Nov. 13, 1956 C. L. CAMPBELL ET AL 2,770,419

KEYBOARDS FOR CALCULATING MACHINES

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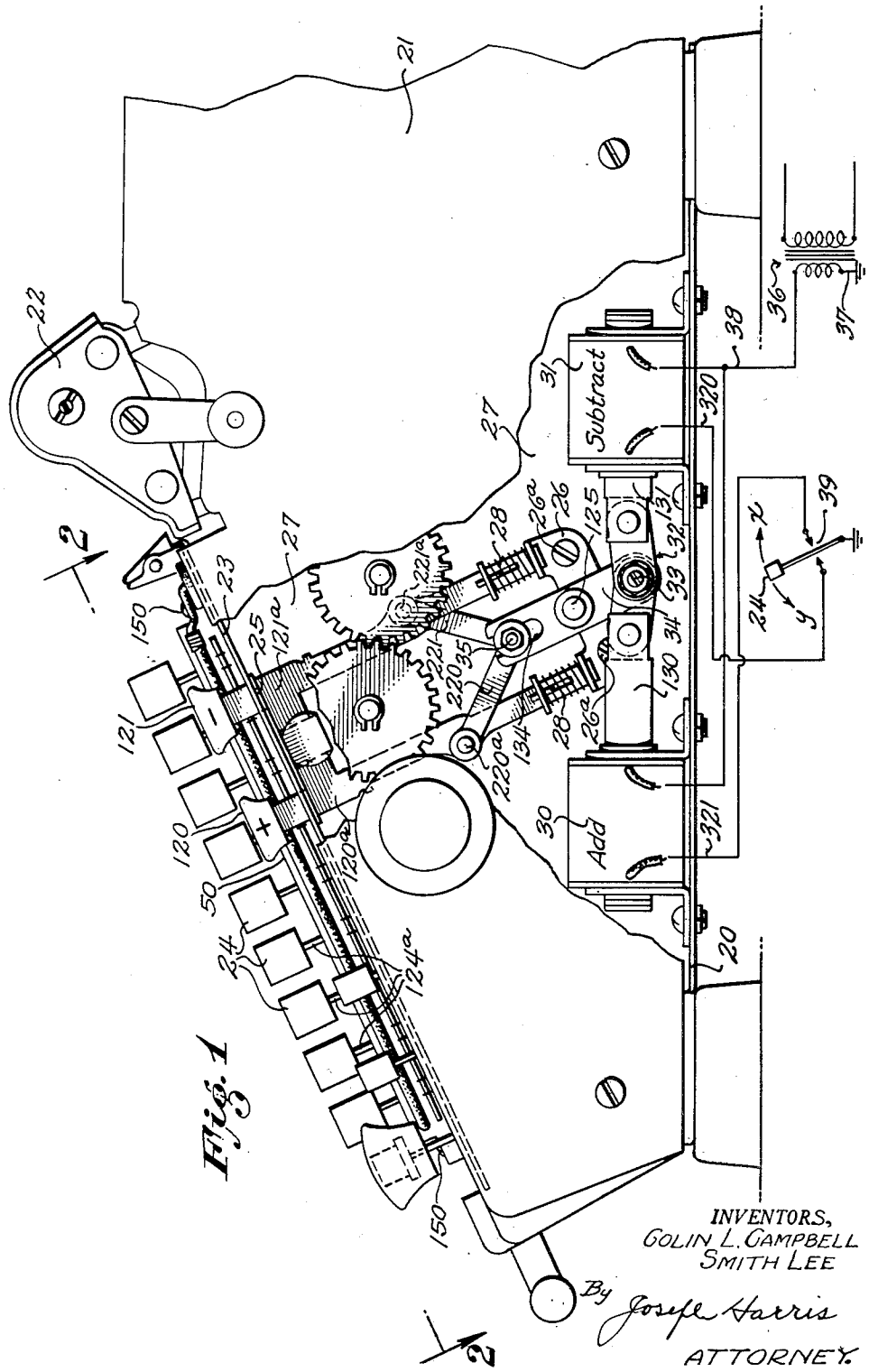


Fig. 1

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Fig. 2

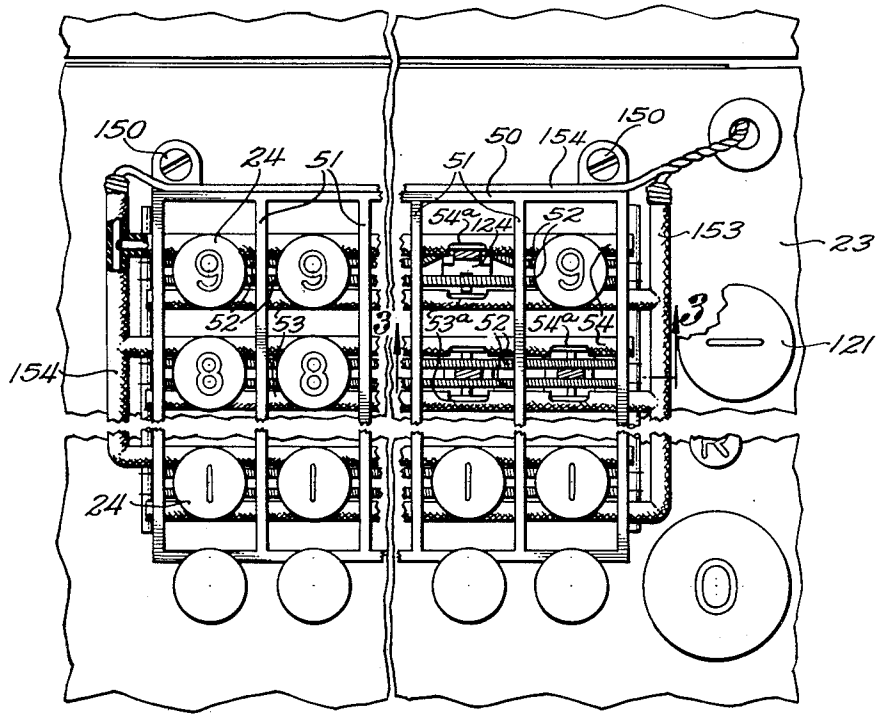


Fig. 3

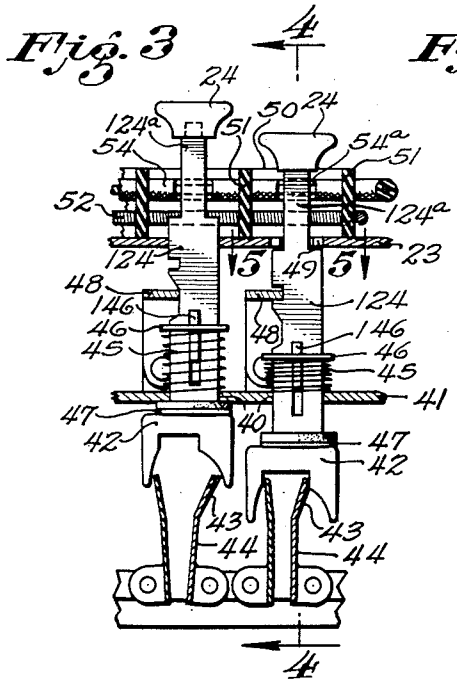


Fig. 4

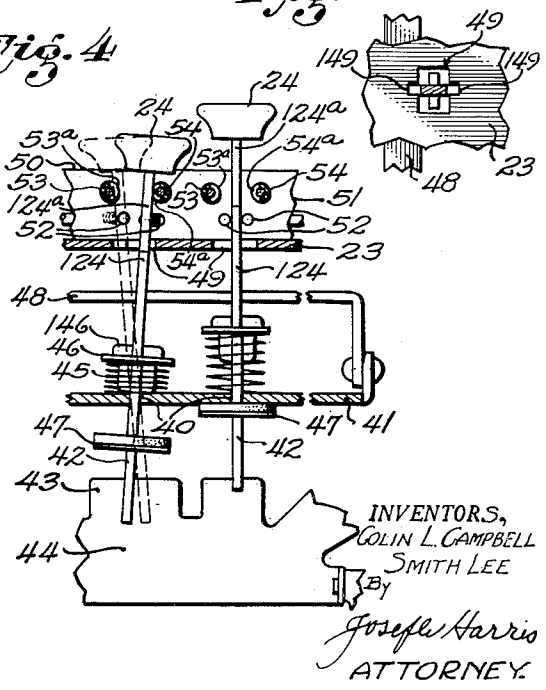


Fig. 5

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Fig. 6

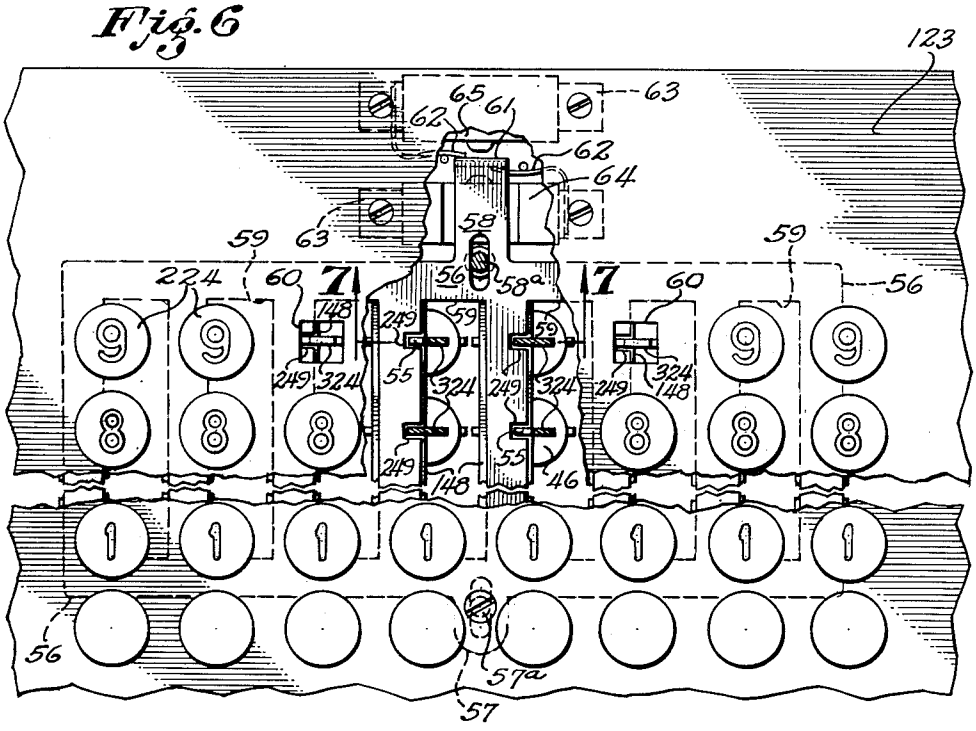


Fig. 7

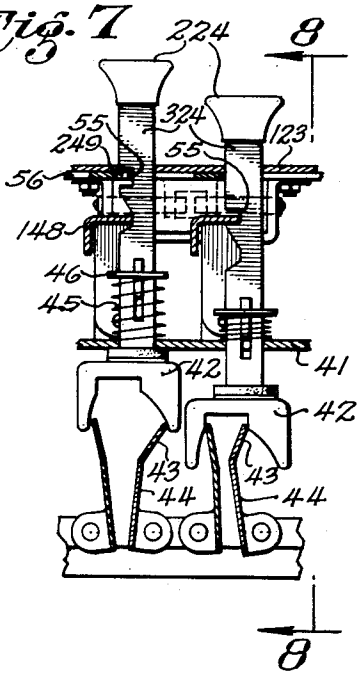
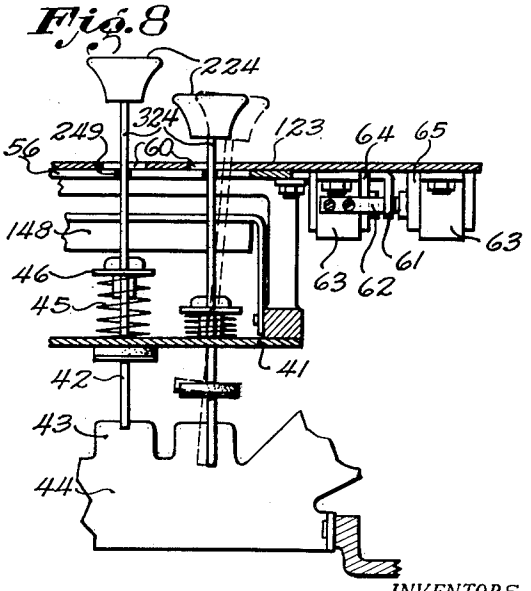


Fig. 8



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Fig. 9

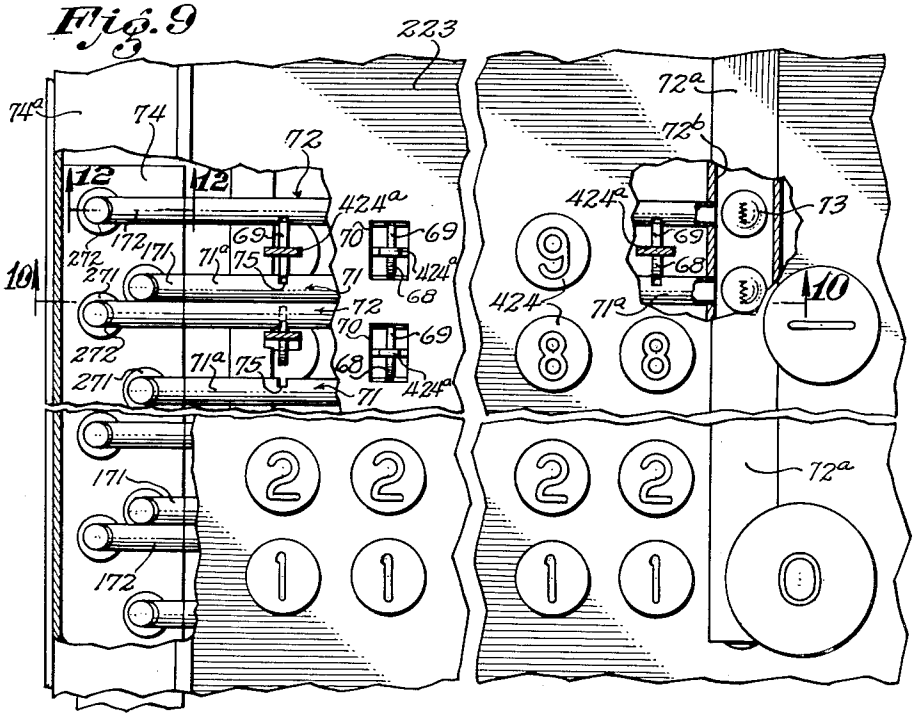


Fig. 10

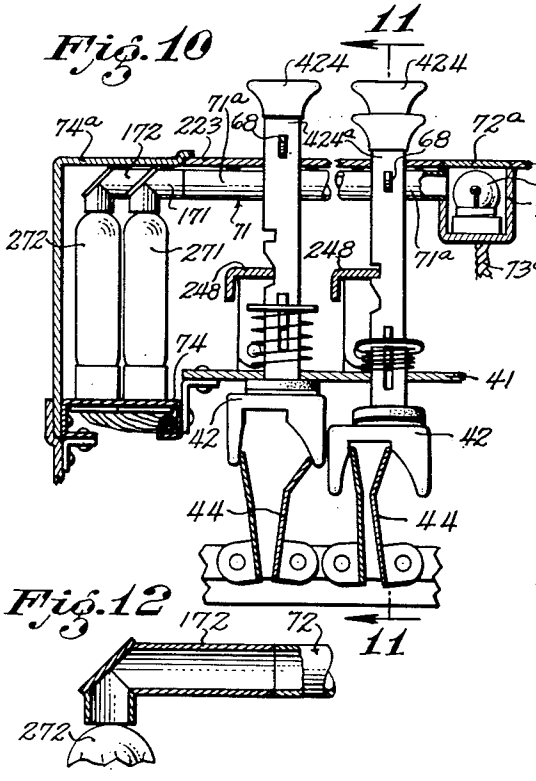


Fig. 11

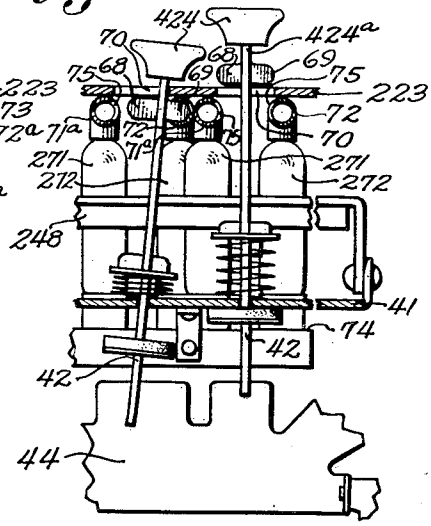


Fig. 12

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2,770,419

KEYBOARDS FOR CALCULATING MACHINES

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Application September 19, 1955, Serial No. 535,077

8 Claims. (Cl. 235—145)

This invention relates to keyboards for calculating machines and, more specifically, all types of power operated, computing machines of the key-set type wherein the amounts to be entered into the machine are first determined by setting or latching the appropriate value or amount keys on the keyboard and the then desired arithmetical functional operation, such as addition or subtraction, performed by initiating a cycle of operation of the operating means.

Of key-set types of calculating machines now in use, doubtless a majority thereof require a time-consuming movement of the operator's hand from the value key section of the keyboard, after the proper value keys have been set up, to a separate function-determining key or bar, usually at one side of the keyboard.

Various expedients have heretofore been proposed to eliminate the necessity of shifting the operator's hand from the value key section to the separated function-determining means after the amount has been set up on the keyboard. Such expedients have included telescopically constructed key buttons and stems; supplemental operating function initiating keys located adjacent each of the value keys, and separate clutch control bars adjacent the several banks or orders of value keys. Said prior expedients, however, are subject to the objection that they involve increased cost of multiple part keys or may be easily unintentionally excessively actuated in their telescopic action so as to cause an accidental cycling of the machine actuating means and are limited to obtaining one only type of function control such as addition only.

One object of the present invention is to provide a keyboard for key set types of calculating machines wherein any value or amount key may be used at any time when in a set or latched position, to optionally initiate one of a multiple of functional machine operations.

Another object of the invention is to provide a keyboard for key set calculating machines such that the value keys may be manufactured in the usual inexpensive manner as of unitary type and the effective cycle function initiating action by any desired set value key accomplished by a simple lateral bodily tilting movement of the key in the optionally selected direction.

Other objects of the invention are: to provide a keyboard for calculating machines of the type indicated in the two preceding objects of invention wherein the force required to effect the cycle-initiating operation of the machine is kept to a minimum in that the tilting of the key is confined to movement of that key only; the lateral tilting of the key is employed to control an electronic circuit which, in turn, controls the electric circuit for the machine actuating means; and to provide a construction such that no cycle initiating action can accidentally be caused by a value key unless in a set condition.

Other objects of the invention will more clearly appear from the following description and claims taken in connection with the accompanying drawings wherein, Fig.

1 is a side elevation of a calculating machine showing the improvements incorporated therein, parts of the machine being broken away to better accommodate the view on the sheet and to illustrate certain details of construction. Fig. 2 is a broken, plan view of portions of the improved keyboard of the machine shown in Fig. 1, several of the key buttons being omitted and the stems being in section to better illustrate certain details of construction. Fig. 3 is a vertical sectional view corresponding to line **3—3** of Fig. 2 showing one value key in normal inoperative position and the adjacent key in latched or indexing position. Fig. 4 is a vertical sectional view corresponding to line **4—4** of Fig. 3 showing a latched value key in full lines in one function, cycle-initiating position and, in dotted lines, an alternative different function, cycle-initiating position. Fig. 5 is a broken, detail horizontal plan corresponding to line **5—5** of Fig. 3. Figs. 6, 7 and 8 are views similar, respectively, to Figs. 2, 3 and 4 but illustrating a different embodiment of the invention, Fig. 7 corresponding to line **7—7** of Fig. 6 and Fig. 8 to line **8—8** of Fig. 7, respectively. Figs. 9, 10 and 11 are views similar, respectively, to Figs. 2, 3 and 4 but illustrating still another embodiment of the invention, Fig. 10 corresponding to line **10—10** of Fig. 9 and Fig. 11 to line **11—11** of Fig. 10, respectively. And Fig. 12 is an enlarged detail section corresponding to line **12—12** of Fig. 9.

For illustrative purposes the several embodiments of the invention have been shown in connection with certain features of the well known Monroe type of calculating machine, only such parts of the machine being illustrated as are believed necessary for an understanding of the present invention. For a more detailed description of the value keys and related latching and indexing means, reference may be had to United States Reissue Patent 13,841 of Dec. 8, 1914, to Baldwin and to Phinney Patent 1,399,652 of Dec. 8, 1921. For details of structure and operation of other features of the calculating machine, such as the cyclic actuating means, transfer means, registering means, reference may be had to United States patent to Chase 1,566,650 of Dec. 22, 1925.

Referring now to the specific embodiment shown in Figs. 1 to 5 and more especially, Fig. 1, the calculator is provided with a base **20**, outer casing or shell **21**, shiftable carriage **22**, a top or upper keyboard plate **23**, digit or value settable keys **24—24** and two functional operation keys **120** and **121** for effecting, when depressed, operating cycles of addition and subtraction, respectively, in known manner. The stems or shanks **120a** and **121a** of the respective functional keys **120** and **121** are guided by suitable slots in an upper guide plate **25** and, at their lower ends, in a slotted bracket **26** secured to the side wall member **27** of the machine by screws **26a**, as shown. Said keys **120** and **121** are normally held in raised or inoperative position by springs **28** interposed between the bracket **26** and suitable washers on the stems and limited in their upward movement by shouldered engagement with plate **25**.

To initiate either an additive or subtractive operation of the machine, electromechanically, and to produce the same effect as would otherwise be obtained by manual depression of the keys **120** and **121**, any suitable alternatively operable means may be employed, one such means being illustrated conventionally and diagrammatically in Fig. 1. As shown, two solenoids **30** and **31** are mounted on the machine base in horizontal opposed positions with their respective armatures **130** and **131** pivotally linked together by linkage **32**. Due to the angular position of the add and subtract keys **120** and **121** relative to the horizontally disposed solenoids **30** and **31**, the armature **130** will be elongated relative to the armature **131** in order

to allow centering of the pivot 33 at the center of linkage 32 to assume a neutral position relative to the rock lever 34 which is inclined similarly to key stems 120a and 121a. The solenoids are so wound and wired that, when the circuit to add solenoid 30 is closed, the armature linkage 130, 32, 131 will be momentarily shifted to the left, as viewed in Fig. 1 and, conversely, when subtract solenoid 31 is momentarily energized, the armature linkage 131, 32, 130 will be shifted to the right.

Rock lever 34 is rigid with a rock shaft 125, the latter being adapted by means, not shown, for actuating the add and subtract key group of mechanism in a well known manner. When solenoid 30 is energized, rock lever 34 and shaft 125, journaled in bracket 26, will be oscillated clockwise, as viewed in Fig. 1 as obvious. At its upper end, lever 34 is formed with an elongated slot 134 in which is slidable a pin 35 pivotally connecting two links 220 and 221 extending to and pivotally connected at 220a and 221a, respectively, to the stems of add and subtract keys 120 and 121. With the construction shown and described, it will be evident that, as lever 34 turns clockwise, pivotal connection 221a remains stationary and functions as a fulcrum for link 221 because subtract key 121 is prevented from moving upward since it is in its normal inoperative elevated position. As the clockwise movement of rock lever 34 continues, the pivotal link connecting pin 35 slides within slot 134 and swings about pivot point 221a, thereby pulling link 220 downwardly and hence add key 120 with it, thus initiating an add cycle of operation. Conversely, when subtract solenoid 31 is energized, lever 34 will be moved counterclockwise at which time link connecting pin 220a functions as a fulcrum, thereby causing the subtract key 121 to be pulled down or depressed, thus initiating a subtract cycle of operation. Upon de-energizing of either solenoid, the keys 120 and 121 will automatically be restored to normal position and likewise the solenoid armatures and linkages, as will be understood. It will also be apparent that the solenoid arrangement shown and described, in no way interferes with direct manual operation of add and subtract keys 120 and 121.

For energizing the function key-operating solenoids, power is preferably obtained from the same source of supply as that employed to operate the machine motor and the voltage cut down as by transformer 36, illustrated conventionally. In carrying out the present invention, as more specifically described hereinafter, one side of the secondary coil of the transformer will preferably be grounded to the calculating machine body as indicated at 37 and the other side run to the solenoids as by live wire 38. Separate return lines 321 and 320 are indicated conventionally from the respective add and subtract solenoids, it being understood that these both will be normally open as indicated at 39 but adapted to be selectively closed by any value key 24 on the keyboard as about to be described with reference to the specific embodiment shown in Figs. 1 to 5, one such grounded key only, being indicated conventionally at 24 in Fig. 1.

Referring now to Figs. 2 to 5, all of the platelike stems 124 of value keys 24 are guided in special shaped openings in the top plate 23, hereinafter described, and in slots 40 in the lower keyboard plate 41. Each key is formed at its lower end with a cam head 42 adapted to cooperate with differential cam flanges 43 on pivoted rock bars 44 in a well known manner. As customary, each key 24—124 if normally held in its uppermost, inoperative position by an encircling spring 45 interposed between keyboard plate 41 and retainer washer and pin 46—146 and limited in its upward movement by washer 47 engaging the underside of keyboard plate 41. Each key stem 124 is adapted to be held in depressed latched indexing position, as indicated by the right hand key in Fig. 3, by a spring biased bail 48, it being understood that there are a pair of cam rock bars 44 and a latching bail 48 for each order or bank of the machine and that the latching bails automatically release all latched keys upon an actuating cycle of the machine unless for repeat operations, as well understood in the art.

In carrying out the invention, the openings for the key stems 124 in the top keyboard plate 23 are of special form to permit lateral tilting of a key when and only when in depressed and latched condition, as shown in Figs. 3, 4 and 5. As indicated in plan, Fig. 5, each such opening 49 is of generally rectangular shape and of a width only slightly wider than the width of the reduced upper section 124a of the stem, except at its center, where the opening 49 is laterally extended to each side as indicated at 149 to an overall width slightly greater than the width of the main section of the key stem. With the opening construction described, it will be obvious that each value key 24 is initially limited to a vertical downward movement from its normal inoperative position but, when in latched position, at which time the lower end of reduced section 124a of the key stem will have just moved to a position slightly below the keyboard plate 23, the key 24 may then be tilted laterally a few degrees in either direction from vertical as indicated by the full and dotted line positions of the left hand key of Fig. 4, without being released from the bail 48 or changing the effective differential setting of the rock bars 44. Advantage is taken of the construction just described to utilize any desired key of the entire keyboard, when in latched indexing position, to make such key, in effect, selectively motorized for initiating either of a plurality of functional operating cycles of the machine.

In the specific embodiment of Figs. 2 to 5, an electronic, individual key contact system is preferably employed, dependent upon the particular direction a latched key is tilted. As shown, a frame 50 of insulating material is preferably secured to the upper surface of keyboard plate 23 as by screws 150, said frame having wall sections 51—51 extending from front to rear of the keyboard alongside each bank or column of keys 24, as shown. Supported in said wall section are series of pairs of coil springs 52—52, said springs extending transversely of the keyboard, one coil of each pair being disposed in front of and the other in back of and both normally in contact with the stems of all the keys of similar denomination or value, as shown. Said springs, as best indicated by Fig. 4, are readily extendable when a key is tilted from vertical and will act to restore the key to vertical position when released, as will be understood.

Also supported in said insulation sections, are two, alternated series of electrical conductors, 53 and 54, arranged in pairs with respect to each transverse row of like value keys but at a somewhat higher lever than the springs 52 as shown in Figs. 3 and 4. All of the conductors 53, as for example those forward of their respective transverse rows of keys, are connected to a common conductor 153 at the right hand side of the keyboard and which corresponds, functionally, to the conductor referenced 320 in the schematic wiring diagram of Fig. 1, as will be understood. Similarly, the other series of conductors 54 are connected to a common conductor 154 at the left hand side of the keyboard and which corresponds, functionally, to the conductor 321 of Fig. 1. All the conductors 53 and 54 are of insulated construction and the insulation is removed for a short distance at each space facing a key stem as indicated at 53a and 54a, respectively, best shown in Figs. 3 and 4.

With the construction thus far described, it will be seen that, whenever a depressed and latched key 24, all of which are grounded, is tilted by the operator toward the back of the machine and which corresponds to the direction of arrow *x* in Fig. 1, the circuit to solenoid 30 will be closed, thus causing add key 120 to be actuated and thereby initiating an add cycle of operation of the machine. Correspondingly, when any latched key 24 is tilted by the operator toward the front of the machine, and which corresponds to the direction of arrow *y* in Fig.

1, the circuit to solenoid **31** will be closed, thus causing subtract key **121** to be actuated and thereby initiating a subtract cycle of operation of the machine.

Referring next to the embodiment of the invention shown in Figs. 6, 7 and 8, the construction and arrangement of the keyboard plates, keys, rock bars and latching bars are the same as in the embodiment of Figs. 2 to 5 except as follows. Each key **224** has its stem **324** of the same width throughout its length, as shown, and the notch **55** for cooperation with the latching bail **148** so located, when the keys are in normal or inoperative position, that it clears a special plate **56** reciprocatingly mounted on the under side of the top keyboard plate **123**, as best indicated by the position of the key **224** at the left of Fig. 7. The latching bails **148** are preferably slightly elongated, vertically, to cooperate with the relocated notches **55**, as will be understood.

The plate **56** is of such rectangular area as to cooperate with the stems of all the value keys **224** as indicated in Fig. 6 and is freely slidably supported in any suitable manner to move a limited distance in a direction toward and from the front of the machine. Such means, as shown, comprise front and rear, centrally disposed, slotted extensions **57** and **58** on plate **56** and screw bolts **57a** and **58a** carried by keyboard plate **123**. The slide plate is preferably provided with a series of elongated cutouts **59** for the respective banks or orders of keys **224** and, along one edge of each cutout in line with the corresponding key stems, with series of notches **249**, one for each key **224**.

With the key stem formations and plate **56** construction described, it will be seen that any value key **224**, when in latched indexing position, may be tilted either forwardly or rearwardly of the keyboard as indicated by dotted lines in Fig. 8, it being understood that the openings in keyboard plate **123** for the key stems, are enlarged to approximately square openings **60** for this purpose, as shown in Figs. 6 and 8. Such tilting of a key **224** will obviously produce a corresponding shift of plate **56**, either forward or backward, inasmuch as the latching notch **55** of the key stem will then be below the plane of plate **56**.

At the upper end of slide plate **56**, the extension **58** is preferably provided with a turned down flange **61** with which cooperate, on opposite sides thereof, two springs **62** secured to two brackets **63**, the latter in turn being secured to the underside of keyboard plate **123**, as shown. With this spring arrangement, plate **56** will automatically be restored to its normal or neutral position upon release of any tilted latched key **224**. Also supported by the brackets **63** are two, opposed click switches **64** and **65** in alinement with plate flange **61** so that one or the other will be closed upon movement of plate **56** by any latched tilted key **224**. As will be understood, the switches **64** and **65** may be utilized with suitable relays and electric circuits not deemed necessary to illustrate, to operate selectively solenoids or equivalent for initiating action of arithmetical functional keys as described in connection with Fig. 1, but without using the machine itself as a ground.

In the embodiment of the invention shown in Figs. 9 to 12, use is made of an electronic system employing photocells, the latter being preferably arranged for an interrupted beam type of circuit although equally adapted for an intermittent type of circuit, as will be understood. In this construction, the keys **424** are similar to those previously described except that each stem **424a** is provided with forwardly and rearwardly extended, slightly arcuate, shutter flanges **68** and **69** at locations on the stems which are normally just above the keyboard plate **223** and slightly below said plate when the keys are in latched indexing position, as indicated in Figs. 10 and 11. The keyboard plate **223** is provided with openings **70**, one for each value key, of the shape best indicated in Figs. 9 and 11 to permit passage of said flanges **68—69** therethrough and also to permit tilting or lateral movement of the keys **424** when in held in set or latched position by bail **248**. In lieu of electrical conductors with bared points of contact as employed in the first described modification, the present form employs pairs of opaque, transversely extending light-passage tubes **71** and **72**, for each transversely arranged row of value keys of the same denomination, the tubes **71** being located forwardly of the key stems and tubes **72**, rearwardly thereof, as shown. Said tubes are disposed below plate **223** and each preferably employs a main, elongated section **71a** welded or otherwise secured to plate **223** as indicated in Fig. 10. At their righthand ends, as viewed in Fig. 10, all tube sections **71a** communicate with an elongated, channel shaped light box **72b** extending the length of the column of lowest order of value keys and in which box are located a series of miniature light bulbs **73**, or equivalent, supplied from a suitable source of energy as indicated by wires **73a**. At their other ends, the light tubes **71** and **72** are connected up with relatively short and long elbows **171** and **172**, respectively, having mirrors in the interior corners thereof to reflect the light beams to the tops of two series of photo cells **271** and **272**, respectively, the latter being supported on a platform **74** suitably secured to adjacent fixed parts of the machine. For convenience of inspection and maintenance, a snap-in cover plate **72a** may be employed with light box **72b**, and the elbow sections **171** and **172** may all be welded or otherwise secured to a removable cover plate **74a**, as shown.

As best shown in Fig. 11, each main tube section **71a** is provided with a series of small openings **75** on that side thereof facing a transverse adjacent row of keys, one such opening for each key as shown in Figs. 9 and 11. Said openings are disposed for cooperation with the stem shutter flanges **68—69** when the keys which carry said flanges are in latched position as clearly shown in Fig. 11 where the left hand key is shown tilted or laterally displaced to enter its flange **69** into the adjacent opening **75** of light tube **72**.

As will be understood by those skilled in the art, all photo cells **271** will be connected in parallel with a suitable series of relays, switches and sources of appropriate energy in such manner that, so long as beams of light continue to be transmitted through all the light tubes **71**, no energization of a functional key, such as the subtract key, will take place. However, when any one of the series of tubes **71** has its light beam therein broken or interrupted by any one of the key shutter flanges **68** being moved into a tube, the corresponding phot cell circuit will be then conditioned to permit energization of the corresponding solenoid or equivalent to initiate an operative subtract cycle. The same conditions obviously will apply to the series of tubes **72** and photo cells **272** to produce a different arithmetical function of the machine, such as addition.

In the preceding description, the improved type of keyboard has been described for illustrative purposes with particular reference to initiating machine functional cycles of operations of addition and subtraction. However, as will be obvious, the improved keyboard is equally adaptable for controlling other machine functions such as repeat, total and sub-total or various combinations thereof as desired.

What is claimed, is:

1. In a calculating machine of the key-set type having power driven, cyclic actuating means and a plurality of different arithmetical function-controlling means, a keyboard comprising, in combination: an upper keyboard plate; a plurality of value keys having key stems extending through openings in said plate and depressible for setting up amounts to be entered into the machine upon a cyclic operation thereof; means for latching said keys in depressed setup condition, said keyboard openings for the key stems being shaped and enlarged, relative to the cross section of the key stems, to permit limited amounts of tilting movements from normal latched position of the key stems therein relative to the keyboard

plate, optionally in a plurality of different directions; electronic means, normally functionally inoperative, adapted for selectively initiating action of a plurality of said different function-controlling means; and means, operative upon tilting of a latched value key in an optionally selected direction from normal position, for rendering said electronic means operative to initiate action of the selected function-controlling means.

2. In a calculating machine of the key-set type having power driven, cyclic actuating means and a plurality of different arithmetical function-controlling means, a keyboard comprising, in combination: an upper keyboard plate; a plurality of value keys having key stems extending through openings in said plate and depressible for setting up amounts to be entered into the machine upon a cyclic operation thereof; means for latching said keys in depressed set-up condition, the key stems and keyboard openings therefor being of such cooperative conformations that, in latched position of a key, the latter is tiltable from its normal latched position, optionally in a plurality of different directions; mechanical means optionally adapted to initiate operation of a plurality of said function-controlling means; electronic means selectively adapted to actuate said mechanical means, said electronic means being normally conditioned to be inoperative with respect to said mechanical means; and means, actuated upon selective tilting movement of a latched key, for changing the condition of said electronic means to one that is operative with respect to said mechanical means.

3. In a calculating machine having power driven actuating means and two arithmetical function-controlling means, a keyboard comprising, in combination: a keyboard plate; a plurality of value keys having stems extending through openings in said plate and depressible for setting up amounts to be entered into the machine; means for latching said keys in depressed set-up condition, the key stems and keyboard openings therefor being of such conformations that, in latched position of a key, the key is laterally movable from its normal position in either of two different directions; electronically controlled means, normally functionally inoperatively conditioned, for optionally operating either of said function-controlling means; and means cooperative with a latched value key upon lateral movement thereof in either direction, for reversing the condition of said electronically controlled means to one that is operative with respect to said function-controlling means.

4. In a calculating machine having power driven actuating means and two arithmetical function-controlling members, a keyboard comprising, in combination: a keyboard plate; a plurality of value keys having stems extending through openings in said plate and depressible to a latched condition, said keys being laterally movable in either of two directions relative to the keyboard plate while in latched condition; normally inoperatively conditioned, electronically operable means for selectively actuating either of said control members; and means, operative upon lateral movement of a latched key, for reversing the condition of said electronic means to one that is operative with respect to one of said control members.

5. In a calculating machine of the key set type and having power driven actuating means and add and subtract control members, the combination with a keyboard plate, of a plurality of value keys mounted in said plate and normally held in elevated position; means for latching said keys in depressed, indexing condition, said keys being each movable in one direction relative to the keyboard plate while in latched condition for governing the operation of one of the control members and in a different direction for governing the operation of the other of said control members; and electronically controlled means for optionally operating each of said control members, said means including two electronic circuits normally inoperatively conditioned, each of said circuit including elements for reversing the condition from inoperative to operative, said elements being cooperative with a value key when in latched condition, selectively, upon movement of the key in either of said directions.

6. Apparatus according to claim 5 wherein the elements for reversing the circuit condition from inoperative to operative comprise contacts located adjacent each key and selectively electrically contacted thereby when moved in either of said directions to close the corresponding circuit.

7. Apparatus according to claim 5 wherein said electronically controlled means includes a member common to all of the value keys adapted to be moved by any latched value key for reversing the circuit condition from inoperative to operative.

8. Apparatus according to claim 5 wherein said electronically controlled means includes photo cell systems whose condition is reversed upon movement of a latched key in either of said directions.

No references cited.