

Sept. 17, 1968

G. D. CUSHMAN ETAL

3,401,878

ACTUATOR MEANS FOR CALCULATING MACHINES

Filed Oct. 5, 1966

4 Sheets-Sheet 1

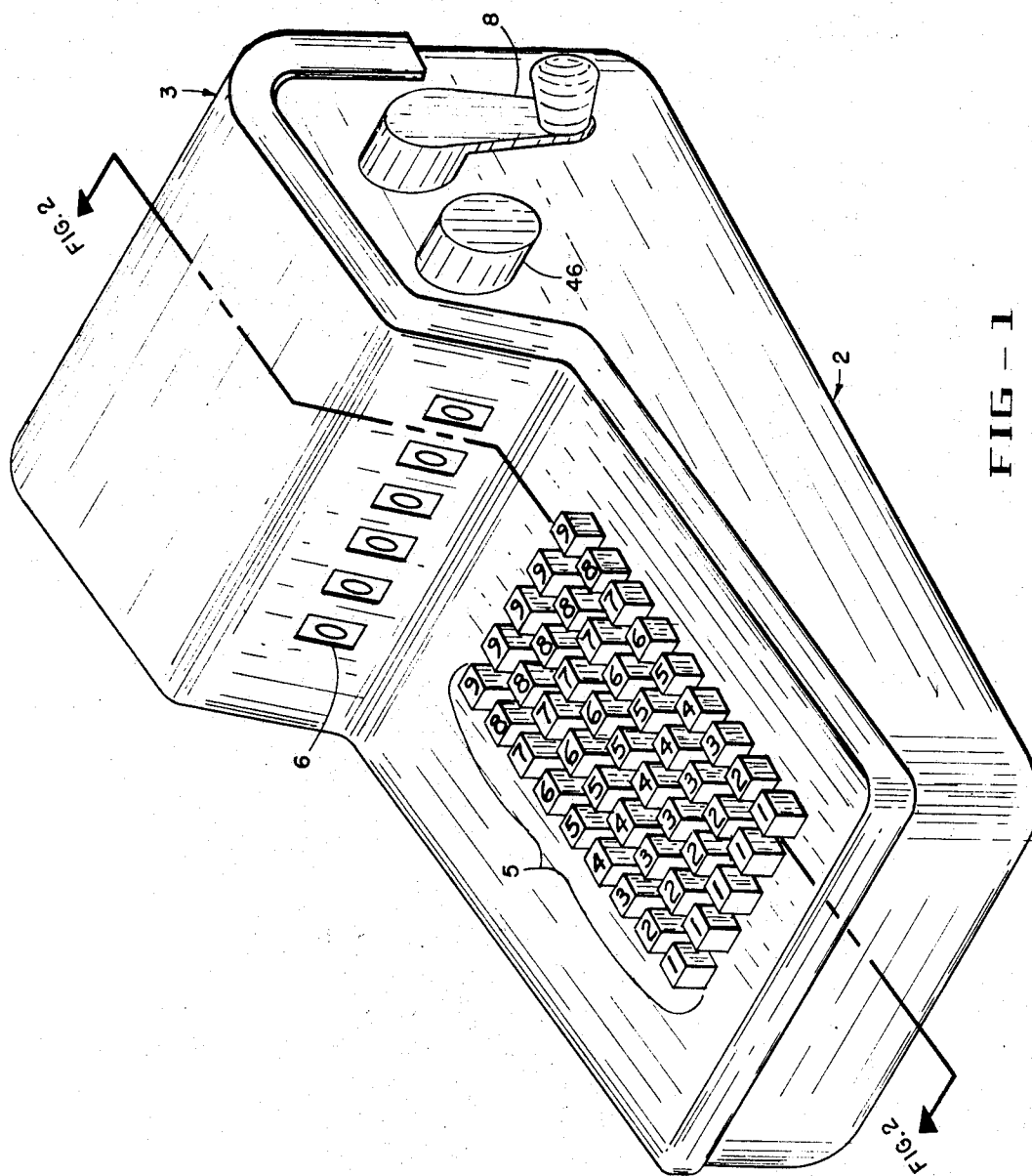


FIG - 1

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4 Sheets-Sheet 2

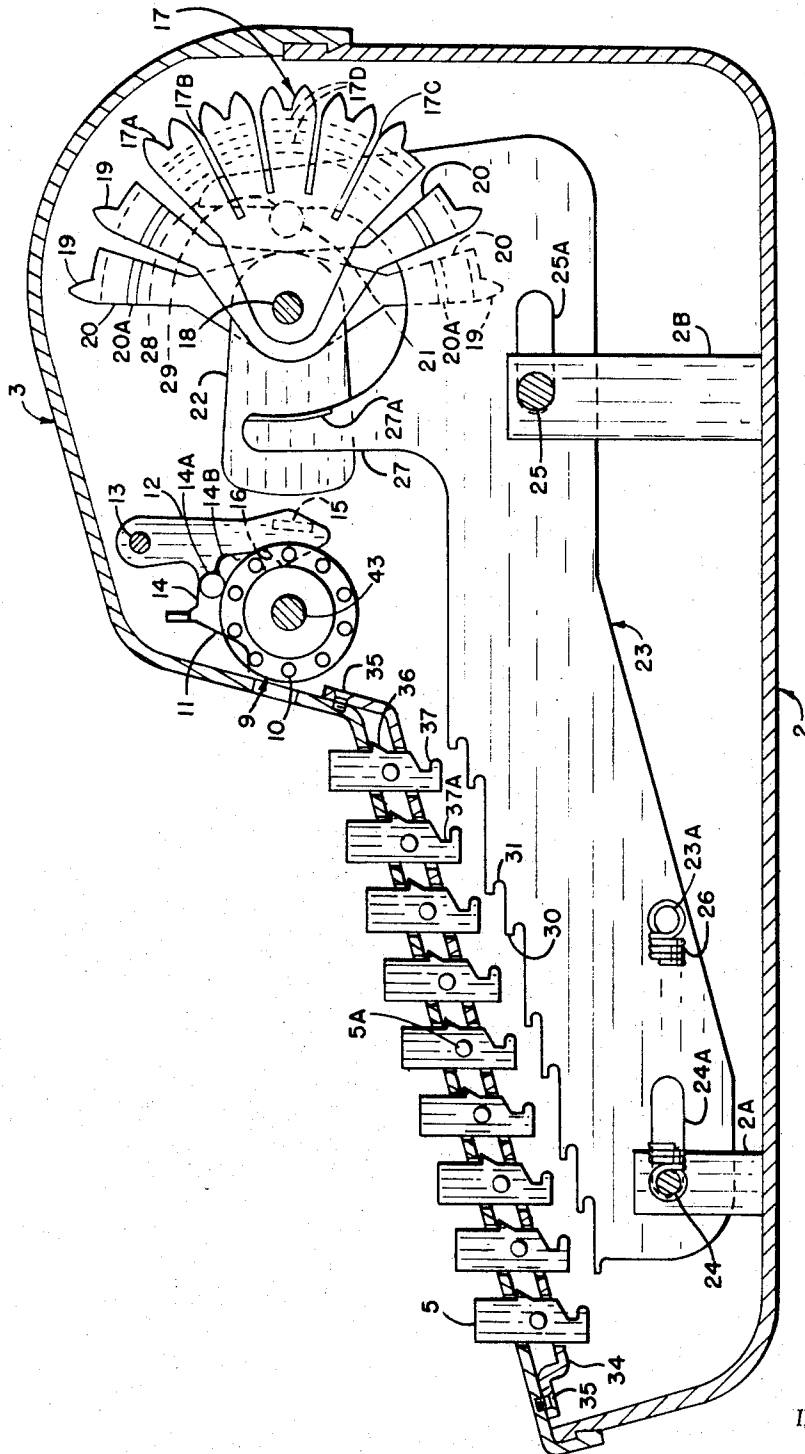


FIG - 2

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4 Sheets-Sheet 3

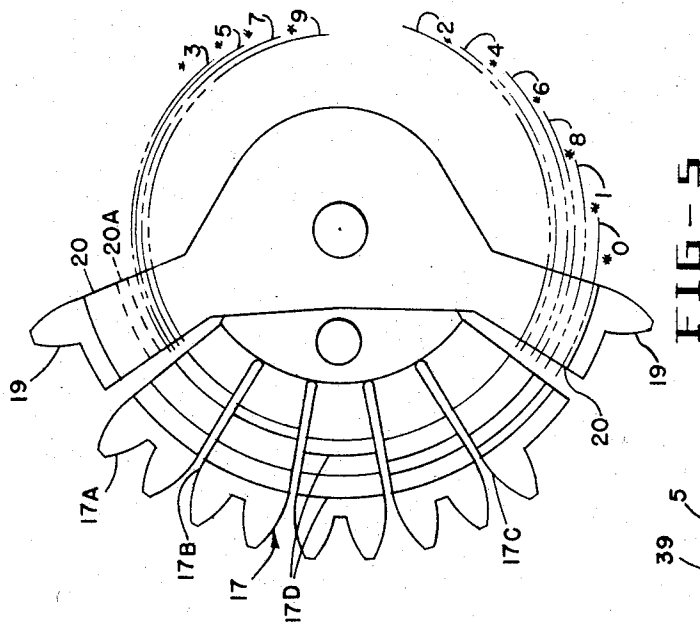


FIG - 5

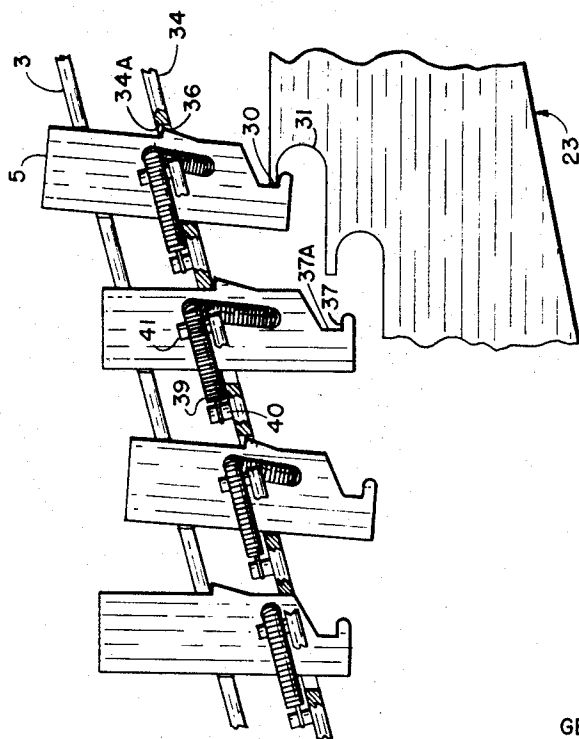


FIG - 3

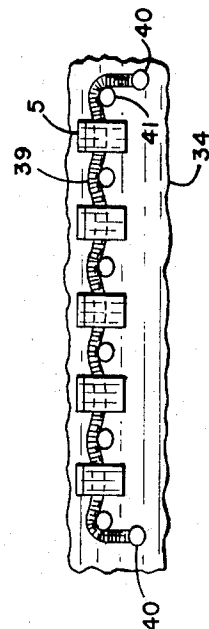


FIG - 4

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4 Sheets-Sheet 4

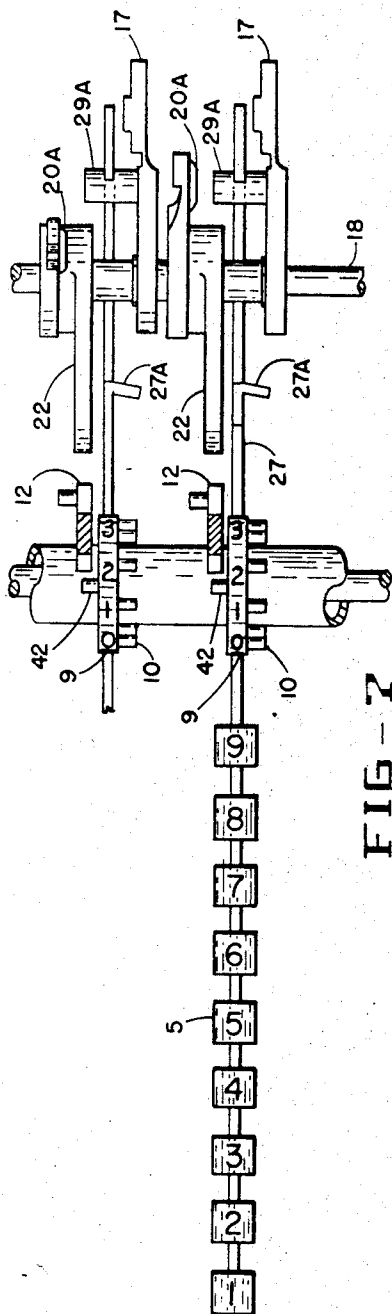


FIG. 7

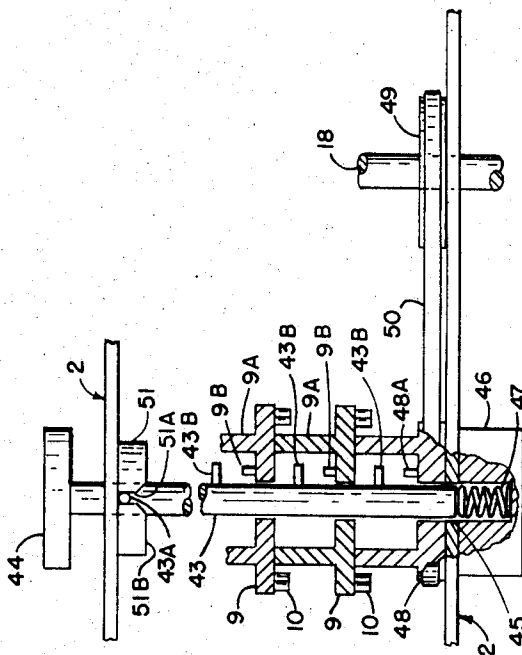


FIG. 8

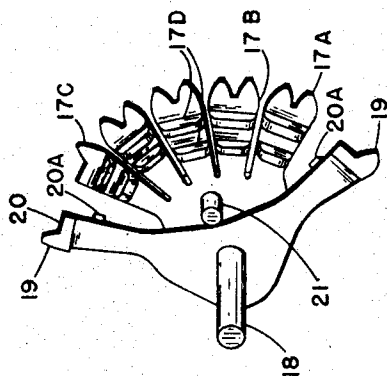


FIG. 9

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ACTUATOR MEANS FOR CALCULATING MACHINES

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15 Claims. (Cl. 235—9)

The invention relates to calculating machines of the type embodying a rotatable actuator upon which the values to be calculated are set up, rotation of the actuator by suitable means serving to transmit the values entered into the actuator directly to numeral wheels of the counting mechanism.

An object of the invention is to simplify the construction and lessen the cost of manufacture of calculating machines of the rotatable actuator type.

Another object of the invention is to provide a rotatable actuator of the multi-tooth type in which rotation of the actuator serves to move the selected number of teeth into cooperative relationship with the counting mechanism.

Another object of the invention is to provide a rotary actuator which is constructed as an integral part and of material which has inherent resiliency.

A further object of this invention is to provide an improved keyboard setting mechanism for calculating machines.

A further object of the invention is to provide a keyboard which has dual function stop and latch mechanism.

With these and incidental objects in view, the invention includes certain novel features of construction and combination of parts, the essential elements of which are set forth in appended claims and a preferred form or embodiment of which is hereinafter described with reference to the accompanied drawings, in which;

FIG. 1 is a right front perspective view embodying the present invention;

FIG. 2 is an enlarged vertical section view taken along lines 2—2 of FIG. 1;

FIG. 3 is an enlarged fragmentary view of FIG. 2, with certain parts broken away for purposes of clarity, showing various positions of the selection keys and the relationship of the selection keys, selection key support and selection bars (it is to be noted that showing all the key positions on one order row was done merely for simplicity of illustration);

FIG. 4 is a top fragmentary view of one transverse row of selection keys showing the relationship of the key spring, keys, guideposts, and anchoring posts, drawn on a reduced scale.

FIG. 5 is a planned view of one of the actuating wheels;

FIG. 6 is a perspective view of one of the actuating wheels drawn on a slightly reduced scale;

FIG. 7 is a fragmentary top planned view, with certain parts omitted, showing the relationship of the selection keys, selection bar and actuator wheels to the counting mechanism; and

FIG. 8 is an enlarged fragmentary view, with certain parts shown in section and certain parts omitted, of the counting mechanism showing the zero restore means.

Referring now in more detail to the accompanying drawings, the calculating machine will be described with reference to a supporting base and side frame section 2, (FIG. 1), a cover plate 3, value selection keys 5, a hand crank 8, counting mechanism 9, (FIG. 2) actuator segment 17 and value selection bars 23.

Counting mechanism

Referring now particularly to FIGS. 2, 7, and 8, the counting mechanism includes a support shaft 43 supported

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on frame section 2 and on which are rotatably mounted a plurality of numeral wheels 9. The numeral wheels are provided with collar portions 9A (FIG. 8) to ensure proper spacing. Each of the numeral wheels includes ten projection pins 10 corresponding to the values 0-9, inclusive, and a tens transfer projection pin 42 (FIG. 7). The numeral wheels 9 (FIG. 2) are provided with spring detent means 11 engaging projection pins 10 to hold them in their set position. The tens transfer mechanism includes a tens transfer lever 12 pivotally mounted at 13 and including a camming element 15 and a camming surface 16. The tens transfer lever 12 is provided with spring detent means 14 having a neutral position 14A and transfer position 14B for holding the tens transfer lever in either a neutral of tens transfer position.

Actuator means

Associated with the counting mechanism and mounted in the frame of the machine, is an actuator having a reversible cycle of operation, which serves, upon rotation in either direction, to transmit the values entered therein to the numeral wheels of the counting mechanism. Rotation of the actuator segment in one direction will cause numbers to be added into the counting mechanism and rotation in the opposite direction will subtract numbers. The actuator comprises a plurality of actuating units secured to a rotatable shaft 18, the shaft being provided with a hand crank 8 for rotating in either direction.

Each actuating unit comprising a segment 17 upon which are arranged nine ordinal registration teeth 17A, two tens carry teeth 19 (one for addition and one for subtraction), and a tens carry lever restoring cam 22. The nine ordinal registration teeth 17A are disposed radially of the shaft 18 on five radially projecting fingers 17B. All of the fingers 17B include two registration teeth except for finger 17C which has only one registration tooth and by selecting various combinations of these fingers, it is possible to enter any number 1-9, inclusive, into the counting mechanism. Integral with each of the fingers 17B is a pair of laterally projecting cam elements 17D detailed in different widths and differentially spaced from the axis of shaft 18, as clearly shown in FIGS. 5 and 6. The tens carrying teeth 19 are integral with the outer ends of radially projecting fingers 20. Each of the tens carrying fingers includes a laterally projecting cam element 20A. The tens carry fingers 20 of each of the next adjacent orders are staggered relative to each other (as shown in FIGS. 2 and 7) to permit a carry as a result of a carry or what is commonly referred to as a "chain-carry." The actuator units including fingers 17A and fingers 20 are made as integral components and of a material having inherent resiliency, such as delrin plastic.

Due to the inherent resiliency of the actuator segments, the fingers 17B and registration teeth 17A are rockable sideways with respect to the associated numeral wheel 9. Each of the actuator segments is mounted relative to a numeral wheel 9 so that during rotation of a segment 17, all nine of the teeth 17A will engage pins 10 to enter a nine into the counting mechanism. In order to enter a different number into the counting mechanism, the non-selected fingers 17B must be rocked sideways to prevent the registration teeth 17A from engaging pins 10.

Selection bars

Fingers 17B (FIG. 2) with registration teeth 17A are rocked sideways by positioning a cam element 27A in the path of cam elements 17D on the actuating fingers. The cam element 27A is laterally projecting from an upstanding arm 27 integral with a selection bar 23 associated with each order of the calculating machine. The selection bar 23 is supported in the base frame 2 by upstanding supports 2A, 2B. Each of the upstanding supports 2A,

2B has mounted thereon a transverse shaft 24, 25, respectively, which are fitted in elongated slots 24A, 25A defined in the selection bars. The selection bars 23 are individually urged toward the front of the machine (from right-to-left as seen in FIG. 2) by means of a tension spring 26 connected to the transverse shaft 24 at one end and connected to a stud 26A on each of the selection bars. The selection bars are held in a neutral or home position (as shown in FIG. 2) by means of a laterally projecting stud 21 mounted on each of the actuator segments 17 and engaging notch portion 29 on an upstanding arm 28 integral with each of the selection bars 23. Reciprocation of the selection bar 23 is accomplished by rotating segment 17 to disengage stud 21 from notch 29 allowing spring 26 to move bar 23 toward the front of the machine. Each of the selection bars 23, including stops 30, arms 27, 28 and cam 27A, are made as integral elements.

Key section

Means are provided for moving the cam element 27A to an adjusted position and in the present instances this means includes a plurality of numeral keys 5 having values from 1-9, inclusive, the key at the front end of the row preferably having the value one and the key at the rear end of the row preferably having the value nine, as shown in FIGS. 1 and 7. The value 0 is entered into an order of the counting mechanism by rotating the actuator segment without depressing any key. Each keystem is supported for vertical translating movement in openings 34A (FIG. 3) provided in a keyboard supporting plate 34, connected to the top of the calculating machine at 35 (FIG. 2). Referring now particularly to FIGS. 2 and 4, each of the transverse rows of keys is provided with a spring 39 anchored at its opposite ends on the support plate 34 by means of upstanding anchoring post 40. The spring passes around a plurality of upstanding guideposts 41 mounted on the support plate 34 on each side of the numeral keys as shown in FIG. 4, and passes through an opening 5A in each of the keystems. Each of the keystems is provided with a rearwardly projected dual purpose latch and stop element 36 intermediate the top and bottom and a latch 37 having a stop portion 37A on its lower end. The transverse alignment of the keystem openings 5A, anchoring posts 41 and spring 39 is such that the spring 39 is continually urging each of the keystems upward and toward the rear of the machine or from left-to-right as seen in FIG. 3. Therefore, it can readily be seen that by depressing any one of the keystems that the latching element 36 will pass through opening 34A in support plate 34 and will be urged in a counterclockwise direction relative to support plate 34 by tension spring 39 so that the latching element 36 will engage the underside of support plate 34 and hold the keystem in a depressed position, as clearly shown in FIG. 3. Each of the selection bars 23 is provided with nine stop elements 30 having an undercut portion 31. The selection bar stop elements 30 are arranged on the selection bars so that when the stop elements engage a selected one of the numeral keys, the cam element 27A will be positioned relative to the axis of the actuator segment (as represented by the phantom lines in FIG. 5) to enter the selected number into the counting mechanism.

Zero restore means

The zero restore means illustrated in FIG. 8 is associated with the counting mechanism and includes a zero restore button 44 fixed to the shaft 43 on the left side portion of bottom frame 2. Fixed to the shaft 43 between each of the numeral wheels is a plurality of laterally spaced zero restore pins 43B. The zero restore mechanism is aligned with a home position showing the value zero in each of the viewing windows by means of a pin 43A and latching slot 51A in collar 51. The shaft 43 is mounted in side portions of bottom frame 2 for lateral

displacement and is urged from right-to-left of the machine by means of a spring 47 supported in spring support 46. The spring 47 is aligned with and abutting against the right hand end of shaft 43 which is journaled in an opening 45 defined in the right side portion of frame 2. Each of the numeral wheels of the counting mechanism includes a laterally projecting zero restore lug 9B. Journaled on shaft 43 between the side frame 2 and the rightmost numeral wheel is a pulley 48 having a zero restore lug 48A. The pulley 48 is drivingly connected to the actuator shaft 18 by means of a pulley 49 and belt 50. When it is desired to restore all of the numeral wheels to the zero position, the zero restore button 44 is pushed inwardly or from left-to-right. In the depression of the button 44 the pin 43A will be moved out of latching slot 51A and at the same time each of the zero restore pins 43B will be moved into the same plane of rotation as lugs 9B. Also, zero restore pin 43B associated with pulley 48 will be moved into the same plane of rotation as lug 48A and by rotating the hand crank 8 each of the numeral wheels will be moved to a zero set position. After the zero restore button 44 has been depressed, it is only necessary to hold the button momentarily because after the shaft 43 has begun to rotate, the pin 43A will engage the camming surface 51B of collar 51 which will hold the shaft 43 in the zero restore position until the shaft 43 has been rotated through 360° moving all the numeral wheels to their zero set position. As the shaft 43 reaches the zero set position, the spring 47 will push pin 43A back into the latching slot 51A thus disengaging the pins 43B from the lugs 9B and 48A. It can readily be seen that after the shaft 43 has been latched back into the zero set position that each of the numeral wheels will be freely rotatable and ready to receive values from the actuating segments. In the restore operation, the actuator segment will have no effect on the counting mechanism since all the fingers 17B with teeth 17A are rocked sideways out of engagement with projections 10 when no value keys have been depressed.

Operation

Having described the foregoing calculating machine components, the operation of a cycle of the machine now may best be understood by referring to FIGS. 2, 3, and 7 of the drawings. In operating the machine, the operator depresses a selected one of the numeral keys 1-9 until the latch element 36 engages the underside of plate 34 to hold the key in a depressed position. The operator then through handle 8 and shaft 18 rotates the actuator segment 17 in either direction thereby disengaging stud 21 from notch portion 29 allowing the selection bar 23 under the control of tension spring 26 to move toward the front of the machine until selection bar stop 30 engages stop portion 37A of the depressed keystem. The tension in spring 26 is sufficient to move the lower edge of keystem 5 toward the front of the machine until the back of keystem 5 engages plate 34 and this will disengage latch element 36 from under plate 34. However, the key will remain in a depressed position because the undercut portion 31 associated with stop 30 will engage latch element 37 on the keystem to prevent the key from moving upwardly. The selection bar 23 is detailed so that the stop 30 engaging the depressed key will thereby position camming element 27A the proper distance from the axis of segment 17 to cooperate with camming elements 17D to rock fingers 17B and integral teeth 17A out of the plane of projection pins 10 on the counting mechanism. As the operator continues to rotate the segment, the camming element 27A will rock the fingers 17B sideways allowing only the number of registration teeth necessary to engage projection pins 10, rotating the numeral wheel the number of steps to show the selected number in viewing window 6. As the operator continues to rotate the segment 17, the stud 21 will engage arm 28 thereby moving the selection bar 23 toward the rear of the machine releasing

stop element 30 from latch element 37 allowing the depressed key to move upwardly to the home position. Moving the stud 21 back into notch 29 will indicate that the segment has completed one cycle of operation.

In the operation of the tens carry mechanism, the tens carry projection pins 42, on one of the numeral wheels 9 passing from 9 to 0, will engage camming surface 16 rotating lever 12 about shaft 13 moving the tens transfer cam 15 to a tens carry position 14B which will cooperate with camming elements 20A on the tens transfer fingers 20, rocking fingers 20 and tens transfer teeth 19 sideways to engage projection pins 10 on the next adjacent numeral wheel thereby rotating the numeral wheel one step to complete a transfer of one to the next adjacent order. The transfer lever 12 is restored to the neutral position 14A by restore cam 22 abutting against the back edge of lever 12 during the last quadrant of rotation of the actuator segment.

While for the purpose of illustrations, a preferred embodiment of the present invention has been shown and described herein, it is clear that various changes, modifications, and adaptations will suggest themselves to those skilled in the art. It is to be understood that all such changes and modifications are contemplated as may come within the scope of the following claims.

What is claimed is:

1. In a calculating machine, an actuator means therefor comprising an integral segment including a series of flexible integrally formed projecting fingers with registering teeth formed on the outer ends thereof.

2. In a calculating machine as defined in claim 1 in which each of said projecting fingers includes integrally formed and laterally projecting camming surfaces, with the camming surfaces on adjacent fingers being differentially positioned along the length thereof.

3. In a calculating machine, an actuator segment rotatably mounted in said machine including, a series of flexible integrally formed and radially projecting fingers having registering teeth formed on the outer ends thereof.

4. In a calculating machine as defined in claim 3 in which each of said radially projecting fingers includes integrally formed and laterally projecting camming surfaces, with the camming surfaces on adjacent fingers at different distances from the axis of rotation of said segment.

5. In a calculating machine, an accumulator mechanism having a plurality of counting orders, actuator means rotatably mounted in said machine and operatively associated with said accumulator mechanism for driving said accumulator mechanism, said actuator means comprising a segment operatively associated with each of said counting orders, each of said segments having a series of flexible integral formed and radially projecting fingers having registering teeth formed on the outer ends thereof, each of said registering teeth adapted when operatively positioned to drive one order of said accumulator mechanism, and selecting mechanism comprising a selection member operatively associated with each segment and differentially settable to a series of operative positions along a line normal to a line tangent to said accumulator mechanism at the driving point to effect operative positioning of a number of said registering teeth, corresponding to the differential setting of said selection member.

6. In a calculating machine as described in claim 5 in which each of said radially projecting fingers includes integrally formed and laterally projecting camming surfaces, with the camming surfaces on adjacent fingers being differentially positioned from the axis of said segment.

7. In a calculating machine as defined in claim 6 in which said actuator means includes a pair of flexible integrally formed tens carry fingers operatively associated with each counting order and having a tens carry tooth formed on the outer end of each of said fingers and

adapted when positioned to drive the counting order of the next higher order through a single step.

8. In a calculating machine as defined in claim 7 in which each of said selection members includes a series of integral stop and latch elements differentially positioned on a portion thereof.

9. In a calculating machine as defined in claim 8 in which each of said selection members includes an integrally formed camming surface which is adapted, when positioned, to cooperate with the camming surfaces on said radially projecting fingers for effecting operative positioning of a number of said registering teeth, corresponding to the differential setting of said selection member.

10. In a calculating machine as defined in claim 9 in which a keyboard means is provided and operatively associated with said selecting mechanism for differentially setting said selection members.

11. In a calculating machine as defined in claim 10 in which said keyboard means includes a series of depressible amount keys, each key including a key stem guided for up and down movement in the frame of the machine and manipulatable from a normal to a fully depressed position, means effective upon manual depression of one of said keys for latching the same in said depressed position, said selection member mounted for movement through a plurality of positions each corresponding to the respective value of a depressed key, stop means on each of said key stems adapted when depressed for positioning the same in the path of movement of said member, stop means on said member adapted for engagement with the key stem stop means of a depressed key for positioning said member in accordance with the value of said depressed key, means responsive to the engagement of the member stop means with the key stem stop means for releasing the depressed key from its latched position, and means on said member for holding the released key in the depressed position after said key has been released from said latched position, said means allowing the released key to return to the normal position upon movement of said member away from said key stem stop means.

12. In a calculating machine having a keyboard comprising a series of depressible amount keys, each key including a key stem guided for up and down movement in the frame of the machine and manipulatable from a normal to a fully depressed position, means effective upon manual depression of one of said keys for latching the same in said depressed position; the combination of, a differentially settable member mounted for movement through a plurality of positions each corresponding to the respective value of a depressed key, stop means on each of said key stems adapted when depressed for positioning the same in the path of movement of said member, stop means on said member adapted for engagement with the key stem stop means of a depressed key for positioning said member in accordance with the value of said depressed key, means responsive to the engagement of the member stop means with the key stem stop means for releasing the depressed key from its latched position, and means on said member for holding the released key in the depressed position after said key has been released from said latched position, said means allowing the released key to return to the normal position upon movement of said member away from said key stem stop means.

13. In a calculating machine as defined in claim 12 in which said key latch means includes a detent formation on one side of said key stem, a machine frame member having an underside portion adapted to cooperate with said detent formation to serve as a latching surface, and spring means operatively associated with each of said key stems for urging said key stem against said frame member so that said detent formation will latch against the frame member underside portion after said key has been manually moved to the depressed position.

14. In a calculating machine as defined in claim 13

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in which said key stem stop means is positioned on said key stem relative to said detent formation so that movement of said settable member against said key stem stop means will move said detent formation from against the underside portion of said frame member.

15. In a calculating machine as defined in claim 14 in which said key stem holding means includes cooperative latching elements on said key stem and said settable member adapted for engagement with each other after the detent latching formation has been moved away from the underside of said frame member.

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