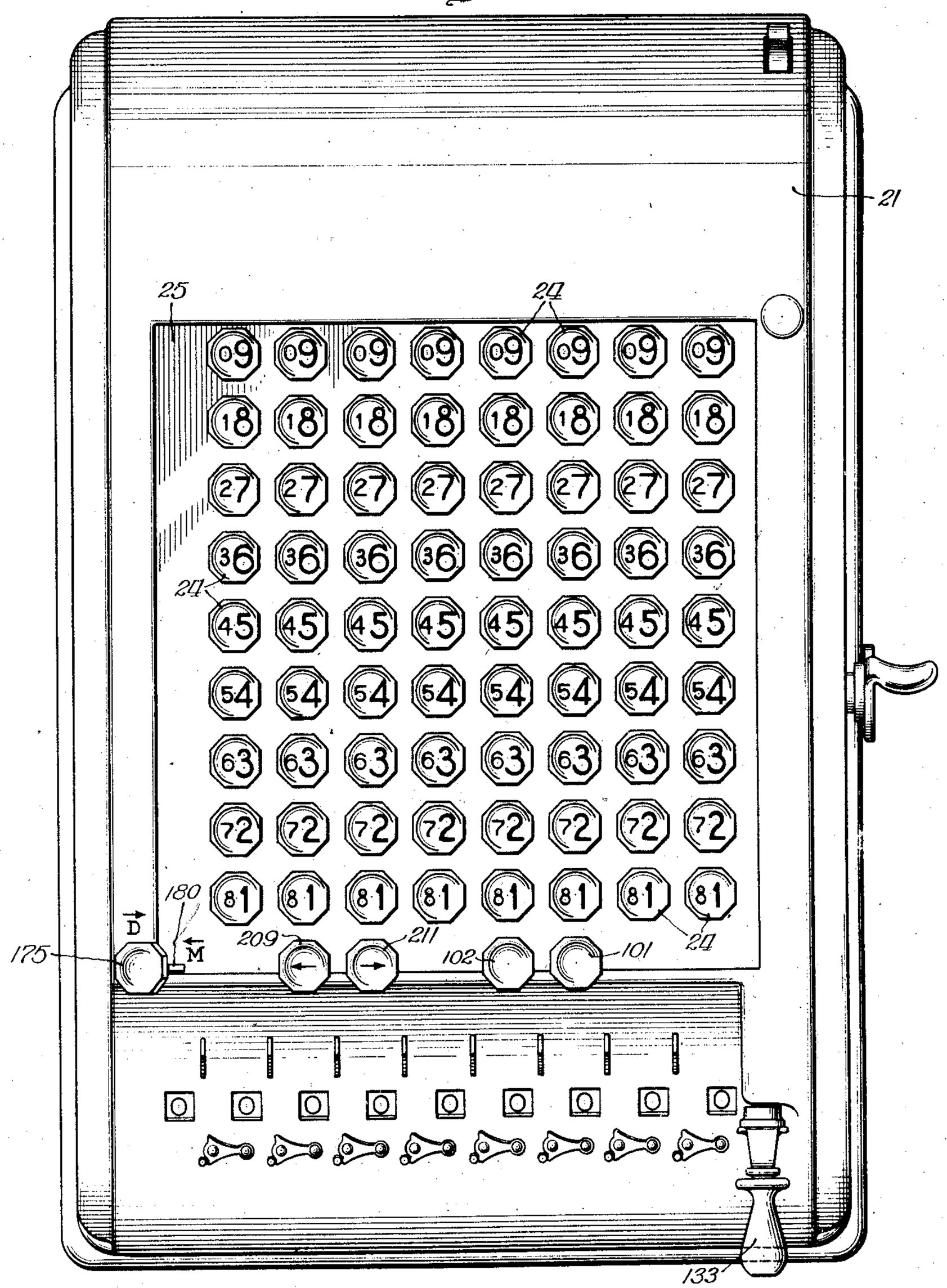
Nov. 11, 1947. J. M. LAIHO 2,430,574

CALCULATING MACHINE

Filed Feb. 5, 1943 8 Sheets-Sheet 1

Fig. 1.



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CALCULATING MACHINE

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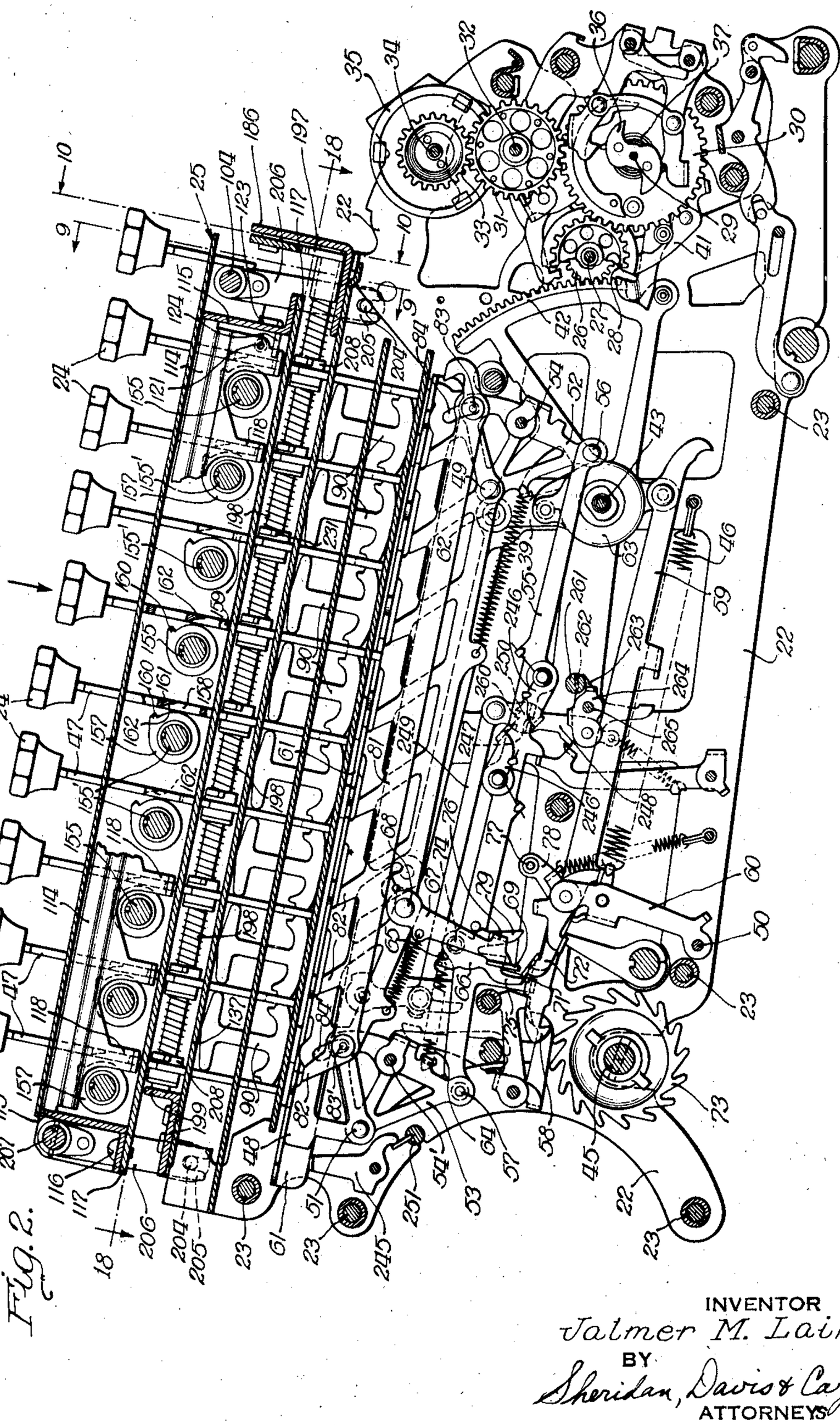

Fig. 2.

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CALCULATING MACHINE

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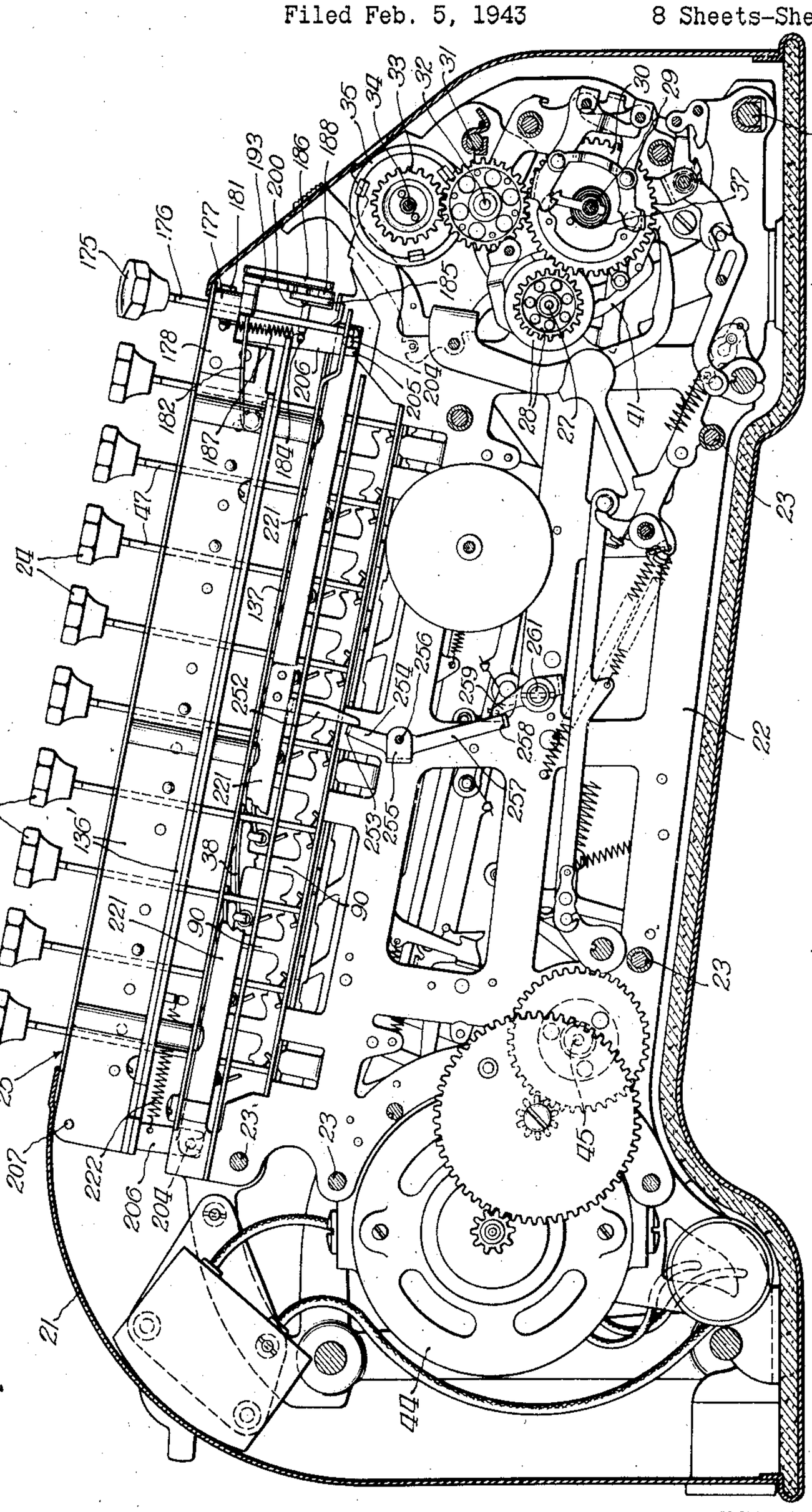

Fig. 3.

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CALCULATING MACHINE

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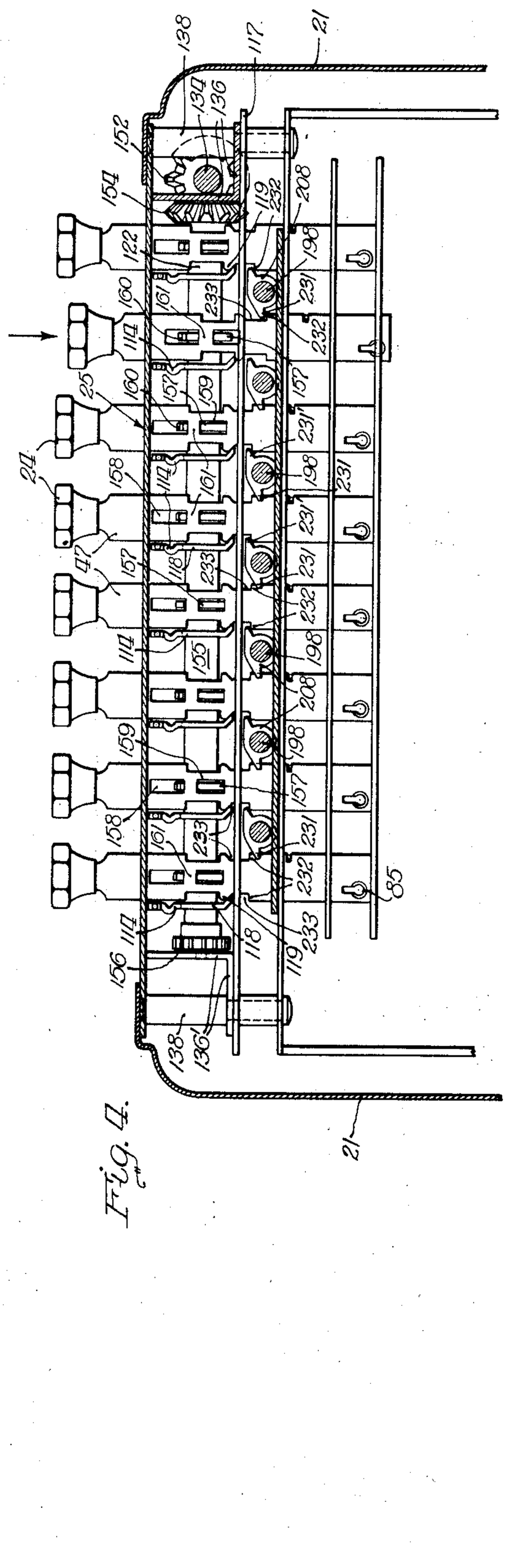

Fig. 4.

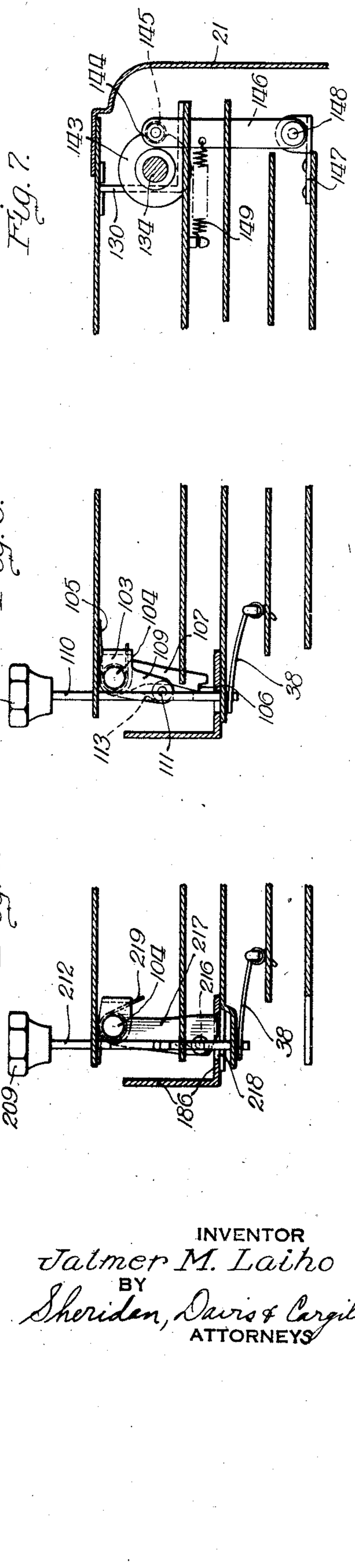

Fig. 7.

Fig. 6.

Fig. 5.

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Fig. 8.

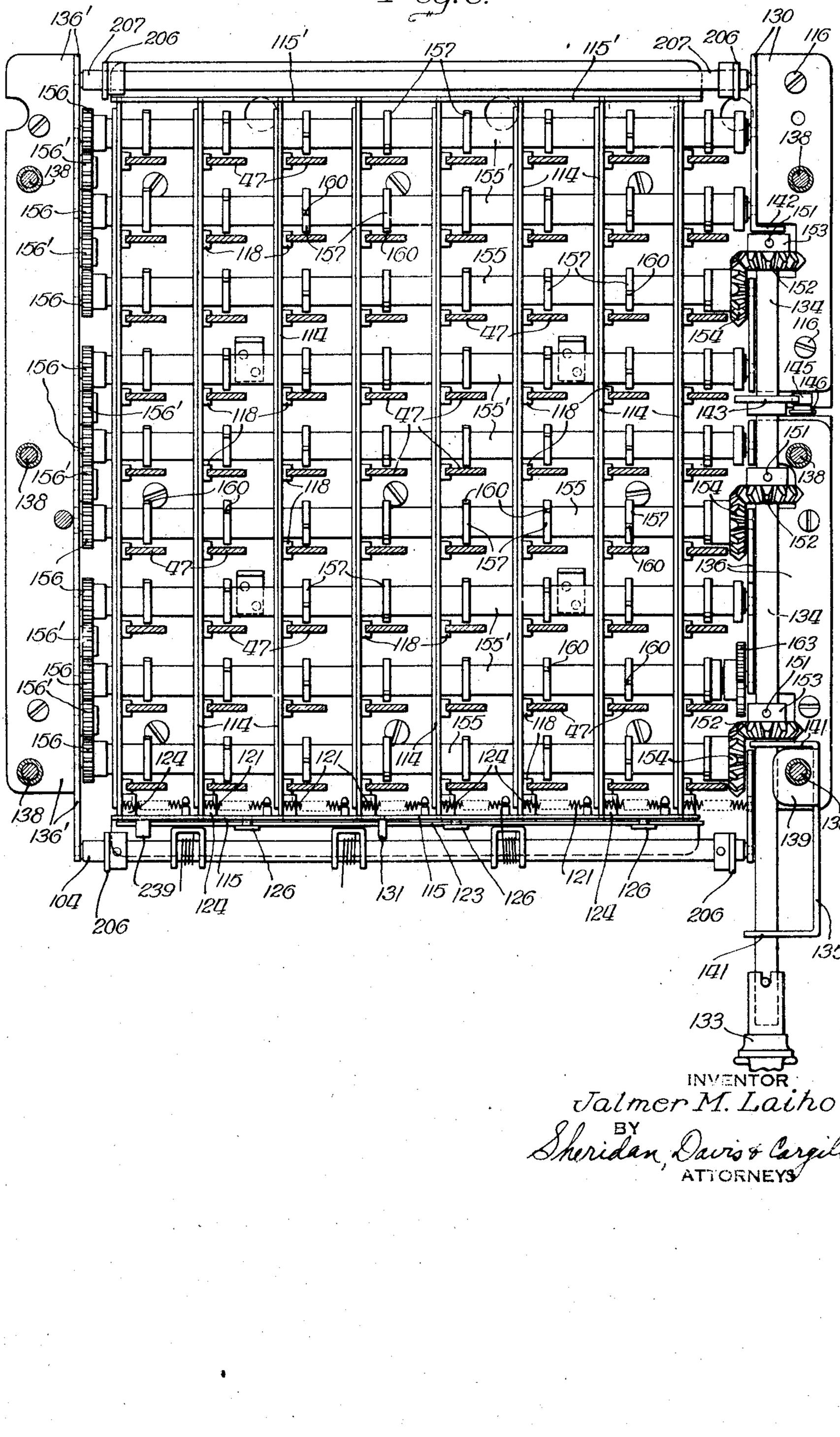

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Fig. 10.

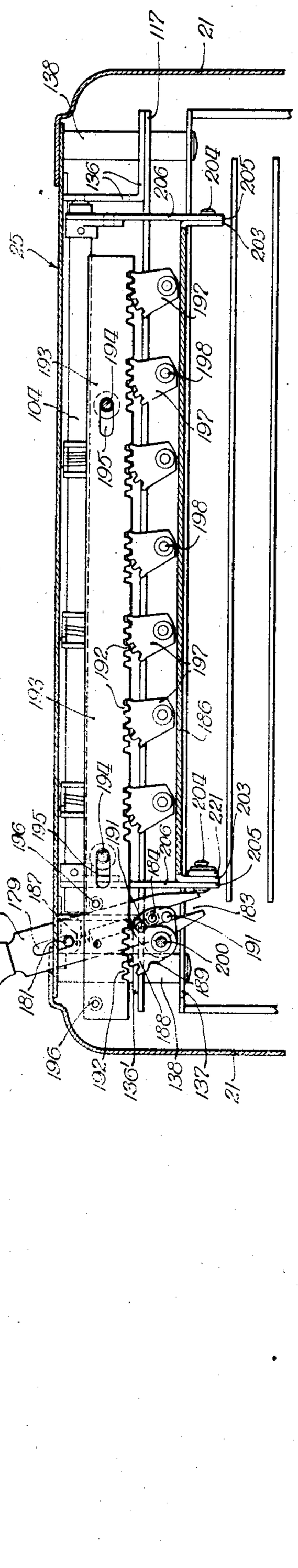
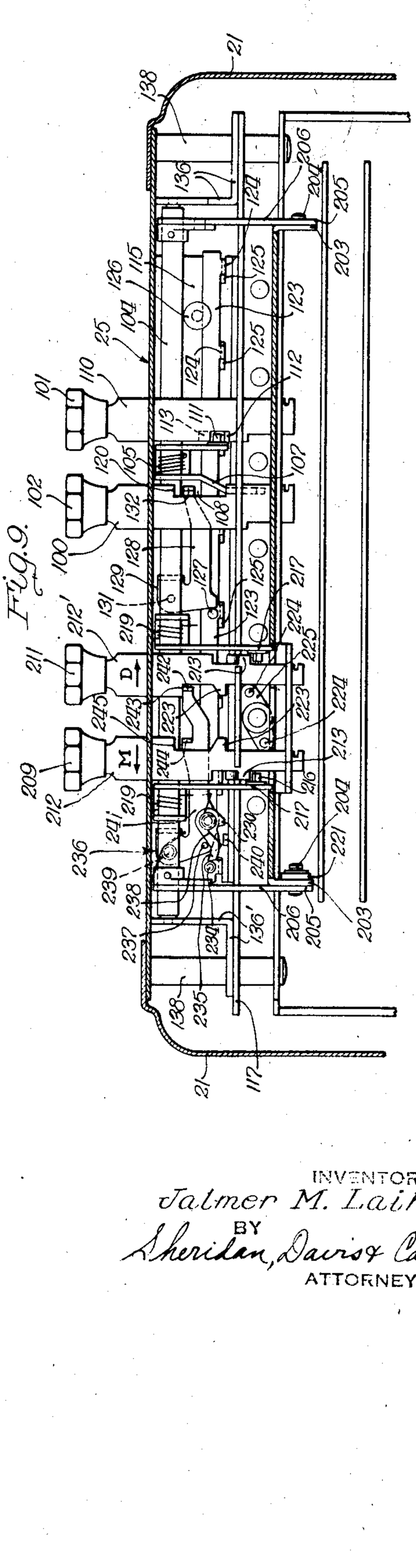


Fig. 9.



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CALCULATING MACHINE

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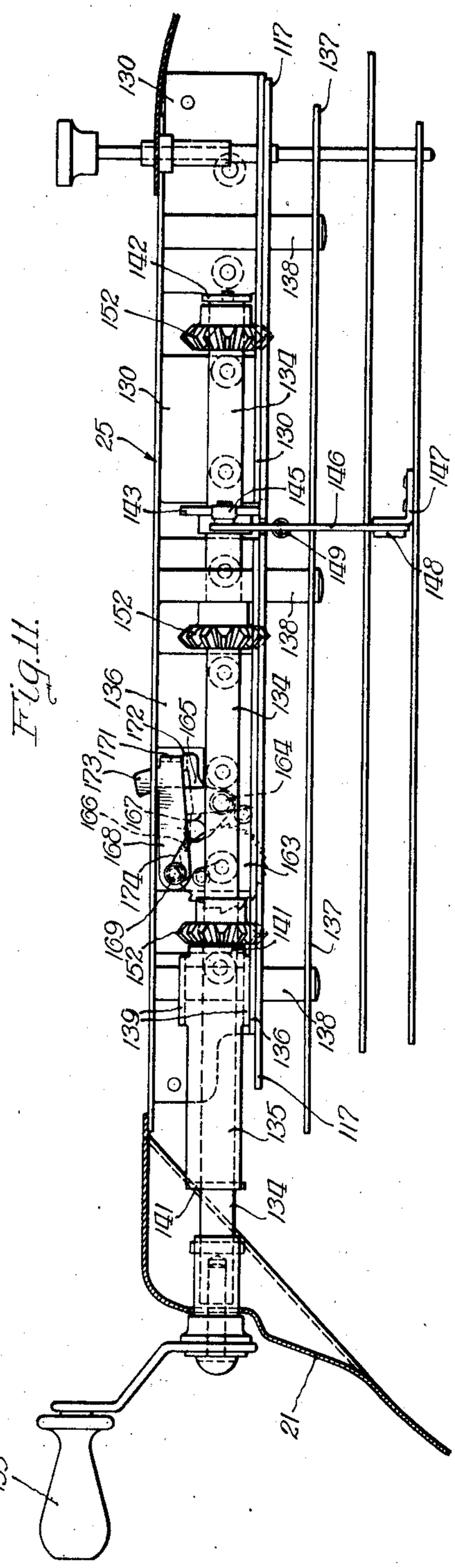

Fig. 11.

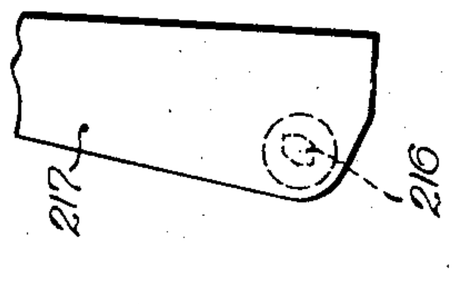

Fig. 16.

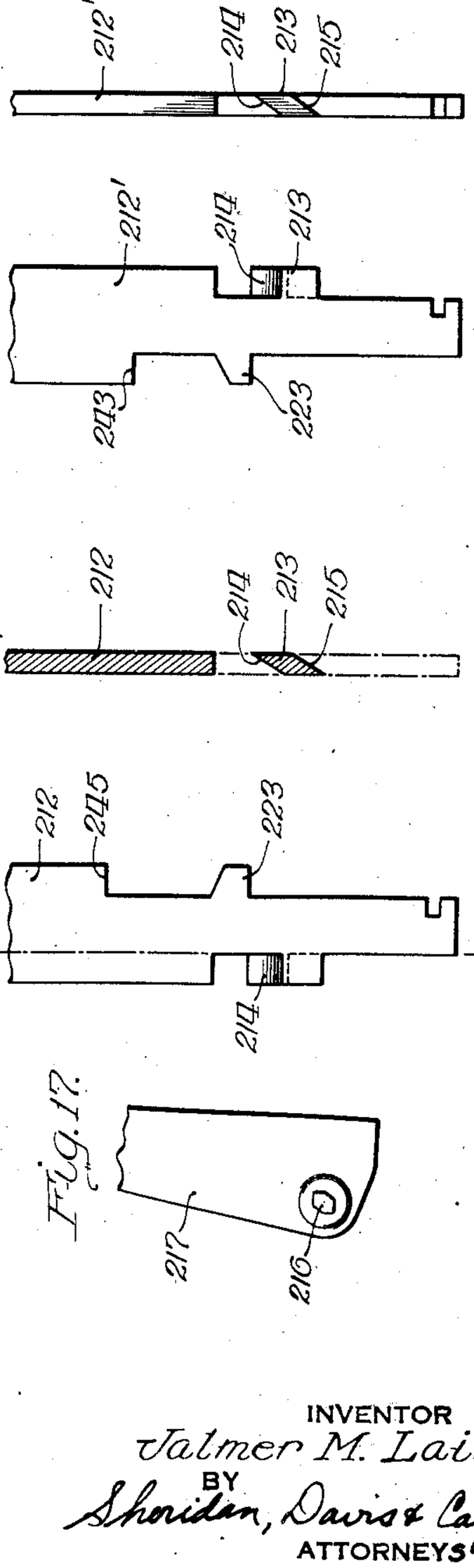

Fig. 13.

Fig. 12.

Fig. 15.

Fig. 14.

Fig. 17.

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CALCULATING MACHINE

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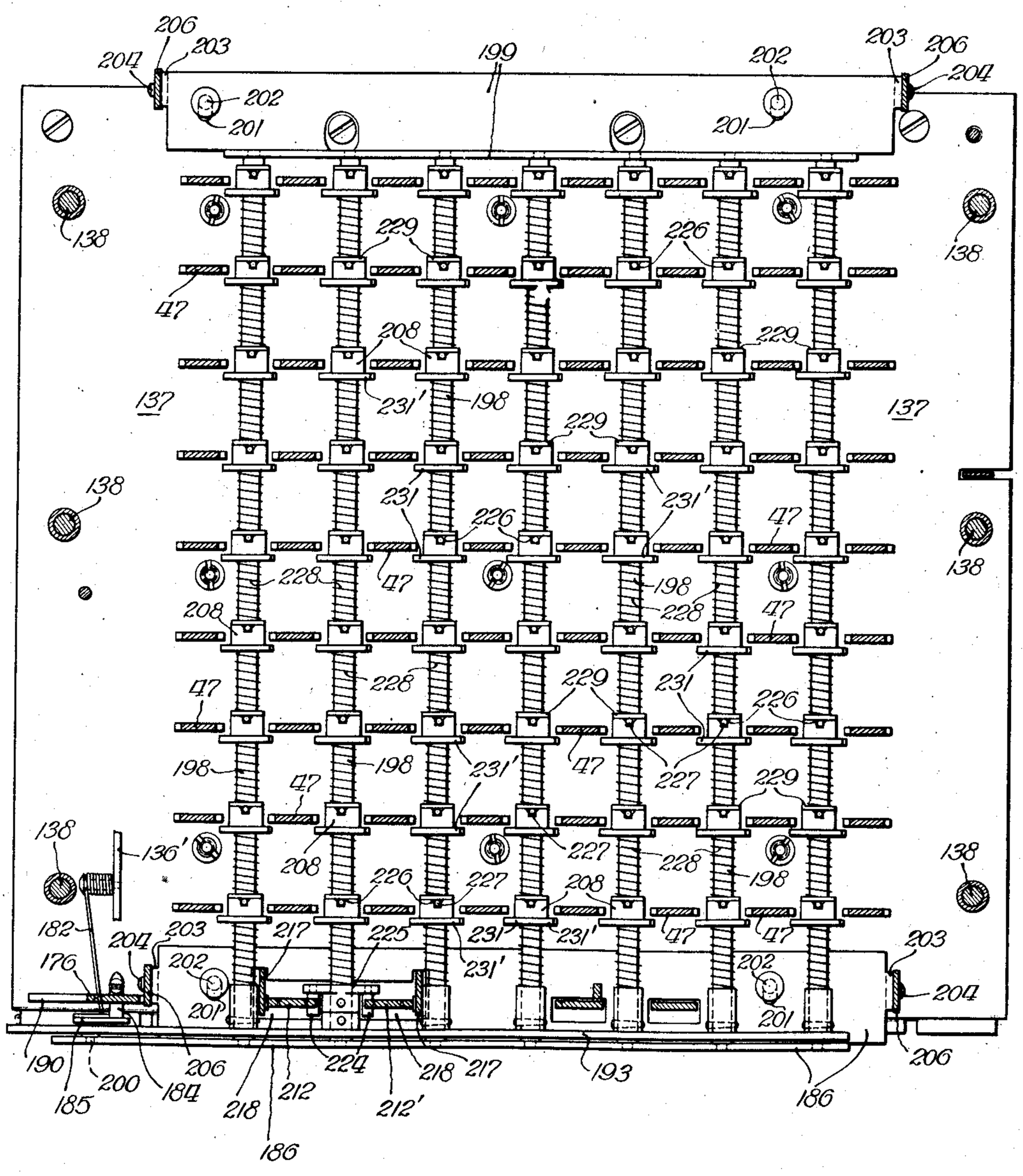
Fig. 18.



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Patented Nov. 11, 1947

2,430,574

UNITED STATES PATENT OFFICE

2,430,574

CALCULATING MACHINE

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Application February 5, 1943, Serial No. 474,808

15 Claims. (Cl. 235—82)

1

This invention relates in general to calculating machines and has more particular reference to the provision of means for facilitating the use of power-driven, key-responsive machines in division and multiplication.

A principal object of the invention is the provision of means to maintain the keys representing the divisor or multiplicand in partially depressed position.

Another important object of the invention is the provision of means for repeatedly and completely depressing said partially depressed keys representing the divisor or multiplicand to enter the value thereof into the accumulator mechanism.

A further important object of the invention is the provision of means for automatically shifting the divisor or multplicand from one denominational position on the keyboard to another in performing division and multiplication.

Another object of the invention is the provision of means for determining the direction in which the divisor or multiplicand is to be automatically shifted.

Another important object of the invention is to facilitate the use of the machine in multiplication and division calculations by making it unnecessary to hold the fingers over all the keys representing the multiplicand or divisor.

An important object of the invention is to eliminate the chance of error through misoperated keys where the divisor or multiplicand contain many figures or the figures are of widely varying values necessitating the spanning of the hand longitudinally of the machine.

A further important object of the invention is the provision of means for releasing all digital control keys maintained in partially depressed position.

Another important object of the invention is the provision of means for locking the last mentioned releasing means to prevent any keys subsequently depressed from being maintained in partially depressed position.

An important object of the invention is the provision of means for releasing the last mentioned locking means to maintain any keys subsequently depressed in a partially depressed position.

A further object of the invention is the provision of means allowing the release of a partially depressed key in any particular order by the depression of another key in that order.

Another important object of the invention is to prevent the simultaneous latching in partially depressed position of more than one digit key of any ordinal column of the keyboard.

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A further object of the invention is the provision of means to compel the release and rising of a digit key from partially depressed or key-set position incident to the depression of any other digit key of the same ordinal column into latched or partially depressed key-set position.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, when taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

In the drawings:

Figure 1 is a top plan view of a calculating machine embodying my invention, showing the various control keys and operating crank;

Figure 2 is a longitudinal vertical section taken through the calculating machine shown in Fig. 1 on a plane adjacent a column of digit keys;

Figure 3 is a longitudinal vertical section taken at the left side of the calculating machine shown in Fig. 1 with the left support plate removed;

Figure 4 is a transverse vertical section through the keyboard of the machine;

Figure 5 is a right side view of one of the denominational setting shift keys;

Figure 6 is a right side view of the calculation control release key and locking mechanism;

Figure 7 is a transverse vertical section of the operating crank full stroke sensing means;

Figure 8 is a plan view taken immediately below the top key plate of the keyboard;

Figure 9 is a transverse vertical section taken on the line 9—9 of Fig. 2;

Figure 10 is a transverse vertical section taken on the line 10—10 of Fig. 2;

Figure 11 is a right side elevation of the keyboard showing the operating crank and drive shaft;

Figure 12 is an enlarged view of part of the stem of one of the denominational setting shift keys;

Figure 13 is a right side view of the key stem of Fig. 12;

Figure 14 is an enlarged view of part of the stem of another of the denominational setting shift keys;

Figure 15 is a sectional view taken on the line 15—15 of Fig. 14;

Figure 16 is an enlarged view of part of the denominational shift mechanism actuated by the key stem of Fig. 12;

Figure 17 is an enlarged view of part of the de-

nominational shift mechanism actuated by the key stem of Fig. 14;

Figure 18 is a plan view taken on the line 18—18 of Figure 2 showing the denominational setting shift mechanism.

For the purpose of illustrating my invention, I have shown in the drawings a key-responsive, power-driven calculating machine similar to that shown and described in Patent No. 2,063,962, issued December 15, 1936, and with some changes as subsequently shown in United States Letters Patent No. 2,018,933, issued October 29, 1935. Referring more particularly to the drawings, the calculating machine is shown as having an outer casing 21 within which the various instrumentalities of the machine are mounted on skeleton frame members or partition plates 22 disposed between the actuating mechanisms of the several denominational orders and secured together in spaced relationship at suitable points by tie-rods 23. A plurality of columns of digital keys 24, normally held in raised position by means of springs 38, are arranged to extend through a keyboard 25, positioned as part of the upper wall of the casing 21, which keys are adapted for manipulation to determine the digital degree of actuation to be imparted to the different denominational orders of accumulator mechanism. Each column of keys 24 controls the rotation of an accumulator actuating pinion 26 (see Fig. 2) journaled upon a transverse shaft 27 that extends across the machine and is supported by the frame members 22. Rotation of each of the actuating pinions 26 is transmitted through an internal ratchet mechanism (not shown) to a combined lantern wheel and accumulator gear 28 (Figs. 2 and 3) which is also journaled on the shaft 27. The gear of the lantern wheel 28 normally meshes with a carrying gear 30 journaled on a shaft 29 (Figs. 2 and 3), which is disposed in parallel relationship to the shaft 27. The carrying gear also meshes with an intermediate gear 31 journaled on a transverse shaft 32, which in turn meshes with a numeral wheel pinion 33 journaled on a transverse shaft 34 and fixed to a numeral wheel 35 (Figs. 2 and 3).

Carrying mechanism is provided in each denominational order of the accumulator mechanism for the purpose of imparting a digital unit of actuation thereto each time that a ten's transfer is to take place from the next lower denominational order of the accumulator. This mechanism, as well as that hereinbefore described, is more fully disclosed in United States Letters Patent No. 1,357,747 and No. 1,357,748, issued on November 2, 1920, and includes a carrying-cam member 36 (Fig. 2), which is given a 180° rotation by a suitable carrying motor spring 37 associated with a carrying gear of the next lower denominational order for each ten's transfer that is to be effected. The carrying-cam member 36 acts upon a dolly roll secured to a bell-crank carrying-lever (not shown) to swing the latter in a clockwise direction, viewing Figs. 2 and 3. Such swinging of the carrying-lever causes a carrying pawl 41 pivotally mounted on said lever to throw the lantern wheel and accumulator gear 28 a sufficient distance to impart, through the train of gears, a digital unit of actuation to the numeral wheel 35.

The adding is accomplished upon depression of the keys 24 and corresponding actuation of gear sectors 42 (Fig. 2) which are in mesh with the pinions 26, a said sector being associated with each denominational section of the accumulator unit in association with its controlling column of keys. The gear sectors and the control and actuating mechanism for them are duplicated for each denominational order of the calculating machine, and a general description of a single set of such mechanism will be sufficient for an understanding of them all, except that they have to be arranged and adapted to cooperate selectively and collectively with the power members.

The gear sectors 42 are mounted upon a shaft 43 which extends through the partition plates 22 of the machine, and are adapted to be moved downwardly (viewing Fig. 2) on an idle or setting stroke an amount determined by the value of the particular digital key 24 of the associated column depressed, this amount increasing in graduating steps from "1" to "9." The keys 24 in addition act through a power trip mechanism to effect a connection whereby power supplied by an electric motor, indicated generally at 44 (Fig. 3), through a power shaft 45, which is connected to the motor in any suitable manner, is effective to extend a spring 46 associated with the particular order of mechanism with which the key depressed is identified. Release of this spring thereafter accomplishes adding movement in amount determined by the particular digital key of the order depressed. Upon depression of said key, the gear sector 42 is moved through its idle or downward stroke by the power shaft 45 into position to impart proper and accurate digital accumulation to the adding mechanism upon its return movement, which is accomplished by the associated spring 46.

In the calculating machine shown in the drawings, depression of a key 24 causes its stem 47 (Fig. 2) to engage a parallel motion bar 48 which is pivoted at the front at 49 and at the rear at 51 to levers 52 and 53, respectively, which levers are pivoted in turn upon cross shafts or rods 54 and 54' extending through the partition plates 22. A link 55 is pivotally connected at 56 to the lever 52 and at 57 to the lever 53. The bar 48, levers 52 and 53 and the link 55 form part of a parallel motion device, and are constructed and mounted as shown and described in United States Letters Patent No. 2,063,962, earlier mentioned. Further and more particular description of these parts is therefore thought to be unnecessary. Each of the gear sectors 42, as stated above, is pivoted upon a cross shaft 43, and through a yielding clutch 63 is articulately connected to a hook 58 by a link 59 (the hook 58 and link 59 being articulately connected to a vertical guide member 60 which in turn is pivotally mounted on a shaft 50). Each gear sector 42 is also articulately connected to a movement controlling bar, shown at 61, by a pin 62 securely fixed to an arm 39 of the gear sector 42 (Fig. 2). A spring 64 attached to lever 53 and to a tail piece 65 of a latch member 66 carried by the link 55 normally contributes toward holding the parallel motion device in elevated position, and also holds latch member 66 in forward position for a purpose which will be presently explained. A dog 67 which is pivoted at 68 on the parallel motion bar 48 is provided with a laterally extending lug 69, which is adapted for engagement with a lug or shelf 71 on a spring-lifted lever 72 pivotally mounted on the guide member 60 with the hook 58. The operation of the parts is such that upon depression of a key 24, the stem 47 engages and depresses bar 48, imparting motion to the parallel motion device, which

carries dog 67 downwardly to depress lever 72. A spring mounted on the pivot between the link 59 and the hook 58 engages the lever 72 and the hook to urge the rear end of the latter downwardly, so that it will normally cause engagement of the hook 58 with a toothed wheel 73 upon depression of lever 72. The toothed wheel 73 is fastened to the power shaft 45, which continually turns in a counter-clockwise direction. The engagement of the hook 58 with the wheel 73 pulls the link 59 toward the rear of the machine, or toward the left, viewing Fig. 2, which imparts downward motion to gear sector 42, through the yielding clutch 63. Forward motion is thus imparted to the digital control bar 61, until one of several lugs projecting laterally therefrom is stopped by the stem 47 of the key 24 depressed.

The rearward motion of hook 58 and link 59, which are articulately connected to each other and to guide arm 60, causes said guide arm to pivot in a counterclockwise direction about its shaft 50 to extend spring 46, one end of which is connected to the guide arm and the other end to a shaft or rod extending through partition plates 22. The link 59 moves the gear sector 42 downwardly on an idle stroke and into position to impart an adding movement upon release of the hook 58 and contraction of the spring 46. The downward movement of the gear sector 42 is under the control of the digital control bar 61 (Fig. 2), and the gear sector is halted when it has been moved downwardly the proper distance, enabling it upon return to impart the degree of digital advancement to the adding mechanism which corresponds to the particular key depressed. The yielding clutch 63 permits the continuation of the rearward movement of the link 59 after downward movement of the gear sector 42 has been stopped, and until the end of the power stroke and the automatic release of the hook 58. The release of the hook 58 is accomplished automatically in each instance, after a set increment of action has been imparted to the link 59, by the teeth of the wheel 73. Upon the return stroke (the operative stroke of the gear sector), the yielding clutch 63 permits relative movement of the parts in reverse direction to the beginning of the adding movement, and thereafter the adding actuation is accomplished.

It is apparent, therefore, that upon depression of a key 24, the digital control bar 61 determines the degree and extent of the downward movement of the gear sector 42, and the bar 48 accomplishes connection of the latter to the power mechanism. Means are provided to prevent return movement of the dog 67 before the hook 58 has opportunity to fully engage the toothed wheel, which means comprise latch member 66 which is pivoted at 74 on bar 55. This latch member has an engaging arm 75 which is adapted to engage upon the laterally projecting end 76 of the dog 67 to hold the dog down against return upward movement and the parallel motion device in depressed position. Just prior to the release of the hook 58, a pin 77 in an upwardly extending arm 78 of vertical guide member 60, which through its connection with hook 58 has been carried rearwardly, engages a finger 79 of latch 66 and frees the dog 67 so that the parallel motion device may return to normal raised position. In this operation, the key 24 which has been operated is held depressed until release of the hook 58 from the wheel 73, when the key will be released and returned to normal raised position. A bar 81 having rearwardly extending pointed locking lugs or teeth 82, is pivoted upon studs 83 and 83' which are secured to the levers 52 and 53, respectively, and which extend through slots 84 and 84' in bars 48 in each denominational order of the machine. Consequently, upon depression of a key 24, bar 81 is moved rearwardly (to the left viewing Fig. 2), relative to key stems 47. Referring more particularly to Fig. 4, each key stem is provided adjacent its lower end with an aperture 85 extending therethrough into which the tooth 82 enters in the rearward movement of the bar 81, thus holding the key down until the parallel motion device is released by the disengaging of latch 66 from dog 67 and the parts returned to normal elevated position. It will be understood that, while no two keys 24 of the same column or denominational order may be operated simultaneously, as described in Patent No. 2,043,021, issued June 2, 1936, any key of one order may be operated at the same time as any desired key of any other denominational order or orders. Briefly, when a key is depressed, adjacent anchor-shaped locking members 90 (Fig. 2) are rocked into locking engagement with the adjacent keys through the medium of the apertures 85 in said keys, preventing full depression of any other key in the same order until the depressed key has returned to release the locking members. Limited downward movement of a key, however, is allowed, even though a key of that order is in a partially depressed position, for a purpose which will presently be explained.

The present invention contemplates more particularly the provision of means for facilitating the use of the machine in performing multiplication and division by causing the digit keys representing the multiplicand or divisor which are depressed to be maintained in a partially depressed position and subsequently to be repeatedly and completely depressed a desired number of times by an operating crank. In accordance with the present invention there is provided means for automatically shifting the divisor or multiplicand from one denominational position to another on the keyboard, and also for determining the direction in which the shift is to be made, depending upon whether division or multiplication is being performed. In performing addition and subtraction the same keys are not normally repeatedly depressed, so it is desirable that the machine remain conditioned for key-responsive manual operation and not be conditioned for key set operation as just mentioned with respect to the performance of multiplication and division. Means are provided, therefore, for conditioning the machine at the will of the operator for either key-set crank operation or key-responsive manual operation. Immediately below the digital control keys of the third and fourth columns from the right are a calculation control key 101 and a release key 102, respectively. When the key 102 is in a depressed position the machine is conditioned for key-responsive actuation only and any keys subsequently depressed will not remain in a partially depressed position until the key 102 is released by depression of key 101 and returned to elevated position under tension of spring 38. The means for maintaining the key 102 in depressed position consists of a lock piece 103 (Fig. 6) which is pivotally mounted on a transverse shaft 104 and is normally urged in a clockwise direction under tension of a spring 105. As the key 102 is depressed, a shoulder 106 formed

on a depending arm 107 of the lock piece 103 enters a notch 108 (Fig. 9) cut in the key stem 100 when the lock piece swings forward in a clockwise direction under tension of its spring 105. Thus the key 102 is maintained in a depressed position until released by depression of the key 101 as will now be explained. The lock piece 103 is also provided with a second depending arm 109 in the lower extremity of which is mounted a pin 111 which is normally disposed in a notch 112 cut in the stem 110 of the key 101 and in the path of a beveled portion 113 of the stem 110. Therefore, when the key 101 is depressed the beveled portion 113 will contact the pin 111 and rock the lock piece 103 in a counter-clockwise direction (viewing Fig. 6) to remove the depending arm 107 and shoulder 106 from the path of upward movement of the key 102 allowing it to be elevated under tension of its spring 38. It will be apparent that if the keys 101 and 102 are depressed simultaneously, the key 102 will not remain in a depressed position but will immediately rise with the key 101 and, as earlier mentioned, the machine will be conditioned for key-set, crank-operated division and multiplication.

To maintain the depressed keys 24 representing the divisor or multiplicand in partially depressed position there is provided a longitudinal latch bar 114 (Figs. 2, 4 and 8) in each denominational order adjacent a row of associated keys 24. The latch bar 114 is journaled forwardly and rearwardly for pivotal movement upon the vertical portion of transverse brackets 115 and 115' which are secured in any suitable manner, such as by screws 116, to a plate 117 forming part of the keyboard 25. Formed on the latch bar 114 are a plurality of depending latch arms 118 the lower ends of which are normally in engagement with the lower beveled portions of projections 119 formed on the stems 47 of the digital control keys when the keys are in their normal elevated position. The latch bar 114 is normally urged in a counter-clockwise direction (Fig. 4) under tension of springs 121 (Fig. 8) so that when a digit key 24 is depressed the projection 119 cams the latch arm 118 outwardly causing the latch bar to be first rocked in a clockwise direction and then counterclockwise under tension of springs 121 disposing the lower end of the arm 118 within the notch 122 cut in the stem 47. In such position the lower end of the latch arm 118 is disposed above the projection 119 and in the path of upward movement of the key stem 47, thus effectively preventing the key 24 from rising to its normal elevated position under tension of spring 38, as shown in Fig. 4.

As earlier mentioned, such a condition prevails only when the control key 102 is in elevated position. When the key 102 is in depressed position the latch bars 114 are rocked in a clockwise direction against the tension of springs 121 and maintained out of engageable relationship with the key stems 47 by means of a laterally shiftable transverse release bar 123 (Figs. 8 and 9). The release bar 123 is positioned adjacent the bracket 115 and is provided with rearwardly extending horizontal lugs 124 for each denominational order of the machine. The lugs 124 extend rearwardly through elongated slots 125 in the bracket 115 to engage the lower ends of the depending latch arms 118 associated with each of the "1" keys. A plurality of guide studs 126 are mounted in the bracket 115 as shown in Figs. 8 and 9, to maintain the release bar 123 in adjacent shiftable relationship with respect to the bracket 115.

Mounted in the bar 123 intermediate its ends is a pin 127 in engagement with which is a lever 128 (shown in Fig. 9) provided with a hub portion 129 pivotally mounted on a stud 131 which is fixed in the bracket 115. The lever 128 extends to the right, viewing Fig. 9 and terminates in a lateral projection 132 disposed in the notch 108 in the stem 100 of the key 102. With such an arrangement it will be apparent that depression of the key 102 will cause the shoulder 120 on the key stem, formed by the notch 108, to contact the lateral projection 132 and rock the lever 128 in a clockwise direction. Such movement of the lever 128 through its engagement with the pin 127 causes lateral movement to the left (viewing Fig. 9) of the release bar 123 which in turn, through the medium of fingers 124, causes clockwise rotation of the latch bars 114 out of engagement with the digit key stems 47. The latch bars 114 and latch arms 118 are maintained out of operative relationship with the key stems 47 against the tension of springs 121 as long as the key 102 is maintained in a depressed position by means of lock arm 107 as earlier described. Thus, when the key 102 is in depressed position, the machine is conditioned for normal key-responsive operation and any digit keys subsequently depressed will not be maintained in a partially depressed position.

When, however, it is desired that calculation in multiplication or division be performed on the machine, the key 102 is released from depressed position by depression of the release key 101 as earlier described. The digit keys 24 representing the multiplicand or divisor thereafter depressed, are maintained in partially depressed position preparatory to being repeatedly and completely depressed a desired number of times by means of an operating crank 133, as will hereafter be described. If the wrong key in any particular order is inadvertently partially depressed in setting up the multiplicand or divisor, to correct the error it is only necessary to depress the correct digit key to set position. Depression of a second key in any particular order in which a key is maintained in partially depressed position will cause clockwise rotation (Fig. 4) of the latch bar 114 and removal of latch arm 118 from latching engagement with projection 119 of the partially depressed key 24, allowing the key to rise under tension of its spring 36. The second depressed key, however, will remain in partially depressed position when the latch arm 118 enters the notch 122 immediately above the projection 119, under the tension of latch bar spring 121. There is thus provided a self-correcting key latch in combination with the means earlier described for preventing depression of a key in one order while a key of that order is in depressed position. As earlier mentioned, limited downward movement of a digit key, while another key of the same order is partially depressed, is permitted before movement of the anchor-shaped locking members 90 takes place. This limited movement is permitted by the length of the slot of aperture 85 and is sufficient to cause rocking movement of the latch bar 114 and latch arm 118 out of latching engagement with a partially depressed key before the slotted aperture 85 engages the locking member 90. As the second key is depressed, the anchor-shaped member 90 in engagement with the aperture 85 of the partially depressed key will force elevation of the key to its normal raised position.

The operating crank 133 is located at the right

hand side of the machine, viewing Fig. 1, for convenient operation, and is secured in any suitable manner to a longitudinal rotatable drive shaft 134 (see Fig. 8). The shaft 134 is supported at its forward end by a support piece 135 which is placed between the two uppermost plates of the keyboard 25 and which rests upon a longitudinal bracket 136 secured to the plate 117, as shown in Figs. 8 and 11. The top key plate, intermediate key plate 117 and the next lower intermediate plate 137 are secured together and spaced from each other by vertical tie rods 138. As may be seen in Figs. 8 and 11, the tie rod 138 at the front of the machine extends through apertures in horizontal ears 139 formed on the support piece 135 to prevent displacement thereof. The support piece 135 is also provided with vertical ears 141 having circular holes through which the drive shaft 134 extends rearwardly. At its rearward end the shaft 134 is supported by and has a bearing in a lateral projection 142 formed on the vertical portion of another bracket 130. As earlier mentioned, the drive shaft 134 is adapted to be rotated by the crank 133 in a clockwise direction (Fig. 4) only, and is normally maintained in the position of Figs. 7 and 8 by a full cycle sensing mechanism comprising a disk 143 rigidly mounted on the shaft 134 intermediate its ends (Figs. 7 and 11). The disk 143 has a fillet 144 formed therein and, when the crank 133 is in the position of Figs. 8 and 11, the fillet is positioned to be engaged by a roll 145 rotatably mounted in the upper extremity of a vertical arm 146. The arm 146 is mounted for limited pivotal movement on a support piece 147 by means of a stud 148 but is normally maintained in the position of Fig. 7 under tension of spring 149. The support piece 147 is secured to the bottom plate of the keyboard 25 in any suitable manner. As the drive shaft 134 is rotated in a clockwise direction, the roll 145 is cammed out of the fillet 144 and the arm 146 is rocked in a clockwise direction, viewing Fig. 7, against the tension of its spring 149. Upon continued rotation of the crank 133, as it nears the end of a complete rotation, the arm 146, under the tension of spring 149, will cause the roll 145 to again enter the fillet 144. The fillet 144 and roll 145 also offer some resistance to the turning of the drive shaft and crank 133 to prevent the accidental displacement thereof.

As earlier mentioned, means have been provided for completely and repeatedly depressing all keys representing the multiplicand or divisor which are maintained in a partially depressed position, thus automatically entering into the accumulator the values of the partially depressed keys. Rigidly mounted on the drive shaft 134 by pins 151 extending through the hubs 153 thereof are a plurality of beveled gears 152 which are adapted to be rotated in a clockwise direction, viewing Fig. 4, coincident with the turning of the drive shaft 134 by the crank 133. The beveled gears 152 are in mesh with associated beveled gears 154 which are rigidly mounted at right angles to the gears 152 upon rotatable transordinal shafts 155 provided in association with the transverse sets of "1," "4" and "7" digit keys (Fig. 8). In association with each remaining set of transverse digit keys are similar rotatable transordinal shafts 155' which, together with the shafts 155, have a bearing in the vertical portions of brackets 136, 130 and 136' which are located at the right and left hand sides of the machine, respectively, viewing Fig. 8. Rigidly mounted upon the left end of each of the shafts 155 and 155' are pinion gears 156 which are interconnected by similar pinion gears 156', except between the third and fourth and the sixth and seventh transverse shafts (see Fig. 8). From the above arrangement, it will be understood that clockwise rotation of the longitudinal drive shaft 134 will communicate similar movement (viewing Fig. 2) to the shafts 155 through the medium of associated beveled gears 152 and 154. Clockwise rotation of the shafts 155 will, in turn, be transmitted to the shafts 155' through connecting pinions 156'. All the transordinal shafts 155 and 155' will, therefore, be actuated simultaneously with rotation of longitudinal drive shaft 134 by operation of crank 133.

Also securely mounted in any desired manner on each of the shafts 155 and 155' are a plurality of single-toothed disks 157, one of which is provided in association with each digit key stem 47 and disposed in alignment with upper and lower slots 158, 159, cut therein (Fig. 4). As will be noted from Fig. 8, the teeth 160 of the disks 157 are in staggered relationship with each other so that all of the partially depressed keys will not be simultaneously depressed when the crank 133 is operated, as will presently be described, whereby to make the operation of the crank more smooth. When the shafts 155 and 155' are simultaneously rotated as previously described, carrying the disks 157 with them, the teeth 160 formed thereon will strike the top edges of the portions 161 of the key stems 47 joining the slots 158, 159 if the key 24 is in partially depressed position, and thus completely depress the engaged key stem. As the key stem reaches its fully depressed position, the tooth 160 of the disk 157 is disengaged from the key stem 47 upon continued rotation of the shafts 155 and 155', and the key 24 is allowed to rise under tension of its spring 38 until the latch arm 118 re-engages the projection 119 on the key stem 47. It will be understood that one complete depression of a partially depressed key 24 is effected each time the crank 133 is operated and, if the operating crank 133 is repeatedly rotated, the values represented by the partially depressed keys will be repeatedly entered into the accumulator the desired number of times that the operating crank is rotated.

No actuation, however, is effected of those keys which have not been partially depressed from their normal elevated position. The tooth 160 of the disk 157 does not contact the portion 161 of the normally positioned keys because the top edge of the portion 161 is not in the path of movement or rotation of the tooth 160. As will be noted in Fig. 2, the portion 161 of the key stem 47 is provided with a bevel 162 so that upon rotation of the shafts 155 and 155', the disks 157 mounted thereon and the teeth 160 will rotate freely past the portion 161 of the normally positioned keys.

As earlier mentioned, the operating crank 133 and longitudinal shaft 134 are adapted to be operated in a clockwise direction (Fig. 4) only. To this end a ratchet wheel 163 is provided on one of the shafts 155' at the right hand side of the machine and is adapted to be operated in a counter-clockwise direction, viewing Fig. 11, upon operation of the crank 133 and rotation of the shaft 155' as earlier described. Pivotally mounted on the bracket 136 at 164 adjacent the ratchet wheel 163 is a back stop pawl 165 which is provided with a lateral projection 166 normally maintained in resilient engagement with the

teeth of the ratchet wheel 163 under tension of a spring 167. The projection 166 is adapted to ride over the teeth of the ratchet wheel 163 when the crank 133 is operated in the proper direction, but if it is attempted to reverse the direction of rotation the projection 166 will engage a tooth of the wheel 163 and prevent clockwise rotation thereof to compel completion of an initiated operation.

Under certain conditions, however, it may be desirable that the projection 166 be released from and maintained out of engagement with the teeth of the ratchet wheel 163 to allow reverse or counter-clockwise rotation of a partially rotated crank 133 back to normal starting position as shown in Figs. 1 and 11. A release lever 168 is pivotally mounted on stud 169 fixed in the bracket 136 and at its rearward end is provided with a lateral projection 171 which overlies a shelf 172 formed on the rear end of the back stop pawl 165. Extending through the top plate of the keyboard 25 for manual operation of the back stop pawl release lever is a finger piece 173 which upon manipulation is adapted to rock the release lever 168 in a clockwise direction about its pivot 169 against the tension of spring 174. Such movement of the lever 168 through the engagement of projection 171 with shelf 172 causes clockwise rotation of the back stop pawl 165 against the tension of spring 167, thus releasing the projection 166 from engagement with the teeth of the ratchet wheel 163. Thus, as long as the finger piece 173 remains in a depressed position the back stop pawl 165 will remain out of engagement with the ratchet wheel 163 to allow reverse or counter-clockwise rotation of the crank 133.

In accordance with the present invention, means are provided for shifting the multiplicand or divisor from one denominational place to another to vary the denominational value of the partially depressed keys representing the multiplicand or divisor. Means are also provided for determining the direction of shift, depending upon the type of calculation to be performed, whether division or multiplication. On the left hand side of the machine, Fig. 1, there is located a shift directional determining key 175 which is provided with a stem 176 extending downwardly through elongated slots 180 and 190 in the top key plate and in an offset portion of intermediate key plate 137, respectively, of the keyboard 25. The stem 176 is housed within a U-shaped lateral extension 177 of a plate 178 secured to the vertical portion of the bracket 136', and is provided with a slot 179. A stud 181 extends through the U-shaped housing 177 and slot 179 of the key stem 176 (see Figs. 3 and 10) and serves to limit vertical movement of the key 175 which is normally maintained in elevated position under tension of spring 182. At its lower extremity the key stem 176 is provided with an open slot 183 which embraces a rearwardly extending stud 184 fixed in a small plate 185 which is rotatably mounted by means of pivot stud 200 in the bracket 186. From the above construction it will be noted that as the key 175 is depressed an amount determined by the length of the slot 179, the plate 185 will be rotated due to the engagement of the key with the stud 184. This depression is against the tension of spring 187 which is interconnected between the studs 181 and 184 and also contributes toward maintaining the key 175 in elevated position. When the plate 185, however, has been

rotated a sufficient distance, slightly past center, contraction of the spring 187 will urge further rotation of the plate 184 and elevation of the key 175 to an angularly disposed position opposite that position it occupied just prior to depression. Also rotatably mounted on the stud 200 between the plate 185 and bracket 186 is a sector gear 188 provided with fillets 189 on either side of the gear teeth (Fig. 10). Fixed in the plate 185 and extending forwardly therefrom are a pair of pins 191 one of which is adapted to engage a fillet 189 to rotate the sector gear 188 about its pivot in the bracket 186 when the key 175 is depressed and rocked. It will be understood, of course, that when a pin 191 is engaged with its respective fillet, the other is completely out of engagement with the other fillet. The sector gear 188 is in mesh with teeth 192 on an intermittently toothed rack bar 193 (Fig. 10) which is mounted for lateral shifting movement on studs 194 fixed to the bracket 196 and which extend through slots 195 in the rack bar 193. From the above construction, therefore, it will be apparent that lateral shifting movement of the rack bar 193 will be accomplished upon depression of the shift directional determining key 175 resulting in rotation of the plate 185 through the medium of the open slot 183 and stud 184. As the plate 185 is rotated, one of the pins 191 fixed therein will contact its respective fillet 189 and rotate the sector gear 188 which, being in mesh with the leftmost set of teeth 192 of the rack bar 193, will cause lateral movement of the rack bar to a position where it is maintained under tension of spring 187. Mounted in the rack bar 193, at the left viewing Fig. 10, are stop studs 196 which, upon lateral movement of the rack bar, contact the key stem 176 and limit further movement of the bar 193.

Formed on the bar 193 are a plurality of sets of teeth 192 which are in mesh with sector gears 197 mounted on the forward end of longitudinal rock shafts 198 (Figs. 2, 4, 10 and 18) which have a bearing in front and rear brackets 186 and 199, respectively. The brackets 186 and 199 are provided in the horizontal portion thereof with elongated apertures 201 for longitudinally movable mounting on studs 202 fixed in the plate 137 of the keyboard 25. Also formed on the brackets 186 and 199 are ears 203 which extend downwardly and have studs 204 fixed therein in engagement with which are the bifurcated portions 205 of vertical arms 206 pivoted on rear and front cross shafts 207 and 104, respectively, as shown in Fig. 2. The cross shafts 207 and 104 are supported in side brackets 136, 130 and 136'.

A longitudinal shaft 198 is provided between each two adjacent rows of keys 24, as will be noted from Fig. 18, and has mounted thereon a plurality of key shifters 208 which are longitudinally shiftable with respect to the shaft 198 and adapted to be positioned in engageable relationship with suitably positioned keys 24 when the longitudinal shaft 198 is moved rearwardly by means now to be described. Toward the left hand side of the machine, viewing Fig. 1, immediately below the "1" keys there will be noted a set of denominational setting shift keys 209, 211, having inscribed thereon oppositely pointing arrows, to the left and right, respectively. The key 211 is utilized for causing denominational shifting of an amount representing the divisor, signified by partially depressed keys, one place to the right to a lower denominational position, for each depression of shift key 211, when the shift direc-

tional determining key 175 is in the "D" (division) position of Fig. 1. When the key 175 has been moved to the "M" (multiplication) position from its position of Fig. 1, the key 209 is utilized for causing denominational shifting of an amount representing the multiplicand, signified by partially depressed keys, one place to the left to a higher denominational position, for each depression of shift key 209. The keys 209 and 211 are provided with stems 212 and 212', respectively, extending downwardly through the plates of the keyboard 25. On the key stems 212 and 212' there are formed projections 213 having upper and lower bevels 214 and 215 respectively (see Figs. 12–15, inclusive). Disposed in the path of projections 213, as will be noted from Fig. 9, are pins 216 which are fixedly secured to the lower extremities of oppositely disposed vertical levers 217 which are pivotally mounted on cross shaft 104. The lower extremity of the levers 217 are disposed in a clearance opening 218 (Fig. 18) in the horizontal portion of the bracket 186 and are normally maintained in engagement with the bracket under tension of springs 219, as will be noted from Fig. 5. Depression of key 209 or 211 will cause the lower bevel 215 of projection 213 formed on the stems 212 or 212' thereof to contact an angular surface on the pin 216 and rock the lever 217 in a counter-clockwise (Fig. 5) direction about its pivot 104. Counter-clockwise motion of the lever 217 results in rearward movement of the bracket 186 and, through the connecting link 221 (Fig. 3) which is mounted forwardly and rearwardly on the studs 204, causes simultaneous rearward movement of the front and rear brackets 186 and 199, respectively, in the slots 201 against the tension of spring 222. The shafts 198, being mounted in the brackets 186 and 199, are moved rearwardly with the brackets to position the key shifters 208 mounted thereon in engageable relationship with any keys positioned to receive them. Viewing Fig. 18, it will be noted that each key shifter 208 has a notch 226 cut therein in which is disposed a pin 227 fixed in the shaft 198. One end of a spring 228 engages and normally maintains the shifter 208 in engagement with the pin 227, the other end being in contact with a backing washer 229 which is mounted on the shaft 196. A key shifter 208 is provided between each two adjacent keys and is provided with left and right (Fig. 4) laterally extending fingers 231 and 231', respectively, which are adapted for engagement with right and left shoulders 232 formed on the key stem 47 by the cutting of notches 233 therein, when the machine is conditioned for key set actuation and keys 24 representing the multiplicand or divisor are suitably positioned for the reception of the fingers 231 and 231'. As shown in Figs. 1 and 10, the shift directional determining key 175 is in the "D" (division) position and the longitudinal shafts 198 are adapted to be moved rearwardly and rocked in a clockwise direction, as will be presently explained, by depression of shift key 211 to shift the divisor, represented by partially depressed keys, one denominational place to the right. In Fig. 4, the second key from the right is shown maintained in partially depressed position by the latch arm 118 and in such position the left finger 231 of the shifter 208 will enter the notch 233 cut in the right side of said key stem, and the right finger 231' will enter the notch 233 of the normally positioned key 24 immediately to the right of the partially depressed key when the shaft 196 is moved rearwardly by depression of shift key 211.

Thereafter, rotation of the shafts 198 in a clockwise direction will cause the right finger 231' to engage the shoulder 232 of the normally positioned key immediately to the right of the partially depressed key and depress it sufficiently far so that it will be maintained in a partially depressed position by latch arm 118.

Means are provided for causing rotation of the longitudinal shafts 198 and shifters 208 to shift the denominational setting of the divisor or multiplicand. To this end there are provided on the key stems 212 and 212' oppositely disposed projections 223 which are adapted to contact pins 224 which are fixed in opposite extremities of a lever 225 which is rigidly mounted on the forward extremity of one of the shafts 198, as shown in Figs. 9 and 18. Viewing Fig. 10, it will be noted that the shift directional determining key 175 has caused lateral shifting to the left of the rack bar 193 and counter-clockwise rotation of the longitudinal shafts 198 through gear sectors 197. The lever 225 is thus positioned as shown in Fig. 9 and a pin 224 is positioned to be engaged by the projection 223 on the stem of the key 211 to rock the shaft 198 on which the lever 225 is mounted in a clockwise direction. This motion of the shaft 198 is communicated to its associated gear sector 197 which in turn transmits such actuation to the rack bar 193 to shift it laterally to the right to cause clockwise rotation of all the shafts 198.

It will be understood that if the shift directional determining key 175 is in the "M" (multiplication) position, the rack bar 193 and gear sectors 188 and 197 and lever 225 would be disposed in a position opposite that shown in Fig. 10, and one of the pins 224 on lever 225 would be positioned to be contacted by the projection 223 on key 209 to rotate all the shafts 198 in a counter-clockwise direction.

Viewing Fig. 4, it will be noted that in the denominational shifting of the divisor a shifter 208 will be positioned in engageable relationship only with the key 24 immediately to the right of the partially depressed keys because when the shafts 198 are shifted longitudinally toward the rear, the left finger 231 will strike the key stem 47 of the normally positioned key. As the shifter 208 contacts the key stem 47 and the shaft 198 continues its rearward movement, the shifter will be moved from engagement with the pin 227 against the tension of spring 228, and relative movement between the shifter and the shaft 198 is allowed upon clockwise rotation of the shaft.

As a second digit key 24 in any particular order is partially depressed by a shifter 208 in the denominational shifting of a divisor or multiplicand, as just described, the first partially depressed digit key will be automatically released from such position and allowed to return to normal elevated position under tension of spring 38 and compulsion of associated lock member 90. This release is effected by mechanism earlier described with reference to the correction, by depression of a second key, of an error in the form of an inadvertently partially depressed key. As the shifter finger 231 or 231' engages a shoulder 232 on a key stem and depresses the key upon rocking movement of the longitudinal shaft 198, the projection 119 thereon will cause clockwise movement (viewing Fig. 4) of the latch bar 114 and removal of latch arm 118 from latching engagement with the previously partially depressed key which will be forced to return to normal elevated position by the action of an adjacent locking

member 90 and its key spring 38, as earlier described. When, however, no figure of value is to be shifted into a denominational order in which a key is maintained in a partially depressed position, means other than depression of a second key must be provided for causing rotative movement of the latch bar 114 to remove latch arm 118 from latching engagement with the partially depressed key. Rocking of the latch bars 114 to release a partially depressed key in orders to which no figure of value has been transferred by shifter 208 is timed to occur simultaneously with the rocking of the latch bars 114 by depression of a key caused by rotation of shifters 208. Thus, it is seen that in the shifting of the divisor or multiplicand to the right or left, respectively, it is desirable and necessary that the leftmost or rightmost partially depressed key representing the highest figure in the divisor or the units figure of the multiplicand as well as any key in any other order to which no value is to be shifted be released and returned to normal elevated position to prevent depression thereof by the one-toothed cam 157 when the operating crank 133 is operated. Such release is caused by simultaneous clockwise rotation (Fig. 4) of all latch bars 114 out of engagement with the key stems 47 through the medium of the shiftable transverse release bar 123. In the bar 123 at the left hand side of the machine there is mounted a pin 234 (Fig. 9) in engagement with which is the end of a pawl 235 which, in turn, is pivotally mounted on a lever shown generally at 236. The pawl 235 is normally urged in a clockwise direction (Fig. 9) into engagement with a stop pin 237 under tension of a spring 238. The lever 236 is rotatably mounted on a stud 239 secured to the vertical portion of the bracket 115 and is provided with a horizontal laterally extending arm 241 having a lug 242 at its extremity which extends forwardly under a shoulder 243 of the stem 212' of the key 211. A similar lug 244 is formed on the arm 241 intermediate its ends and extends forward to be engaged by a shoulder 245 formed on the stem 212 of the key 209. When the key 209 or 211 is depressed to cause denominational shifting of the multiplicand or divisor, the key stems 212 or 212' will contact the lug 244 or 242 and cause clockwise rotation of the lever 236 about its pivot on the stud 239. Such movement of the lever 236 will cause the end of the pawl 235 to engage the pin 234 and shift the bar 123 to the left, viewing Fig. 9 against the tension of springs 121, until the end of the pawl 235 slips off the rounded pin 234 to allow the bar 123 to return to its normal position of Fig. 9. The means for causing disengagement of the pawl 235 from the pin 234 consists of a downwardly extending projection 230 formed on the lower edge of the pawl 235 which, when the pawl is moved laterally to the left (viewing Fig. 9) upon depression of key 209 or 211, is adapted to contact a pin 240 which is fixed in the horizontal portion of the bracket 115 at the left hand side of the machine. When the projection 230 engages the pin 240, continued lateral movement of the pawl 235 will cause the pawl to be rotated in a counter-clockwise direction against the tension of its spring 238 out of engagement with the pin 234. Such disengagement allows the bar 123 to be moved to the right (viewing Fig. 9) under tension of latch bar springs 121. Lateral movement of the bar 123 to the left causes, as earlier described, clockwise rotation of the latch bars 114 out of engagement with the key stems 47 to allow the return

to normal elevated position under the tension of spring 38 of any key 24 not maintained in partially depressed position by a finger 231 or 231' on shifters 208. Again viewing Fig. 4, it will be apparent that when the shafts 198 are rocked in a clockwise direction upon depression of shift key 211, the right finger 231' of the shifter 208 will engage and partially depress the normally positioned key 24 immediately to the right of the partially depressed key. The latch arm 118 is again in engageable relationship with the key stem 47 before the shaft 198 is restored to its former position, and the finger 231 is disengaged from the left shoulder 232 of the key stem 47.

The shafts 198 and front and rear brackets 186, 199 in which they are mounted are longitudinally shifted forward and the shifters 208 removed from engageable relationship with the key stems 47 when the keys 209 or 211 are fully depressed and before the shafts are rocked back to their normal position upon release of the depressed key 209 or 211. As earlier explained, the brackets and shafts 198 are shifted rearwardly upon depression of key 209 or 211, the stem 212 or 212' of which engages the pin 216 to rock the lever 217 in a counter-clockwise direction, viewing Fig. 5, against the tension of spring 222 (see Fig. 3). When the key 209 or 211 is fully depressed, the brackets 186, 199 will return forwardly under tension of spring 222 and the pin 216 will be disposed in the notch immediately above the beveled projection 213. As the key 209 or 211 is allowed to rise under tension of its spring 38, the upper bevel 214 will strike the pin 216 and cam it forwardly of the projection 213. When the key 209 or 211 reaches normal non-depressed position the pin 216 moves below the lower edge of projection 213 and into its initial alignment with the key stem, being so moved by the lever 217 which is urged counter-clockwise by spring 219 (see Fig. 5).

Means are provided for preventing the locking of the machine resulting from depression of a key by a shifter 208 further than is sufficient to cause latching of the key by the latch arm 118, and enough to normally cause setting of the error lock dogs 245 (Fig. 2) to lock the machine until the stroke had been completed and the error corrected. The means for locking the machine in the event of a partial key stroke insufficient to cause a power action has been described in detail and claimed in U. S. Letters Patent No. 2,021,393 and further and more particular description thereof is thought to be unnecessary. In general, as earlier described, the link 55 is moved forwardly upon depression of a digit control key to effect connection between the clutch hook and clutch wheel. If the link 55, however, has not been moved far enough forward to effect such connection, the link 55 and connected parallel motion device is returned to normal position under spring tension. Mounted on the link 55 intermediate its ends is an error control dog 246 which, upon return movement of the link 55 when no power action results from partial depression of a key, engages a tooth 247 forming part of a ratchet member 250 mounted on a lever 248 to move a link 249 rearwardly. Rearward movement of the link causes, through mechanism fully described in the aforementioned patent, counter-clockwise rotation of the shaft 251 (see Fig. 2) to allow the error lock dogs 245 to rock forward under a shoulder on the power trip bar 40 to prevent depression thereof in all orders other than the order in which the key has been depressed. Such order is left open for correction by complete

depression of the misoperated key. If the key has been fully depressed, however, the lever **248** and ratchet member **250** bearing tooth **247** is raised out of the path of return movement of the error control dog **246** and link **55**, and the error lock dogs **245** are not moved to locking position. In such raised position, a series of ratchet teeth **260** formed on the ratchet member **250** are disposed in the path of another error control dog **246'** which is also mounted on the link **55**, and forward movement of the link **55** and depression of digit keys **24** is thereby effectively prevented. The keys **24** may, however, be depressed sufficiently to be latched in a partially depressed position by latch arms **118**. Means are provided, therefore, for removing the ratchet member and tooth **247** from the path of movement of the link **55** and dog **246** and disposing the teeth **260** in the path of dog **246'** when the shifter keys **209** or **211** are depressed to cause rotative movement of the longitudinal shafts **198** and depression of the keys **24** by shifters **208** to latched position. As earlier explained, depression of a shifter key **209** or **211** causes rearward movement of the front and rear brackets **186**, **199**, and connecting link **221**. Mounted on the link **221** intermediate its ends is a leg **252**, the lower end of which is in engagement with a lateral lug **253** formed on the upper extremity of an arm **254** of a lever **255** rotatably mounted on a short shaft **256**. The lever **255** is also provided with a depending arm **257** having a lateral lug **258** formed at its lower extremity. The lug **258** is in engagement with an arm **259** rigidly mounted on a transverse rock shaft **261**, and when the lever **255** is rotated in a counterclockwise direction upon rearward movement of the link **221** and leg **252**, the shaft **261** will be rocked in a clockwise direction. The shaft **261** is provided with notches **262** (Fig. 2) in engagement with a forwardly extending arm **263** of a lever **264** which is pivotally mounted on a transordinal shaft **265**. Also pivotally mounted on the lever **264** is the lever **248** which bears the ratchet member **250**. From such construction, it will be understood that when the shaft **261** is rocked in a clockwise direction upon depression of key **209** or **211**, the lever **264** will also rock in a clockwise direction to cause vertical movement of the lever **248**. Such movement of the lever **248** causes removal of the tooth **247** from the path of the dog **246** and disposal of the teeth **260** in the path of the dog **246'**. Therefore, upon depression of shift key **209** or **211**, the digit keys **24** are locked against any but limited vertical downward movement sufficient to be latched in a partially depressed position by latch arms **118**.

It is thought that the invention and its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described and illustrated in the drawings being merely a preferred embodiment thereof.

I claim:

1. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, and a multi-denominational accumulator actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed position subsequent to the depression

and rising of the keys to such position that they have allowed the denominational accumulator actuator elements to return to normal position, ordinal key lock latches which prevent the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed but non-actuating position, means operable to repeatedly and completely depress any digit keys which are held in partially depressed position by said latching means for causing said actuating means to respond to repeated depressions to add the values corresponding to the keys so depressed, and means for simultaneously releasing the partially depressed digit keys in the various ordinal columns and for partially depressing the corresponding digit keys in the next adjacent respective ordinal columns either to the left or right thereof.

2. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, and a multi-denominational accumlator actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed position subsequent to the depression and rising of the keys to such position that they have allowed the denominational accumulator actuator elements to return to normal position, ordinal key lock latches which prevent the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed position, said key lock latches cooperating with said latching means to permit the depression of a digit key in any ordinal column and thereby to release any other digit key in the same ordinal column which is held in partially depressed position by said latching means, means for repeatedly and completely depressing any digit keys which are held in partially depressed position by said latching means, selectively operable means for collectively shifting the partially depressed setting of the digit keys of the various ordinal columns to the next adjacent respective ordinal columns either to the left or right thereof, and means settable prior to the operation of said selectively operable means for determining the direction of the shift.

3. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, and a multi-denominational accumulator actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed position subsequent to the depression and rising of the keys to such position that they have allowed the denominational accumulator actuator elements to return to normal position, ordinal key lock latches which prevent the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed position, said key lock latches cooperating with said latching means to permit the depression of a digit key in any ordinal column and thereby to release any other digit key in the same ordinal column which is held in partially depressed position by said latching means, means for repeatedly and completely depressing any digit keys which are held in partially depressed position by said latching means, selectively operable means for simultaneously releasing the partially

depressed digit keys in the various ordinal columns and partially depressing the corresponding digit keys in the next adjacent respective ordinal columns either to the left or right thereof, and means settable prior to the operation of said selectively operable means for determining the direction of the shift.

4. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational register, and a multi-denominational register actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed key-set position, ordinal key locks which permit the depression of a digit key to cause said latching means to release any other digit key in the same ordinal column from key-set position and which prevent said latching means from simultaneously holding more than one digit key of the same ordinal column in key-set position, means for repeatedly and completely depressing any digit keys which are held in partially depressed position, selectively operable means for collectively shifting the partially depressed setting of the digit keys of the various ordinal columns to the next adjacent respective ordinal columns either to the left or right thereof, and means settable prior to the operation of said selectively operable means for determining the direction of the shift.

5. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational register, and a multi-denominational register actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed key-set position, ordinal key locks which permit the depression of a digit key to cause said latching means to release any other digit key in the same oridinal column from key-set position, means for repeatedly and completely depressing any digit keys which are held in partially depressed position, selectively operable means for simultaneously releasing the partially depressed digit keys in the various ordinal columns and for partially depressing the corresponding digit keys in the next adjacent respective ordinal columns either to the left or right thereof, and means settable prior to the operation of said selectively operable means for determining the direction of the shift.

6. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational register, and a multi-denominational register actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed key-set position, ordinal key locks which permit the depression of a digit key to cause said latching means to release any other digit key in the same ordinal column from key-set position and which prevent said latching means from simultaneously holding more than one digit key of the same ordinal column in key-set position, means for repeatedly and completely depressing any digit keys which are held in partially depressed position, selectively operable means for releasing a digit key in any column from partially depressed key-set position and for partially depressing the corresponding digit key in the next adjacent ordinal column either to the left or right thereof into partially-depressed key-set position.

7. In a power-driven, key-responsive calculating machine having an accumulator mechanism and actuating mechanism therefor responsive to denominational orders of depressible keys, means for maintaining the said keys representing a divisor or multiplicand in partially depressed position, means for repeatedly and completely depressing said partially depressed keys to enter the value thereof into the accumulator mechanism, and means for causing the release of said partially depressed keys and depression of keys of corresponding value in adjacent denominational orders either to the right or left of the order in which the partially depressed keys are released.

8. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, and a multi-denominational accumulator actuator each denominational element of which is responsive to one ordinal column of digit keys; latching means settable to hold said digit keys in partially depressed position subsequent to the depression and rising of the keys to such position that they have allowed the denominational accumulator actuator elements to return to normal position, ordinal key lock latches which prevent the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed position, means for repeatedly and completely depressing any digit keys which are held in partially depressed position by said latching means, means for collectively shifting the partially depressed setting of the digit keys of the various ordinal columns to the next adjacent respective ordinal columns either to the left or right thereof, and means for predetermining the direction of shift of the divisor or multiplicand represented by partially depressed keys.

9. In a power-driven, normally key-responsive calculating machine having an accumulator mechanism and actuating mechanism therefor responsive to denominational orders of depressible digit keys, latching means for maintaining said keys depressed in entering a divisor or multiplicand in partially depressed key-set position, means for controlling said latching means, means for automatically depressing said partially depressed keys completely and repeatedly, means for causing release of said partially depressed keys and for causing the partial depression of digit keys of corresponding value in adjacent denominational orders of higher or lower denominational value, means for determining the direction of shift of the denominational setting of the divisor or multiplicand, and means for locking said control means in ineffective position to recondition said machine for key-responsive actuation, and prevent the maintenance in partially depressed position of any digit keys subsequently depressed.

10. In combination in a calculating machine, a multi-denominational accumulator, a multi-denominational actuator therefor, denominational rows of depressible keys to determine the extent of movement of said accumulator, detent means for holding keys partially depressed, means for sensing which key in one row has been partially depressed, for effecting partial depression of a key of corresponding value in an adjacent

row, and for releasing the first mentioned partially depressed key, and means for completely and repeatedly depressing the partially depressed keys in all denominational rows.

11. In a calculating machine having a multi-denominational accumulator and a multi-denominational actuator therefor, the combination with denominational rows of depressible keys to determine the extent of operation of said accumulator, said keys normally being reciprocable between the extremes of an initial elevated position and a completely depressed position, of detent means settable to engage every key thereafter depressed for releasably holding it in a partially depressed position, each such key so held being reciprocable between said partially depressed position and said completely depressed position to control the operation of said accumulator, and means for setting said detent means.

12. In a calculating machine having a multi-denominational accumulator and a multi-denominational actuator therefor, the combination with denominational rows of reciprocable keys, of means for limiting movement of said keys between two extreme positions, means engageable with said keys to hold them at a position intermediate said extreme positions for limiting movement of said keys between the intermediate position and one of said two extreme positions, said keys being adapted to determine the extent of operation of said accumulator both when they are reciprocated between said two extreme positions and when they are reciprocated between said intermediate position and the said one of said extreme positions, and means for selectively predetermining the limiting means to be effective in determining the extent of reciprocation of said keys.

13. In a calculating machine having a multi-denominational accumulator and a multi-denominational actuator therefor, the combination with denominational rows of reciprocable keys to determine the extent of operation of said accumulator, of selectable key-movement control means for rendering said calculating machine subject to either key-responsive actuation or key-set actuation, selector means for selecting said selectable key-movement control means to set the machine for key-responsive actuation and key-set actuation selectively, and means for effecting reciprocation of a key in one row under control of a previously moved key of corresponding value in an adjacent row when said machine is set for key-set actuation by said selector means.

14. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, a multi-denominational accumulator actuator including denominational elements respectively responsive to the ordinal columns of digit keys; settable latching means for holding said digit keys in partially depressed position subsequent to the depression and rising of the keys to such position as to allow the denominational accumulator actuator elements to return to normal position, ordinal key lock latches preventing the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed position, means manually operable to repeatedly and completely depress the digit keys held in partially depressed position by said latching means for operating the respectively corresponding elements of said multi-denominational accumulator actuator once for each such key depression in accordance with the values of the depressed keys, and trans-setting means manually controlled to collectively partially depress respectively corresponding digit keys in the respectively next adjacent ordinal columns of digit keys to each of those wherein a key is held in partially depressed position by said latching means for trans-setting the key values of partially depressed keys in each of a number of ordinal columns of keys to the respectively next adjacent columns of keys.

15. In a calculating machine having a plurality of ordinal columns of depressible digit keys, a multi-denominational accumulator, and a multi-denominational accumulator actuator including denominational elements respectively responsive to the ordinal columns of digit keys and permanently aligned with respectively corresponding denominational orders of said accumulator; settable latching means for holding said digit keys in partially depressed position, ordinal key lock latches preventing the simultaneous depression of more than one digit key in any ordinal column sufficient to be held by said latching means in partially depressed position, manually operable means for repeatedly and completely depressing the digit keys held in partially depressed position by said latching means whereby to cause said actuating means to respond to repeated depression to add the values corresponding to the keys so depressed, and mechanical means manually controlled to partially depress respectively corresponding keys in the ordinal columns respectively next adjacent to each of those wherein a key is held in partially depressed position by said latching means for trans-setting the key values of partially depressed keys in each of a number of ordinal columns of keys to the respectively next adjacent columns of keys to the left or right.

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