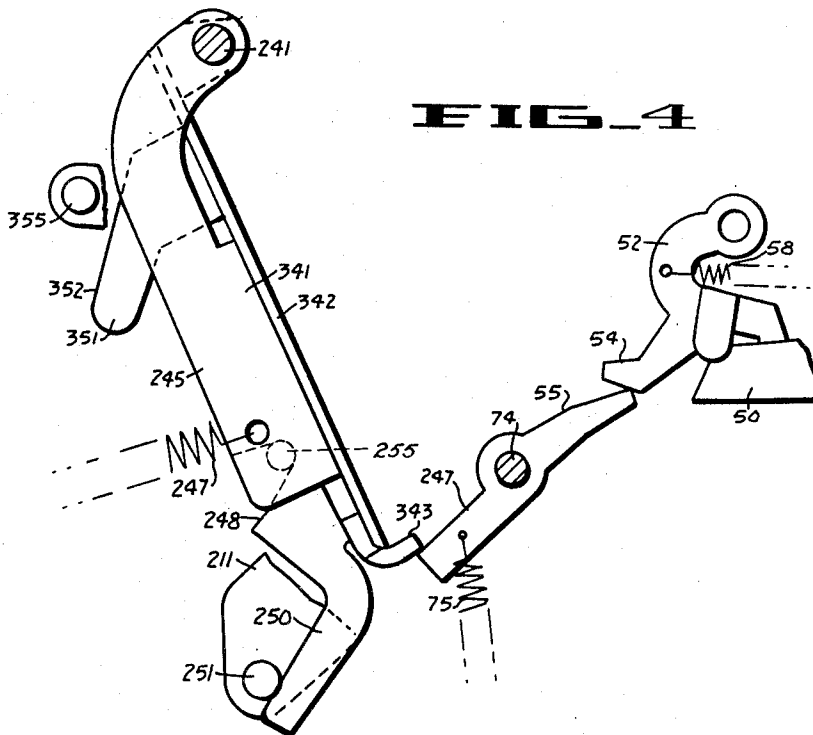


FIG. 4

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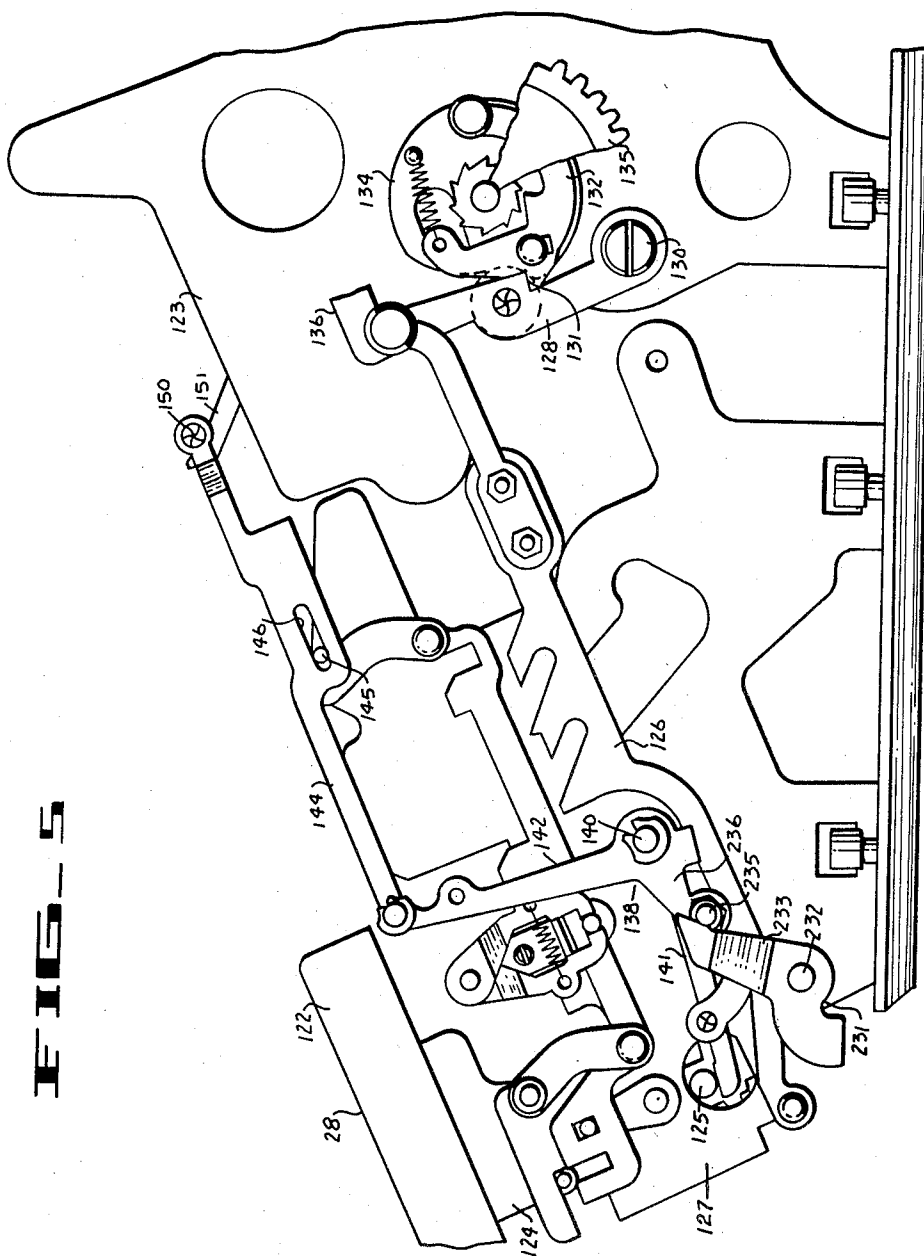
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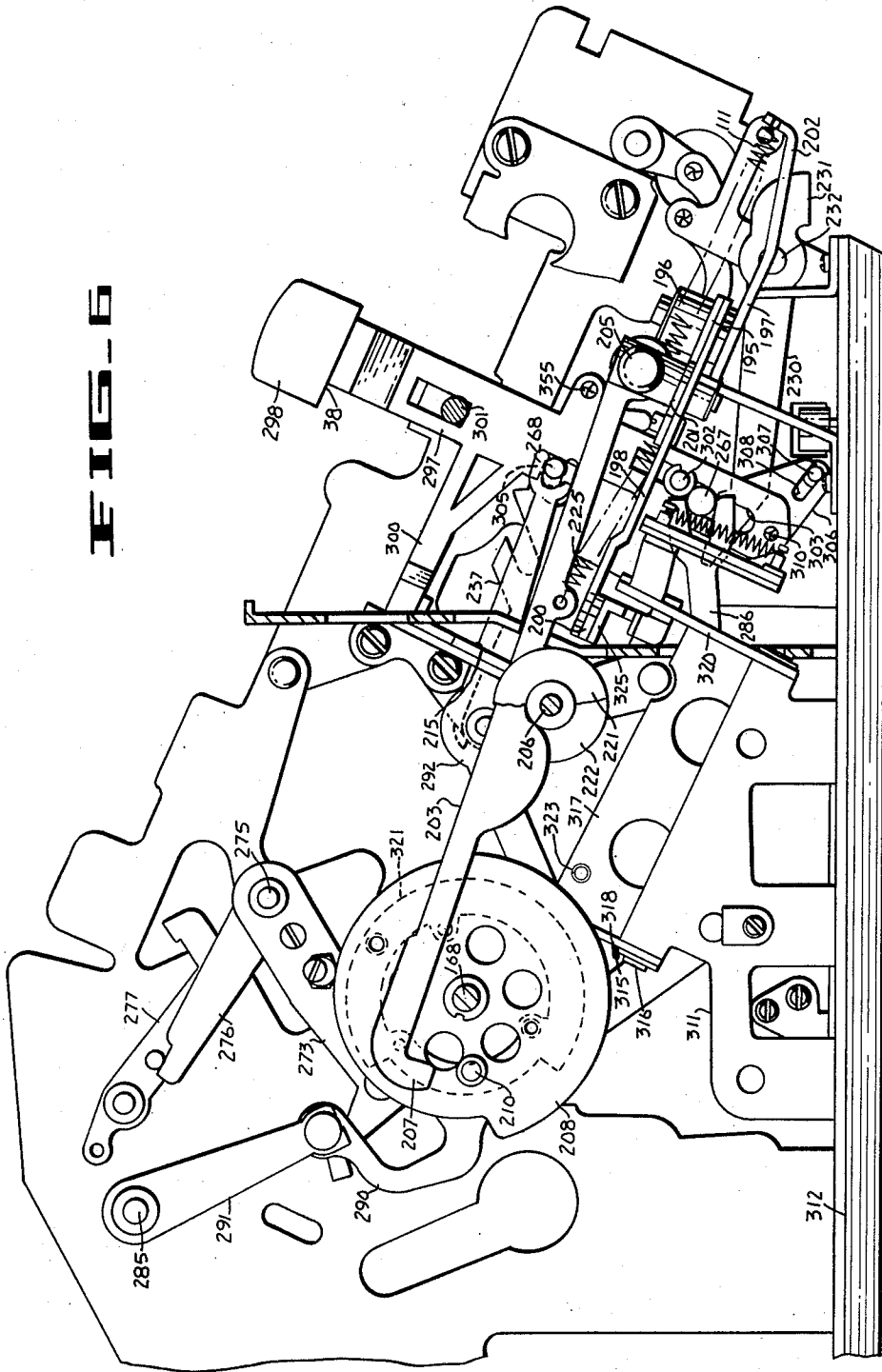
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FIG-6



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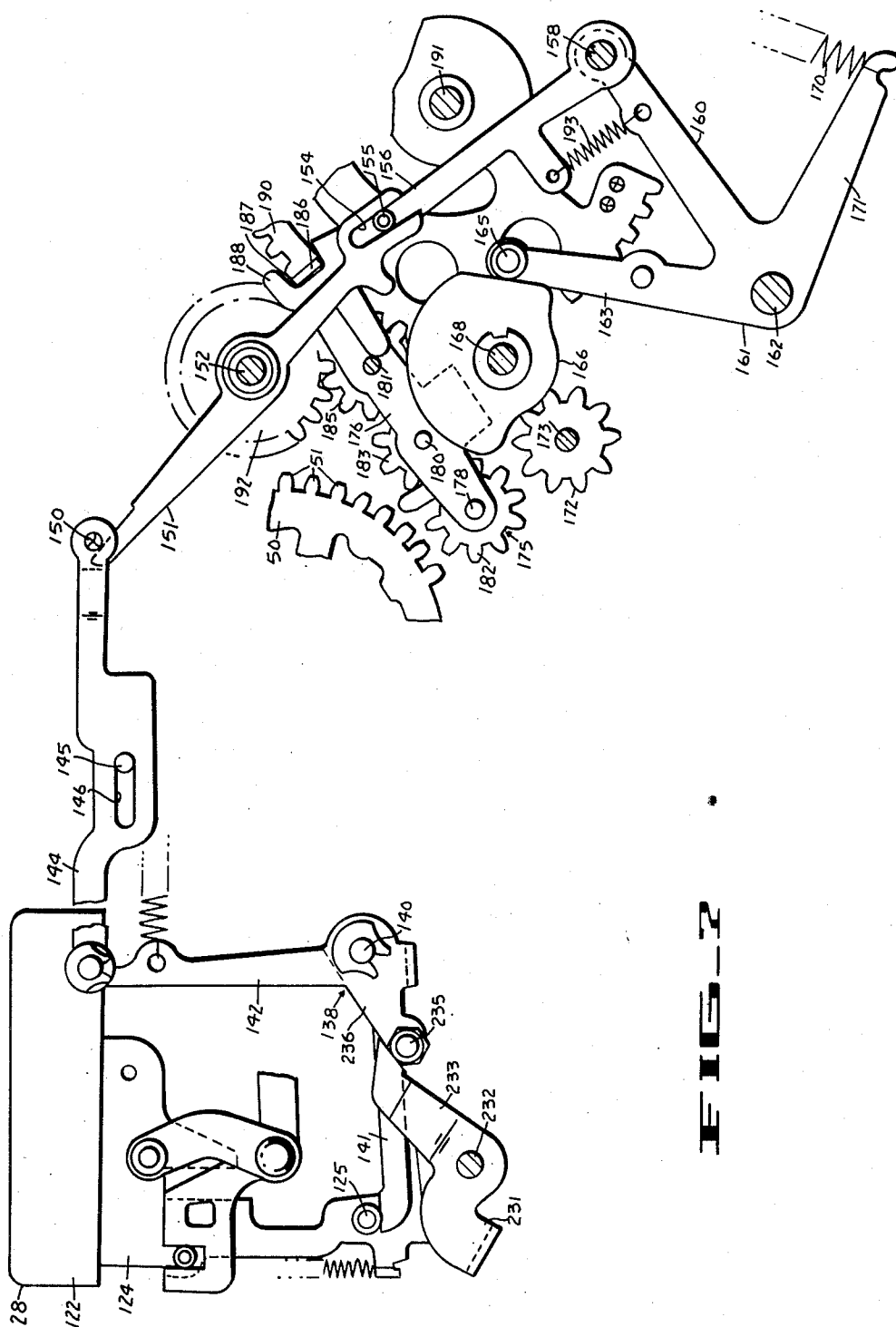
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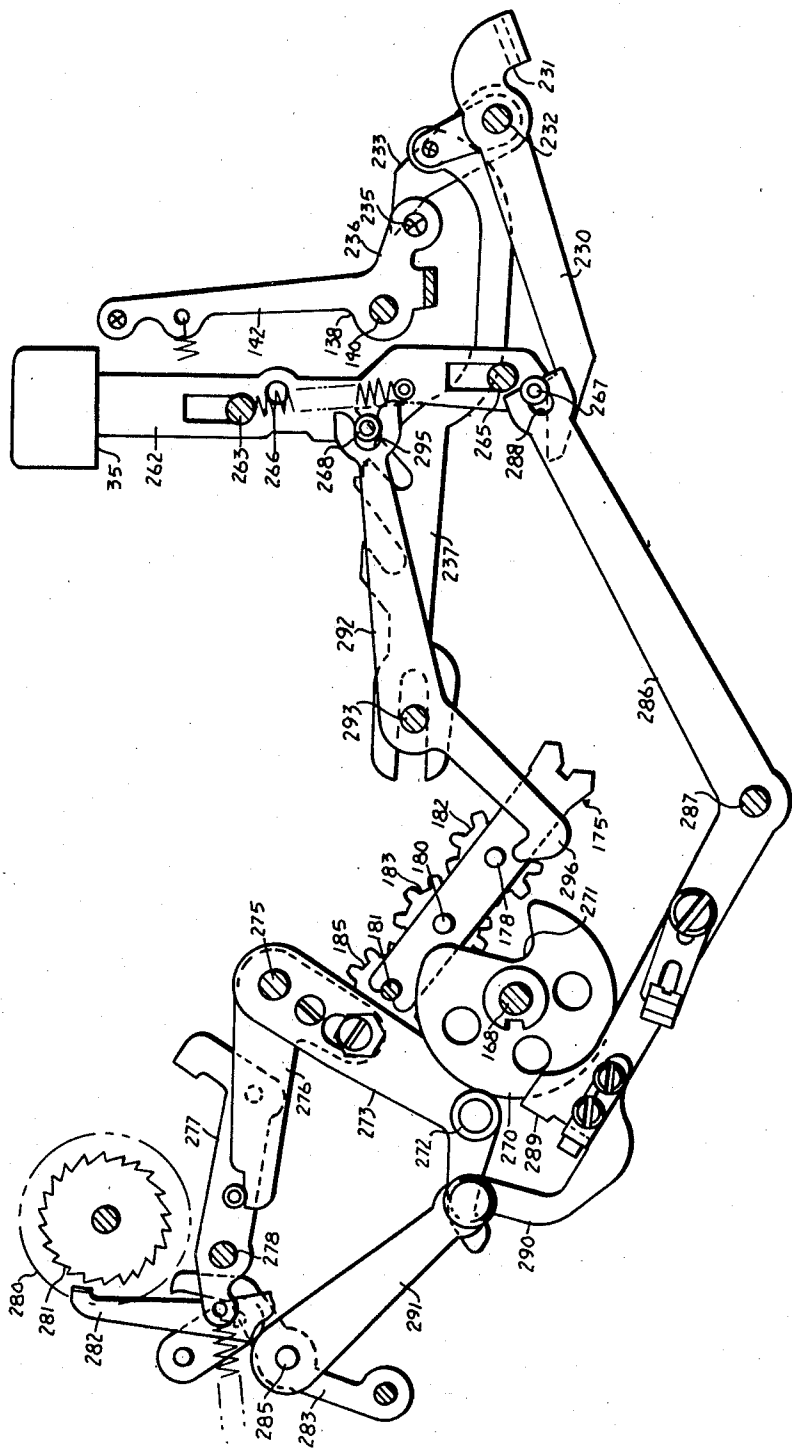
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FIG. 8



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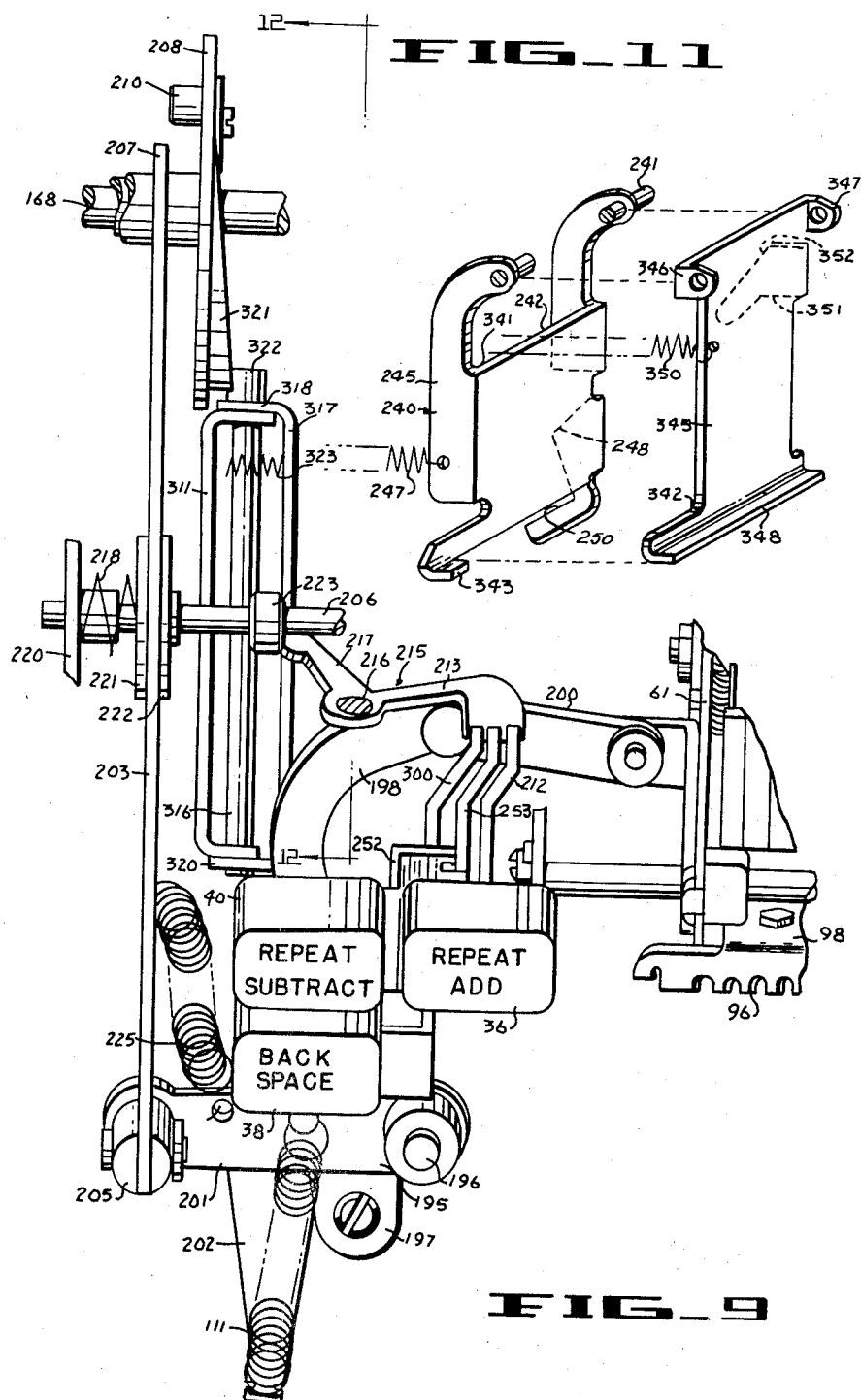
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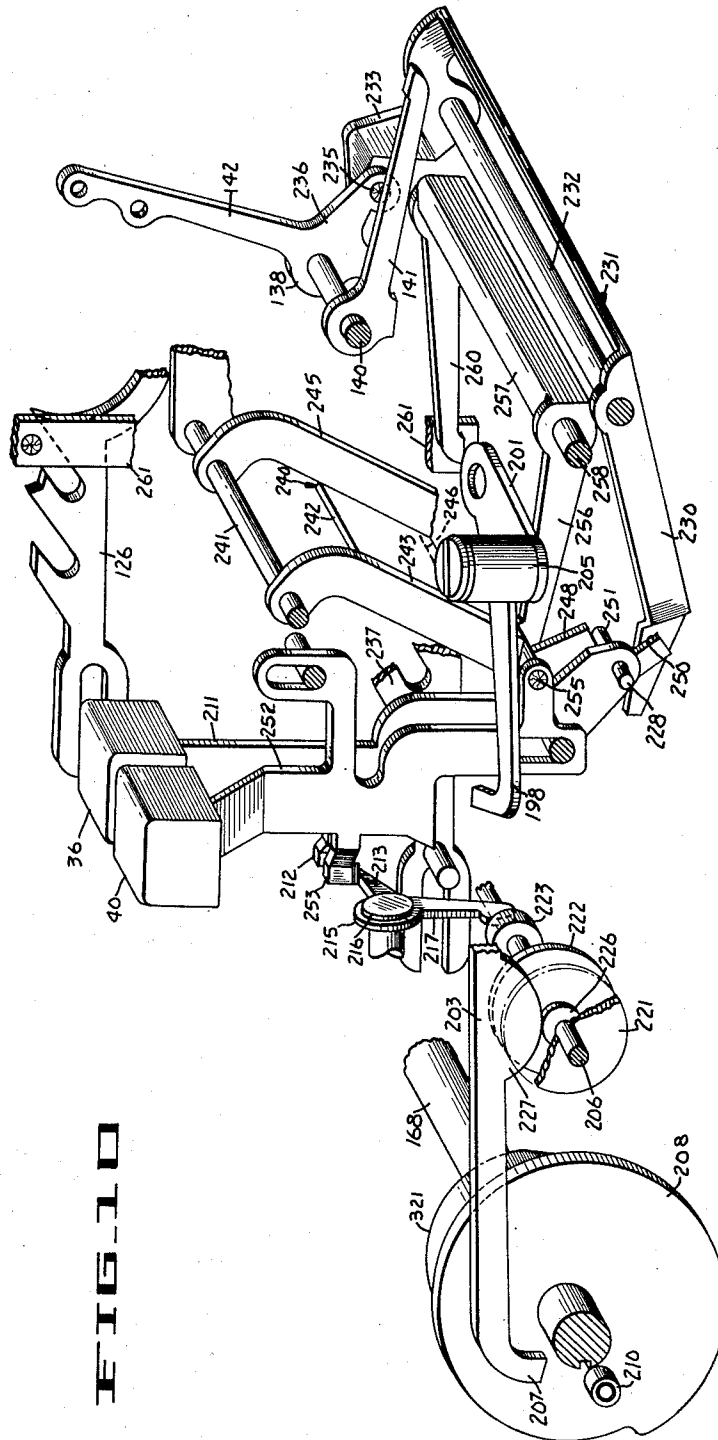
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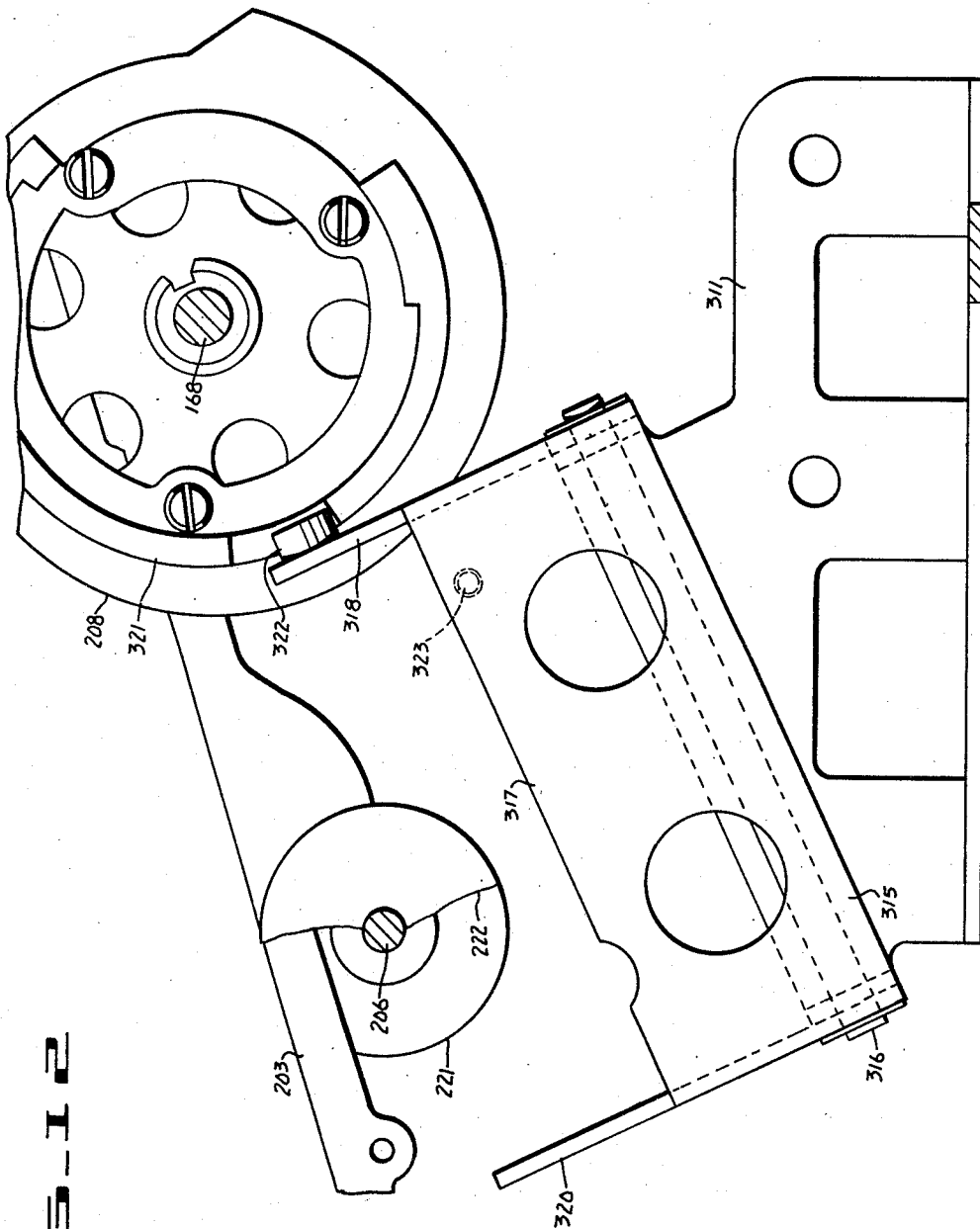


FIG. 12

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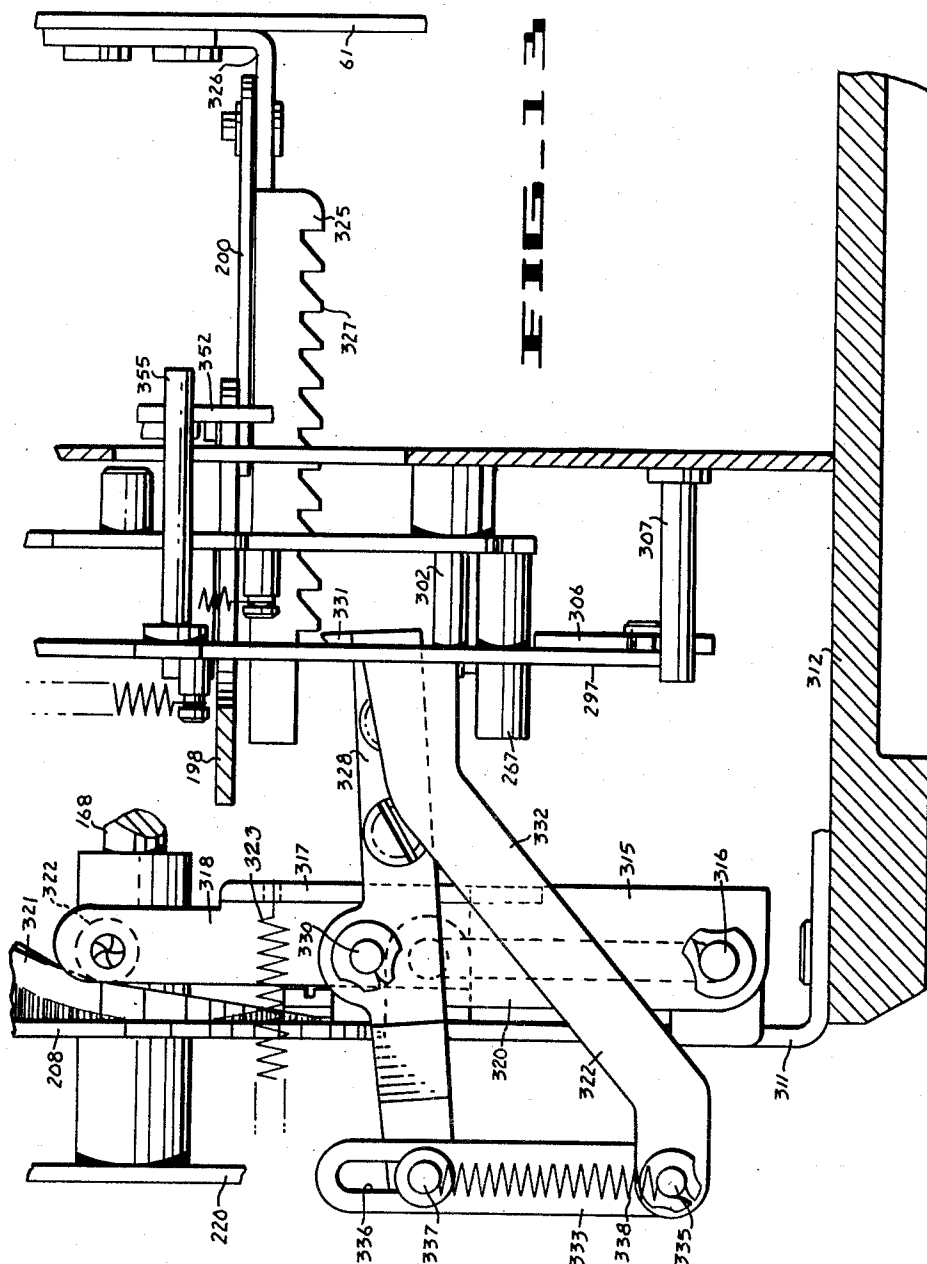
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TEN-KEY CALCULATING MACHINE WITH BACKSPACING MECHANISM

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Application October 21, 1955, Serial No. 541,972

4 Claims. (Cl. 235—60)

This invention relates to mechanical adding machines, such as the adding machine disclosed in patent application S. N. 407,016, filed January 29, 1954, by Harold J. Chall for Listing Adding Machine Mechanism, and is concerned with the addition to such a machine, of backspacing mechanism and a control key for operating such mechanism.

It is among the objects of the invention to provide in an adding or calculating machine of the ten-key type having a shiftable stop pin carriage stepped from right to left as keyboard selections are made, mechanism for backspacing the pin carriage one step at a time so that an erroneously entered digit can be cancelled out and corrected without disturbing the portion of the entry to the left of the order in which the error occurred; which mechanism is power-operated and enabled by a manually depressible control key; which causes backspacing of the stop pin carriage and zeroizing of the corresponding order of the selection mechanism while suppressing accumulation, printing and other operations of the machine; which utilized for its operation a maximum number of parts already provided in the machine for other purposes; and which is of simple construction, completes its operation in one operating cycle of the machine, and places the machine in condition for continuing the selection as soon as the backspacing cycle is completed.

Other objects and advantages will become apparent from a consideration of the following description and the appended claims in conjunction with the accompanying drawings wherein:

Fig. 1 is a plan view of a ten-key calculating machine provided with backspacing mechanism and a backspacing control key in accordance with the present invention;

Fig. 2 is a fragmentary cross-sectional view on an enlarged scale on the line 2—2 of Fig. 1 with the machine cover omitted and showing one order of the selection mechanism of the machine without the keyboard;

Fig. 3 is a fragmentary cross-sectional view on an enlarged scale on the line 3—3 of Fig. 1 with the machine cover omitted and showing the escapement mechanism for the pin carriage of the selection mechanism of the machine;

Fig. 4 is a view similar to Fig. 2 but with parts omitted and showing the illustrated parts in a different position from that shown in Fig. 2;

Fig. 5 is an elevational view of a fragmentary portion of the right-hand side of the machine with the machine cover removed;

Fig. 6 is an elevational view of a fragmentary portion of the left-hand side of the mechanism with the machine cover removed and with other parts broken away and shown in cross-section;

Fig. 7 is a fragmentary cross-sectional view on an enlarged scale on the line 7—7 of Fig. 1 with the machine cover omitted and showing particularly the addition control mechanism of the machine;

Fig. 8 is a fragmentary cross-sectional view on an enlarged scale on the line 8—8 of Fig. 1 with the machine

cover omitted and showing the keyboard clearing mechanism of the machine;

Fig. 9 is a perspective view of the backspacing mechanism of the machine and certain of the machine components adjacent to the backspacing mechanism;

Fig. 10 is a perspective view of a portion of the mechanism shown in Fig. 9;

Fig. 11 is a perspective view of the "0" latch releasing bail shown in Figs. 2 and 4, as modified for use in backspacing the stop pin carriage of the machine;

Fig. 12 is a cross-sectional view on the line 12—12 of Fig. 9; and,

Fig. 13 is a fragmentary cross-sectional view on an enlarged scale on the line 13—13 of Fig. 1 with the machine cover omitted and shows the backspacing mechanism of the machine.

Only those parts of the complete calculating machine which cooperate in some way with the backspacing mechanism constituting the subject matter of the present invention are shown in the accompanying drawings. For a complete understanding of the machine, reference may be had to the following United States applications of Harold J. Chall:

- S. N. 407,016, filed January 29, 1954
- S. N. 439,552, filed June 28, 1954
- S. N. 416,730, filed March 16, 1954
- S. N. 509,022, filed May 17, 1955

With continued reference to the drawings and particularly to Fig. 1, the machine, as illustrated, has a cover 20 provided in its upper rearward portion with a rectangular opening 21 through which the printing tape 22 extends from the interior of the machine and this opening is provided with a tear strip 23 for tearing off desired lengths of printed tape. The cover is also provided forwardly of the opening 21 with a rectangular opening, preferably covered by a transparent pane or closure 24, through which the check dials 25 of the machine are visible to the operator, and forwardly of this opening a ten-key keyboard 26 is located and includes nine keys 27 arranged in a three-by-three square pattern and consecutively numbered from "1" to "9." An addition key 28 is disposed at the right-hand side of the keyboard 26 and extends forwardly of this keyboard, a subtraction key 30 is disposed adjacent the rear end of the elongated addition key 28 and a print-only key 31 is disposed immediately rearwardly of the subtract key 30. A "0" key of elongated, rectangular shape is disposed at the left-hand side of the keyboard 26 and extends forwardly of the keyboard and a subtotal key 33 and total key 34 are disposed in side-by-side relationship forwardly of the keyboard 26 and between the front end portions of the addition key 28 and the "0" key 32. A keyboard clearing key 35 is disposed at the rear end of the "0" key 32 and a repeat addition key 36 is disposed immediately rearwardly of the keyboard clearing key 35 while the backspacing key 38 is disposed immediately to the left of the keyboard clearing key and a repeat subtract key 40 is disposed at the rear of the backspacing key and at the left-hand side of the repeat addition key. The machine, as illustrated, is provided with an optionally useable multiply arm for use with the repeat addition and repeat subtraction keys, as is shown in application S. N. 528,154, filed August 15, 1955, by Harold J. Chall and Charles Balaz, and a lever 42 for enabling and disabling this multiply arm is shown at the left-hand side of the backspace key 38.

Referring now to Fig. 2, the check dials 25 are the outer parts of sector shaped portions 44 of ordinarily arranged selection sectors, generally indicated at 45. Each of the sectors 45 includes a hub 46 rockably mounted on a sector shaft 48 and carrying the sector shaped portion

44 and an additional sector shaped rack portion 50 disposed substantially diametrically opposite the portion 44 and provided on its outer edge with gear teeth 51 to constitute these portions of the sectors' curved selection racks. Each selection sector carries at the forward end of its rack portion 50, a live point 52 pivotally mounted at one end on a radial extension 54 of the corresponding hub 46 and provided at its opposite or lower end with a nose formation 54 which engages the rearward end of a pivotally mounted "0" latch lever 55. Each selection sector 45 is urged to rotate in a clockwise direction, as illustrated in Fig. 2, by a tension spring 56 and each live point is resiliently held against the forward end of the associated selection rack 50 by a tension spring 53.

A stop pin carriage, fragmentarily illustrated and generally indicated at 60, is disposed in front of the series of selection sectors 45 and the pin carriage 60, the actuator sectors 43 and the sector shaft 48 are all mounted in a unitary frame, the left-hand side of which is shown in Fig. 2 and indicated at 61. The frame 61 is slidably mounted on upper and lower guide rails 62 and 64 which extend transversely of the forward portion of the machine in spaced-apart and parallel relationship to each other so that this shiftable selection unit can move transversely of the frame from right to left and left to right.

The pin carriage 60 comprises parallel front and rear plates 65 and 66 apertured to slidably receive ordinal rows of stop pins 68, there being eight pins in each vertical row of pins and as many vertical rows of pins as there are selection sectors 45, usually ten or eleven. Each stop pin 68 is provided at its rearward end with a nose formation 70 which is engaged by the nose formation 54 of the live point 52 on the coordinial selection sector 45 to stop the selection sector at the digital position corresponding to the position of the set stop pin in the corresponding vertical row of stop pins. The stop pins are set by levers operated by the keyboard keys, as fully illustrated and described in application S. N. 407,016, referred to above, and the pins are retracted at the end of an operating cycle by means of cam fingers 71 extending through slots in the forward ends of the pins, as is also fully illustrated and described in application S. N. 407,016. There is a settable stop pin 68 in each vertical row of pins for each of the digit keys from "1" to "8," inclusive. When the "9" key is depressed, no pin is set but a nose formation 67 of the dial sector portions 44 will come to rest against the fixed stop bar 73, to stop the selection sectors, or racks, in their "9" position.

The "0" latch levers 55 are pivotally mounted intermediate their length on a shaft or rod 74 mounted in the shiftable unit frame 61 above and parallel to the lower guide rail 64. These latch levers are resiliently urged to position to engage the nose formations of the corresponding live points 52 by individual tension springs 75. A hooked lever or bail, not illustrated, operated by the keyboard keys, engages the forward ends of the "0" latch levers 55 and rocks the latch lever of the order in selection position in a direction to release the coordinial live point 52 and sector 45 when a keyboard key is depressed. The release of the live point and sector by the "0" latch lever occurs immediately after the stop pin 68 in the same order has been set so that, as soon as the selection sector 45 is released, its spring 56 will rock it to the differentially set position determined by the position of the set stop pin 68 in the corresponding vertical row of stop pins which, in turn, is determined by the digital number of the keyboard key which was depressed to set the stop pin and rock the "0" latch lever 55 to sector releasing position.

Referring to Fig. 3, each of the keyboard keys 27 has an elongated flat stem 76 extending through aligned apertures in upper and lower keyboard frame plates 78 and 80 and each key stem carries on its upper end, a key top 81 and is resiliently urged to its upper position by a compression spring 82. The key stems 76 are provided with lateral offsets which respectively engage the corre-

sponding pin setting levers, as disclosed in application S. N. 407,016, to set the stop pins. These offsets also engage a common escapement operating bar 84, which bar is carried at the distal ends of a pair of parallel levers, one of which is illustrated in Fig. 3 and indicated at 85, mounted at their proximal ends on a shaft 86 carried by ears 88 upstanding from the lower keyboard frame plate 80 at the front and rear edges and near the left-hand side of this plate. The bar 84 is substantially parallel to the common pivotal axis of the two levers 85 so that the bar is moved downwardly whenever a digit key of the keyboard is depressed.

A pair of escapement control levers 90 and 91 are disposed at the rear side of the keyboard and the lever 90 is pivoted near its left-hand end on an ear 92 upstanding from the left rear corner of the keyboard by a pivot pin 94. This lever extends from the pivot pin 94 to the right across a portion of the keyboard and carries at its right-hand or distal end an upstanding detent formation 95 which engages between two adjacent teeth 96 of an escapement rack 98 mounted on the upper edge of the stop pin carriage 60, as illustrated in Fig. 2. The lever 91 is pivoted at its right-hand or proximal end on an ear 100 upstanding from the rear, right-hand corner of the plate 80, by pivot pin 101 and extends to the left from the pivot pin 101 into overlapping relationship with the right-hand end of the lever 90. The lever 91 carries on its left-hand or distal end an inclined abutment formation 102 which enters an interdental space of the escapement rack 98 when the control bar 84 is depressed by depression of a selection key 27. The levers 90 and 91 are provided with arms 104 and 105, respectively, depending from the pivot pins 94 and 101 and a tension spring 106 connected between the lower ends of these arms resiliently urges the distal ends of the levers 90 and 91 to their raised position, as illustrated in Fig. 3, at which they are stopped by engagement with the teeth 96 of the escapement rack 98. The escapement control bar 84 is extended at its rearward end into an opening 108 in the lever 91 and a pin 110 extends forwardly from the distal end of the lever 90 under a shoulder formation on the distal end of the lever 91 so that when the bar 84 is depressed, the distal ends of both of the levers 90 and 91 are moved downwardly against the force of the spring 106. As the distal end of the lever 90 is moved downwardly to move the detent formation 95 out of the interdental space of the escapement rack 98 in which this detent formation is engaged, the distal end of the lever 91 is moved downwardly moving the abutment formation 102 into the interdental space to the left of the space cleared by the detent formation 95. The abutment formation 102 is so positioned and dimensioned that when it enters an interdental space of the escapement rack 98, it will permit the rack to move a fraction of a step to the left under the urgency of the carriage shifting spring 111 shown in Fig. 9. When the depressed selection key 27 is subsequently released, the abutment formation 102 will be moved upwardly out of the interdental space of the escapement rack 98 in which it is engaged, and the upper end of the detent formation 95 will move against the underside of the adjacent tooth 96 to the right until the rack is moved the remainder of the escapement step, at which time the detent formation 95 will be forced upwardly into the next interdental space and a full escapement step of the rack 98 and the shiftable selection unit 45 will be completed.

A bar 112 supported at the distal ends of arms 114 mounted on a common shaft 115 supported by ears 116 upstanding from the bottom plate 80 of the keyboard frame is extended at its rearward end to enter the opening 108 in the lever 91. This bar is connected with the key stop and interlocking mechanism of the machine, as disclosed in application S. N. 407,016, to preclude operation of a control key while a selection key is depressed and vice versa. A rockable lever 118 extends longitudinally of and above the lever 90 and carries at

its right-hand or distal end, an inclined abutment formation 120 which enters an interdental space of the escapement rack 98. The abutment formation also engages the upper edge of the lever 90 and forces the detent formation 95 of this lever out of the interdental space in which it is engaged to cause an escapement of the escapement rack and shiftable selection mechanism to the left whenever the lever 118 is rocked down and returned to its upper limiting position, as determined by the stop formation 121 on this lever engaging the top plate 78 of the keyboard frame, as shown in Fig. 3. The arm 118 is the optionally useable multiplier arm particularly disclosed in application S. N. 528,154, filed August 15, 1955, by Harold J. Chall and Charles Balaz for "Escapement Control Mechanism for Ten-Key Calculating Machine."

After a selection has been made by consecutively depressing the selected digit or selection keys 27, and stepping the shiftable selection mechanism the proper number of ordinal spaces to the left from its right-hand home position, as described above, a control key is depressed to enter the selected value into the accumulator and the printing mechanism of the machine, unless it is desired to merely print the value without entering it into the accumulator, or to clear a value from the selection mechanism without entering it into the accumulator or printing it. Reference may now be had to Figs. 5, 7 and 8 in which certain of the essential components for additively entering a selected value into the accumulator and printing mechanism are illustrated. The addition key 28 has a key top 122 of elongated, rectangular shape mounted on the upper end of a flat key stem 124 which is slidably mounted for vertical movement on the forward frame plate 127 of the machine. The key stem 124 is connected by a stud 125 projecting from its lower end, and a rockable arm, transverse shaft and radius arm, not illustrated, to the front end of the right-hand clutch and motor bar 126 of the machine to move the bar 126 forwardly when the addition key is manually depressed. The motor bar 126 is pivotally connected at its rearward end to the upper end of a clutch control lever 128 pivotally mounted at its lower end on the frame side plate 123 by a pivot screw 130 and provided intermediate its length with a shoulder 131 which engages a complementary shoulder on the control dog 132 of the single cycle machine clutch 134. The clutch is driven from the machine motor through a train of gears, as indicated at 135. The bar 126 is extended rearwardly, as indicated at 136, to close the motor switch, not shown, when the bar 126 is shifted forwardly, as is well-known to the art. Thus, depression of addition key 28 will establish an operating cycle of the machine and this is true of all of the other control keys of the machine since all of the other control keys, either directly or through connecting linkages, shift the bar 126 forwardly when any one of these keys is depressed.

A bellcrank lever 138 is pivotally mounted at its angle on the forward side plate 127 by a pivot stud 140 and has a forwardly extending, offset arm 141 extending under the stud 125 so that the lever 138 is rocked in a counter-clockwise direction, as viewed in Fig. 5, when the addition key 28 is depressed. Bellcrank lever 138 also has an upwardly extending arm 142 pivotally connected at its upper end to the forward end of a link 144 slidably mounted intermediate its length on a fixed stud 145 extending through an elongated slot 146 in the link. A stud 150 projects perpendicularly from the rearward end of the link 144 and engages the rear edge of the upper portion of a lever 151 pivotally mounted intermediate its length on a print wheel drive gear shaft 152. At its lower end, the lever 151 is provided with an elongated notch 154 which receives a pin 155 projecting from a link 156 intermediate the length of the link. At its lower end, the link 156 is pivotally connected by a pivot pin or screw 158 to the distal end of the inter-

mediate arm 160 of a three-armed lever 161 which is pivotally mounted at its angle on a shaft 162 extending transversely of the machine. The front outside arm 163 of the cam follower lever 161 carries at its distal end a cam following roller 165 which engages the periphery of an addition programming cam 166 mounted on the main drive shaft 168 of the machine, which drive shaft is driven by the single cycle clutch 134. A tension spring 170, connected to the distal end of the rear or lower outside arm 171 of the cam following lever, resiliently urges this lever to turn about the shaft 162 in a direction to maintain the cam following roller 165 firmly against the peripheral edge of the cam 166.

A series of accumulator drive gears 172 are mounted on a shaft 173 for independent rotation about the shaft and the shaft 173 is adjacent and parallel to the main drive shaft 168. An addition pendent gear assembly, generally indicated at 175, is disposed between the gear racks 50 of the selection sectors 45 and the accumulator drive gears 172 and comprises a gear cage or bail 176 having three gear shafts 178, 180 and 181 extending transversely therethrough at locations spaced-apart longitudinally of the bail and in spaced and parallel relationship to each other, and series of gears 182, 183 and 185 journaled on the shafts 178, 180 and 181, respectively. The shaft 181 is extended at the opposite sides of the bail and has its ends journaled in fixed portions of the machine frame to provide a pivotal mounting for the gear assembly. The rearward end of the right-hand bail link, as shown in Fig. 7, is provided with an offset tongue 186 received in the notch 187 of a hook formation 188 provided on the distal end portion of the link 156. A series of actuator sectors 190 are rotatably mounted on an actuator shaft 191 disposed rearwardly of, and parallel to, the main drive shaft 168. These actuator sectors are moved from their home or full-cycle position to differentially set positions and returned to their home position during each cycle of the machine by an actuator bail, not shown, driven from a cam on the main drive shaft 168, as is fully disclosed in application S. N. 407,016, referred to above. There is one add pendent gear 185 for each order of the selection sectors 45, one actuator sector 190 for each gear 185, one gear 183 for each gear 185, one gear 182 for each order of the gears 183 and 185, and one accumulator drive gear 172 for each order of the gears 182. There is also one print wheel drive gear 192 for each of the gears 185 and these print wheel drive gears drive the print wheels of the machine in the manner shown in the aforementioned application S. N. 407,016. Each gear 185 is constantly in mesh with the actuator sector 190 and the print wheel drive gear 192 of the same order. The pendent gear assembly 175 is swingable about the pivotal mounting provided by the extended shaft 181 to move the gears 182 into mesh with the corresponding selection sector racks 50 or with the accumulator drive gears 172 and is movable to a centered or neutral position in which the gears 182 are out of mesh with both the selection sector racks and the accumulator drive gears. The gears 183 are idler gears which drivingly connect the gears 182 to the gears 185 of the corresponding orders so that the gears 185 differentially set the actuator sectors 190 from the selection sectors 50 and drive the accumulator gears 172 from the differentially set actuator sectors.

A spring 193 connected between the link 156 and the lever arm 160 resiliently urges the link 156 to a position in which the tongue 186 on the add pendent gear assembly bail is clear of the notch 187 in the link 156, in which case the add pendent gear assembly will be held in its central or neutral position by resilient centering means well-known to the art and particularly described in application S. N. 407,016. When the lever 151 is rocked by a forward movement of the link 144, as explained above, the connection between the lower end of this lever and the link 156, comprising the stud 155

received in the notch 154 of the lever, swings the link 156 in a clockwise direction, as viewed in Fig. 7, to seat the tongue 186 in the notch 187 of the link hook 188. When the machine is then cycled by a forward movement of the clutch and motor bar 126, as described above, the cam 166 makes a complete rotation and swings the cam following lever 161 to first pull the link 156 downwardly, thereby meshing the gears 182 with the teeth of the selection sector racks 50. The actuator sectors 190 are pulled downwardly at the same time and through their meshing engagement with the gears 185, turn the gears 182 and 183 and the selection sectors 45 until all of the selection sectors which have been differentially set are returned to their "0" position in which they are latched by the corresponding "0" latch levers 55. During this part of the cycle, the gears 185 also turn the print wheel drive gears 192 to set the print wheels to the digit values entered from the keyboard into the corresponding orders of the selection sectors. After the actuator sectors 190 have completed their downward movement and after a brief dwell at the downward positions of these sectors for the printing operation, the cam 166 rocks the cam following lever 161 to move the link 156 upwardly and thereby move the add pendent gears 182 out of mesh with the selection sector racks 50 and into mesh with the accumulator drive gears 172. Since the actuator sectors 190 were differentially set during their downward movement as the selection sectors of the several orders were returned to their "0" position, as the actuator sectors are now returned upwardly to their home position, the value for which they were differentially set from the selection sectors is now entered into the accumulator through the accumulator drive gears 172. Shortly after the actuator sectors 190 reach their home position, the cam follower 165 rides on to an intermediate portion of the cam 166 and returns the add pendent gear assembly 175 to its centered or neutral position. During the above-described cycle the value selected in the keyboard has been printed and entered into the accumulator of the machine and during the time that the value is being entered into the accumulator, the print wheels are returned to their "0" position and the machine is then ready for a new operation.

At the end of the keyboard selection, the stop pin carriage 60 was left in the position to which it had been stepped to the left by the entry of the selected value into the selection sectors 45. Near the end of the operating cycle, the shiftable selection unit including the stop pin carriage and the selection sectors and the supporting frame therefor is returned to its right-hand, home position by mechanism briefly illustrated in Figs. 6, 9 and 10 and shown in detail in application S. N. 407,016, referred to above.

A bellcrank restore lever 195, Fig. 9, is mounted at its angle on a fixed pivot 196 carried by a bracket 197 secured to the base of the machine. This restore lever has an arm 198 extending rearwardly from the pivotal mounting 196 and connected at its rear end to the left-hand frame plate 61 of the shiftable selection unit by a pivoted link 200. The lever 195 also has an arm 201 extending to the left from the pivotal mounting 196. The spring 111 is connected between a stud on this arm and the forward end of an extension 202 of the bracket 197 to resiliently urge the lever 195 to turn in a direction to step the shiftable selection unit from right to left.

An elongated restore link 203, Fig. 6, is connected at its forward end to the distal or left-hand end of the lever arm 201 by a universal joint connection 205 and extends rearwardly from the connection 205 over the shaft 206 and over the main drive shaft 168. At its rearward end, the link 203 is provided with a downwardly extending hook formation 207 and a disk 208 is mounted on the shaft 168 and carries a stud 210 spaced radially from the shaft 168 and engageable with the hook formation

207 of the link 203 to give the link 203 a rearwardly directed pull near the end of each operating cycle of the machine. This rocks the lever 195 in a clockwise direction, as viewed in Fig. 9, and forces the shiftable selection unit to the right and back to its home position against the force of spring 111.

The repeat add key 36, Fig. 10, has a flat, elongated stem 211 mounted on the left-hand side of the machine frame for up-and-down movement and is resiliently urged to its uppermost position by a suitable spring, not illustrated. An arm 212 extends rearwardly from the rearward edge of the repeat add key stem 211 and rides on the upper edge of the distal end portion of one arm 213 of a bellcrank lever 215 pivotally mounted at its angle on a fixed pivot 216 and having a second, downwardly extending arm 217. The shaft 206 is mounted for longitudinal sliding movement in the side plates of the machine frame and is resiliently urged to its right-hand limiting position by a compression spring 218, Fig. 9, which surrounds the shaft between the left-hand side wall 220 of the machine and the left-hand one of a pair of washers 221 and 222 mounted on the shaft in spaced-apart relationship to the right of the side wall 220. The restore link 203 is disposed between the washers 221 and 222 and the distal end of the arm 217 of the bellcrank 215 bears against the right-hand end of a collar 223 fixed on the shaft 206 to the right of the washer 222. With this construction, when the repeat add key 36 is depressed the arm 212 rocks the bellcrank lever 215 and moves the shaft 206 and washers 221 and 222 to the left against the force of the compression spring 218 thereby moving the hook formation 207 on the rear end of the restore link 203 to the left and out of the path of the stud 210 so that the stud cannot engage the hook formation to restore the shiftable selection unit to its home position at the end of the coincidental operating cycle of the machine, shown in operated position in Fig. 9. A spring 225 connected between the restore link 203 and the bracket 197 resiliently holds the restore link down on a collar 226 which surrounds the shaft 206 between the washers 221 and 222. The restore link is provided at its bottom edge with a cam formation 227 which controls the connection between the stud 210 and the hook formation 207 on the rear end of the restore link.

At its lower end of the repeat add key stem 211 carries a pin 228 which rides on the upper edge of the rear end portion of the left-hand arm 230, Fig. 10, of a bail 231 which extends transversely across the front end of the machine and is pivotally mounted at the front end of the arm 230 on a bail shaft 232. The right-hand arm 233 of the bail 231 bears on a stud 235 carried at the distal end of an arm 236 of the bellcrank 138. A stud, not illustrated, on the repeat add key stem 211 also engages the left-hand clutch and motor bar 237 and moves this bar forwardly. As the bar 237 is connected to the right-hand motor bar 126 for simultaneous and coextensive movement, depression of the repeat add key 36 will establish an operating cycle of the machine in the same manner as that described above for the addition key 28. Rocking of the bellcrank 138 will condition the machine to perform an addition operation, as described above, for each cycle of the machine while the repeat add key 36 is depressed.

For repeat operation, it is not only necessary to block restoring of the shiftable selection unit to its right-hand, home position, but it is also necessary to block the relatching of the activated selection sectors 45 in their "0" positions, Fig. 2. For this purpose a bail 240 is disposed in front of the stop pin carriage 60 and rockably mounted at its upper end on a shaft 241 extending transversely of the machine to the left of the ordinal selection position of the shiftable selection unit. The zero latch blocking bail 240, shown in Figs. 2 and 10, is the old form used in a machine which is not provided with a backspace-

ing mechanism and comprises a flat intermediate portion 242, a left-hand bail leg 243 and a right-hand bail leg 245 disposed at corresponding ends of the intermediate portion 242 and extending perpendicularly forwardly from the intermediate portion. The legs 243 and 245 extend above the upper edge of the intermediate portion 242 and are pierced at their upper ends to receive the shaft 241 and the lower edge of the intermediate portion 242 is formed into a rearwardly projecting flange 246 which overlies the forward end portions of the forwardly extending tail portions 247 of the "0" latch levers 55 and holds these levers in position such that the corresponding live points 52 will ride up on the rearward ends of these levers but will not pass the rearward ends thereof to latchingly engage the rear ends of the "0" levers and latch the corresponding selection sectors in "0" position, as shown in Fig. 2. Thus, when the lower end of the bail 240 is rocked forwardly, the activated selection sectors will not be relatched in "0" position at the end of an operating cycle of the machine but will be returned by their corresponding springs 56 to positions determined by the set stop pins 68 in the corresponding orders. The bail 240 is resiliently urged to its forward, inoperative, position by a spring and the left-hand bail link 243 is extended downwardly and provided with downwardly and forwardly inclined cam surfaces 248 and 250 disposed one below the other. A pin or stud 251 projects to the right from the lower end of the repeat add key stem 211 and rides on the lower, inclined cam edge 250 of the bail leg 243 to rock the lower end of the bail 240 rearwardly and thus block the relatching of the activated selection sectors by the corresponding "0" latch levers 55, as explained above, when the repeat add key is depressed.

The repeat subtraction key 40 has a stem 252 slidably mounted on the left-hand frame plate of the machine for vertical movement and carrying a rearwardly directed arm 253 which also bears on the distal end portion of the arm 213 of the bellcrank lever 215 to disable the shiftable selection unit restore mechanism when the repeat subtraction key is depressed in the same manner as described above in connection with the repeat addition key. Near its lower end, the repeat subtraction key stem 252 carries a pin 255 directed to the right and bearing on the cam edge 248 of the bail leg 243 so that the lower end of the bail 240 will be rocked forwardly to block relatching of the activated selection sectors in their "0" positions when the repeat subtraction key 37 is depressed in the same manner in which the relatching of the selection sectors is blocked when the repeat addition key 36 is depressed, as described above. The pin 255 also bears on the distal end of the left-hand arm 256 of a bail 257 pivotally mounted on a bail shaft 258 which extends across the front end portion of the machine. The left-hand leg 260 of the bail 257 bears on a pin projecting from the lower end of the subtraction key stem 261 to establish subtractive operating cycles of the machine whenever the repeat subtraction key 37 is depressed.

Referring to Fig. 8, the keyboard clearing key 35 has an elongated, flat stem 262 mounted for up-and-down movement on the left-hand frame plate of the machine by the fixed studs 263 and 265 extending through elongated slots in the key stems and the key is raised to its normal, upper position by a suitable tension spring 266. At its lower end, the key stem 262 is provided with a perpendicular pin or stud 267 which engages the upper edge of the rearward end portion of the left-hand leg 230 of the repeat addition bail 231 to establish an additive operating cycle of the machine whenever the keyboard clearing key 35 is depressed and also has a stud 268 which engages the left-hand clutch and motor bar 237 to establish the operating cycle. During the former portion of the addition cycle the add pendent gear assembly 175 is swung by the addition control means, illustrated in Fig. 7, and described above, to bring the add pendent gears 182 of the appropriate orders into mesh with the rack portions

50 of the activated selection sectors 45 to return the set or activated sectors 45 to their "0" position in which they are latched by the coördinal "0" latch levers 55. During this former portion of an addition cycle, the print wheels are turned to position to correspond to the selection in the selection unit and during the dwell of the actuator sectors 190 at the lower end of the downward movement of these sectors after the selected value has been transferred to the print wheel, a print cam 270, Fig. 8, on the main drive shaft 168 is brought to position such that its low portion 271 comes into registry with a cam following roller 272 on a print control arm 273.

The print control arm 273 is rockably mounted at its upper end on a shaft 275 and is connected to a lever 276 which is in turn connected to the left-hand leg 277 of the print control bail which is pivoted on the shaft 278 and releases the print wheels for printing movement under the influence of the ordinal print wheel actuating springs when the cam follower 272 drops into the low portion 271 of the cam 270, as is more particularly illustrated and described in application S. N. 407,016 referred to above.

The printing platen 280 of the machine is provided at one end with a ratchet wheel 281 which is engaged by a line spacing pawl 282 operated from the actuating mechanism of the machine to turn the platen for line spacing after each printing operation, as is described in detail in application S. N. 407,016. A lever 283 pivotally mounted at its lower end on a shaft 285 is rockable about this shaft in a counter-clockwise direction, as illustrated in Fig. 8, and is engageable at its upper end with the line spacing pawl 282 to hold this pawl out of engagement with the ratchet wheel 281 and thus block line spacing operation of the printing platen when the lever 283 is rocked as indicated.

An elongated lever 286 of flat V-shape is pivotally mounted intermediate its length on a pivot pin or shaft 287 disposed below and parallel to the main drive shaft 168. This lever has at its forward end a terminal notch 288 which receives the stud 267 on the lower end of the keyboard clearing key stem 262 so that the lever is rocked in a clockwise direction, as illustrated in Fig. 8, whenever the keyboard clearing key is depressed. The print blocking lever 286 is provided at its rearward end with an abutment formation 289 which moves behind the cam following roller 272 when the lever is rocked by depression of the keyboard clearing key and blocks this roller from dropping into the low portion 271 of the print control cam 270 thus blocking the printing operation of the machine. A rearward extension 290 of the lever 286 is engaged with the lower forward end of a lever 291 also mounted on the shaft 285 and connected through this shaft to the lever 283 to move the lever 283 to position the lever 285 to hold the line spacing pawl 282 out of engagement with the platen ratchet wheel 281 when the print suppressing lever 285 is rocked by depression of the keyboard clearing key, as described. Thus, during the former portion of an operating cycle of the machine established by depression of the keyboard clearing key the selection sectors will be zeroized and the print wheels will be turned to position corresponding to the selected value in the selection sectors but printing of this value and line spacing movement of the printing platen will be suppressed.

During an addition operation of the machine, immediately following the printing operation and before the actuator sectors start their return movement to their home position, the add pendent gear assembly 175 would be swung, as described above, to engage the gears 182 thereof with the accumulator drive gears 172 to enter the selected value additively into the accumulator of the machine. An addition suppressing lever 292 is disposed between the add key stem 262 and the add pendent gear assembly 175 and pivotally mounted intermediate its length on a pivot shaft 293. This lever is provided at

its forward end with a terminal notch 295 which receives the stud 268 on the keyboard clearing key stem 262 and is provided at its rearward end with a hook formation 296 which engages behind an extension of the gear shaft 178 of the add pendent gear assembly 175 when the lever 292 is rocked by depression of the keyboard clearing key. Engagement of the hook 296 of the lever 292 with the shaft 178 prevents the gear assembly 175 from moving to mesh the gears 182 thereof with the accumulator drive gears 172 and thus suppresses the entry of the selected value into the accumulator of the machine. Depression of the keyboard clearing key thus establishes an addition cycle of the machine but suppresses printing, line spacing and accumulation so that the only result is that the shiftable selection mechanism is cleared and restored to its right-hand home position.

The backspacing key 38 has a flat, elongated stem 297 carrying on its upper end a key top 298, Figs. 2 and 6, and provided intermediate its length with a rearwardly projecting arm 300, the rearward end portion of which bears on the right-hand end portion of the arm 213 of the restore suppressing bellcrank lever 215. Depression of the backspacing key 38 will thus move the hook formation 207, Fig. 11, of the restore link 203 out of the path of the stud 210 and thereby disable the restore mechanism for the shiftable selection unit of the machine.

The key stem 297 is mounted for up-and-down movement on the left-hand frame plate of the machine by vertically spaced-apart studs 301 and 302 extending through corresponding elongated slots in the key stem and the key is urged to its normal, upper position by a suitable tension spring, not illustrated.

The stud 267 on the lower end of the stem 262 of the keyboard clearing key 35 extends from this key stem through the upper end of an elongated slot 303 in the stem 297 of the backspace key 38. The stud 268 on the keyboard clearing key stem 262 extends from this key stem under a shoulder 305 on the backspacing key stem 297 so that, when the backspacing key is depressed, the keyboard clearing key will be depressed along with it and the levers 292, and 286 and the bail 231 will be rocked in the same manner as that in which they are rocked by the keyboard clearing key 35, as described above in connection with Fig. 8. Thus, when the backspacing key is depressed an addition cycle of the machine is established, but printing, line spacing and accumulation are all suppressed as in the case of the clearing operation. An interlock lever 306 is pivotally supported at its lower end by a fixed stud 307 received in a terminal notch 308 in the lever and is pivotally connected to the lower end portion of the backspacing key stem 297 by a pivot pin 310. The interlock lever 306 has a shoulder substantially parallel to the longitudinal center line of the key stems 262 and 297 and disposed in front of the pin 267 so that, when the clearing key 35 alone is depressed, the stud 267 moves behind this shoulder and blocks the lever 306 against rocking which precludes depression of the backspacing key 38 after an initial depression of the clearing key 35 by itself. When the backspacing key 38 is depressed, however, the interlock lever 306 is first rocked to move the corner thereof at the upper end of its shoulder under and past the pin 267 so that this pin can then follow down the inclined upper edge of the lever and the clearing key can move down at the same time that the backspacing key 38 is depressed.

A bracket 311 is mounted on and extends vertically from the machine base 312 below and forwardly of the disk 208 on the main powered shaft 168 and a wide bail 315 is pivotally mounted on the upper edge of this bracket by a pivot pin 316, Figs. 6 and 12, the axis of which extends longitudinally of the machine and is forwardly and downwardly inclined. The bail 315 has a flat intermediate portion 317 of rectangular shape and legs 318 and 320 extending upwardly past the upper edge of the intermediate portion at the rear and front ends respec-

tively of the intermediate portion and substantially perpendicular to the axis of the pin 316. A face cam 321 of annular or circular shape is provided on the inner or right-hand side of the disk 208 concentrically of the axis of the main drive shaft 168. The bail leg 318 carries at its upper end a cam following roller 322 bearing against the edge of the cam 321 remote from the disk 208, and a spring 323 connected between the upper edge of the intermediate portion 317 of the bail and the left-hand frame plate 220 of the machine, resiliently maintains the roller 322 against the face or edge of the cam. With this arrangement, each time the power shaft 168 rotates, the bail 315 is rocked to the right or clockwise, as viewed in Fig. 13, until the lobe of the cam passes the roller 322, whereupon the spring 323 rocks the bail back to the left or in a counter-clockwise direction.

A rack 325, Fig. 13, is secured at its right-hand end to the left-hand frame plate 61 of the shiftable selection unit by an angle bracket 326 and extends to the left from the shiftable selection unit directly under the link 200 which connects the restore lever 195 to the shiftable selection unit. This rack has teeth or serrations 327 along its lower edge which teeth are inclined to the left and are spaced-apart equal distances equal to the ordinal distance of leftward movement of the shiftable selection unit provided by the escapement mechanism illustrated in Fig. 3, as value digits are entered into the selection mechanism. A lever 328 is pivotally mounted intermediate its length on the upper end of the front leg 320 of the bail 315 by a pivot pin 330 and extends transversely of the bail and substantially parallel to the rack 325 immediately below the rack. The lever 328 carries on its right-hand end a tooth or abutment formation 331 which is engageable with the rack teeth 327 when this end of the lever is raised, to force the rack 325 and the shiftable selection unit to the right when the bail 315 is rocked to the right by the cam 321. An arm 332 projects to the left and downwardly from the intermediate portion of the backspacing key stem 297 and is pivotally connected at its left-hand or distal end to the bottom end of a link 333 by a pivot pin 333. This link is provided in its upper end portion with a longitudinally extending slot 336 which receives a pin 337 projecting from the left-hand end of the lever 328. A tension spring 338 connected between the pins 335 and 337 resiliently maintains the pin 337 in the bottom end of the slot 336 and rocks the lever 328 to lower the left-hand end and raise the right-hand end of this lever when the backspacing key is depressed. As explained above, rocking of the lever 328 by depression of the backspacing key, brings the abutment 331 on the right-hand end of this lever into engagement with a tooth 327 of the rack 325 so that the rocking of the bail 315 by the cam 321 during the coincident operating cycle of the machine will step the shiftable selection unit of the machine one step to the right. While escapement rack teeth 96 cannot move to the left past detent 95 unless the detent is withdrawn from an interdental space in the rack in which it is engaged, the rack can be moved to the right with the teeth 96 ratcheting past the detent formation 95. This detent formation will reengage the teeth and hold the rack in the position to which it is moved to the right against the force of the spring 111 which resiliently urges the rack and the shiftable selection unit to which it is connected to the left.

From the above description, it is apparent that the depression of the backspacing key will establish an addition operating cycle of the machine and will suppress printing, line spacing and accumulation, will disable the shiftable selection unit restore mechanism and will, by other means, move the shiftable selection mechanism back one step to the right where it will be held by the escapement mechanism.

In order that a correction may be made in the selection sector which has thus been brought back to the operative or selection ordinal position, it is necessary

that this sector should have been returned and relatched in its "0" position while any set sectors to the left of this sector should have been left free to return to their set positions after the add pendent gear assembly is disengaged from the selection sectors at about the time of the printing operation of the coincident operating cycle.

Referring to Fig. 11, the modified "0" latch blocking bail 240, as used with the backspacing mechanism, is provided in two parts 341 and 342. The part 341 is similar in all respects to the original bail 240 as illustrated in Fig. 10, except that the flange on the bottom edge of the intermediate portion 242 of this part of the bail which flange overrides the forwardly extending tail portions of the "0" latch levers 55, is reduced in length, as indicated at 343, so that it engages only one "0" latch lever 55 which is the "0" latch lever at the selection position of the orders of the selection sectors 45. The second part 342 of the "0" latch lever blocking bail comprises a flat intermediate portion 345 of rectangular shape having at its upper corners apertured ears 346 and 347 which receive the shaft 341 to pivotally mount this part of the bail on the shaft. A rearwardly projecting flange 348 extends along the bottom edge of the intermediate portion 345. When the two parts of the bail are in operative association, the right-hand end of the flange 348 is adjacent the left-hand end of the flange portion 343 and the flange 348 extends from the flange portion 343 to the left-hand side of the bail to engage all of the "0" blocking levers except the zero blocking lever which is in the selection position. A tension spring 350 connected to the intermediate portion 345 resiliently rocks the lower end portion of the bail part 342 forwardly and the flange 348 thereof out of engagement with the "0" latch levers 55. A tongue 351 extends perpendicularly forwardly from the left-hand edge of the intermediate portion 345 and is provided with a downwardly and forwardly inclined cam edge 352.

Referring now to Figs. 4, 6, and 13, an elongated pin 353 projects to the right from the intermediate portion of the backspacing key stem 297 and overlies the cam edge 352 of the tongue 351 so that depression of the backspacing key, by moving the pin 355 downwardly along the cam edge 352 will rock the bail portion 342 rearwardly but will not move the bail portion 341. Under these conditions, all of the "0" latch levers to the left of the selection position will be blocked so that they cannot relatch the coordinial selection sectors in "0" position but the "0" latch lever at the selection position will be released and will relatch this selection sector in "0" position so that a corrected entry can be made in this order of the selection mechanism.

It is to be noted that the stop pin 63 at the selection position which was previously set will also be retracted by the backspacing action so that another stop pin in this order can be set from the keyboard. After an erroneous entry in one order has been cancelled out by backspacing and a corrected entry made, the selection can proceed in the normal manner and it is possible to cancel the entries made in several orders, if necessary to correct an erroneous digit entry, by merely holding the backspacing key depressed for the required number of cycles of the machine. The length of the rack 323 is so dimensioned that, after the shiftable selection mechanism has been restored all the way to its right-hand, home position, further backspacing operations will be merely idle operations and will not have the effect of attempting to force the shiftable selection mechanism beyond its home position or jamming the machine.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning

and range of equivalency of the claims are, therefore, intended to be embraced therein.

What is claimed is:

1. In a calculating machine having a ten-key keyboard, a shiftable selection mechanism resiliently urged to the left from its right-hand home position and including ordinal selection sectors spring-urged from their "0" positions to differentially set positions, stop pins set by said keyboard for stopping said sectors in differentially set positions, "0" latches releasably latching said sectors in "0" position and means actuated by the keyboard keys successively releasing said "0" latches as they come to the selection position in the leftward movements of said shiftable selection mechanism, escapement mechanism actuated by said keyboard and limiting the leftward movements of said shiftable selection mechanism to successive ordinal steps, restore mechanism effective to restore said shiftable selection mechanism to its home position with said selection sectors latched in "0" position at the end of a machine operating cycle, an accumulator, printing mechanism, a control key, control mechanism conditioned by said control key to establish an operating cycle of said machine and zeroize said selection sectors while connected to said printing mechanism and to sequentially enter the value from said selection sectors into said accumulator, a repeat control key and a "0" latch blocking bail having two relatively movable parts normally conditioned by said repeat control key to block the "0" latches of the orders of said selection sectors at and to the left of the selection position of the selection sectors against relatching the coordinial selection sectors in "0" position, a backspacing key effective to condition said control means to establish an operating cycle of the machine, blocking means actuated by said backspacing key to disable said printing mechanism and said restore means and to disable said control means to enter the value from said selection sectors into said accumulator and to move one part of said "0" latch blocking bail to block the "0" latches of the orders to the left of said selection position while leaving the part of the latch blocking bail at the selection position unmoved to thereby free the zero latch at that position to relatch the coordinial selection sector in "0" position, and means conditioned by said backspacing key and operated incidentally to the operating cycle of the machine to return said shiftable selection mechanism one ordinal step to the right during each machine operating cycle established by said backspacing key.

2. In a calculating machine having an accumulator, power-operated printing mechanism, selection mechanism including a shiftable selection unit resiliently urged to the left from its right-hand home position and having differentially settable selection racks, a ten-key keyboard effective to differentially set said selection racks, an escapement mechanism operated by said keyboard to limit the leftward movements of said shiftable selection unit to successive ordinal steps and power-driven restore means effective at the end of an operating cycle of the machine to restore said shiftable selection unit to its home position, a control key effective to establish an operating cycle of the machine, power-driven control means conditioned by said control key to connect said selection racks to said printing mechanism and return said selection racks to "0" position and to sequentially connect said printing mechanism to said accumulator and zeroize said printing mechanism, and "0" latches latching said selection racks in "0" position, a backspacing key effective to condition said control means and establish operating cycles of the machine, power-driven mechanism conditioned by said backspacing key to move said shiftable selection unit one space to the right during each machine operating cycle established by said backspacing key up to the home position of said shiftable selection unit, and blocking means conditioned by said backspacing key to disable said printing mechanism, said restore mechanism and

the "0" latches to the left of the selection order of said selection racks and prevent said control means from connecting said printing mechanism with said accumulator.

3. In a calculating machine having cyclically operating power means, a shiftable selection unit resiliently urged to the left from its right-hand home position, an escapement mechanism limiting the leftward movements of said selection unit to successive ordinal steps, and power-operated restore means returning said selection unit to its home position at the end of an operating cycle of the machine, a backspacing key effective to establish operating cycles of the machine and disable said restore means, and power-operated means conditioned by said backspacing key to move said shiftable selection unit one ordinal space to the right during each machine operating cycle established by said backspacing key and comprising a cam driven by said power means, a bail rockably mounted on a fixed support and rocked by said cam during each operating cycle of the machine, a rack secured to and projecting to the left from said shiftable selection unit, an arm pivotally mounted on said bail and having on one end an abutment engageable with said rack, overridable means normally holding said abutment out of engagement with said rack, and manual means effective to override said overridable means and bring said abutment formation into engagement with said rack.

4. In a ten-key calculating machine having selectively operable digit keys, a pin carriage having ordinally arranged rows of pins, means supporting said pin carriage for transordinal movement, means resiliently urging said pin carriage to the left, digit key operated means limiting leftward movement of said pin carriage to one ordinal step for each digit key operation, power-operated restore means effective to return said pin carriage from a leftwardly displaced position to its home position, selection elements movably mounted on said pin carriage and resiliently urged away from their "0" positions, zero latches releasably holding said selection elements in "0" position, means disposed at a selection station and operated by said digit keys to selectively set the pins and release the zero latches as the orders of said pin carriage move past

said selection station, a power-driven actuating mechanism, an accumulator, transmission mechanism driven by said actuating mechanism and movable between said selection elements and said accumulator, an addition key, power-operated addition mechanism effective to cycle said machine and sequentially move said transmission mechanism into engagement with said selection elements to zeroize said elements, and into engagement with said accumulator to enter the value from said selection elements into said accumulator, said zero latches being effective to latch said selection element in said "0" position and said carriage restore means being effective after movement of said transmission means from said selection elements to restore said pin carriage to its home position, a repeat addition key effective to condition said addition mechanism for operation and to cycle said machine, repeat mechanism actuated by said repeat addition key to disable said zero latches and said pin carriage restore means, a rack carried by said pin carriage, a cyclically driven cam, a rockable member rocked by said cam, an abutment formation moved by said rockable member and normally disposed clear of said rack, a backspacing key effective when operated to cycle the machine, condition said addition mechanism and said repeat addition mechanism for operation and move said abutment formation into engagement with said rack to step said pin carriage one ordinal step to the right during each machine cycle, and mechanism operated by said backspacing key to block movement of said transmission means into engagement with said accumulator and to free the zero latch at the order immediately to the right of said selection station to latch the coordinial selection element in "0" position.

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