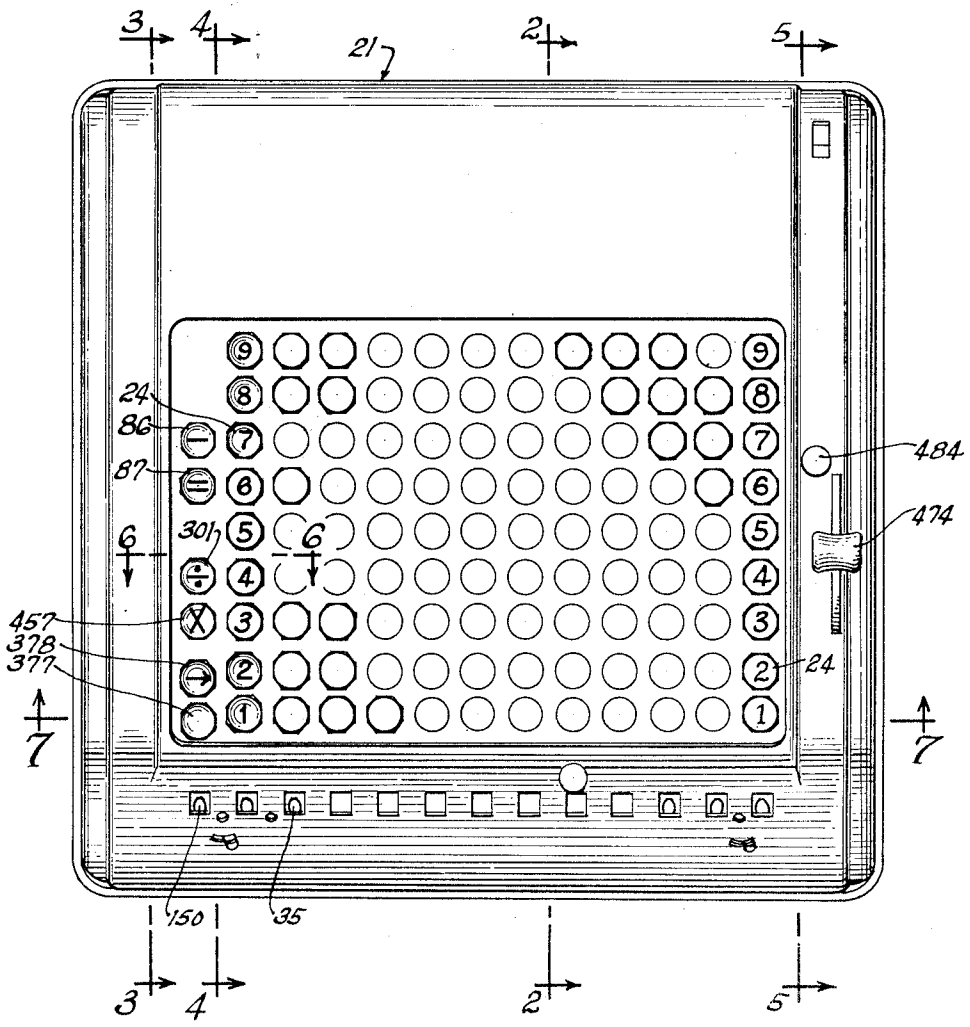
May 4, 1954 J. M. LAIHO 2,677,500

CALCULATING MACHINE

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Fig. 1



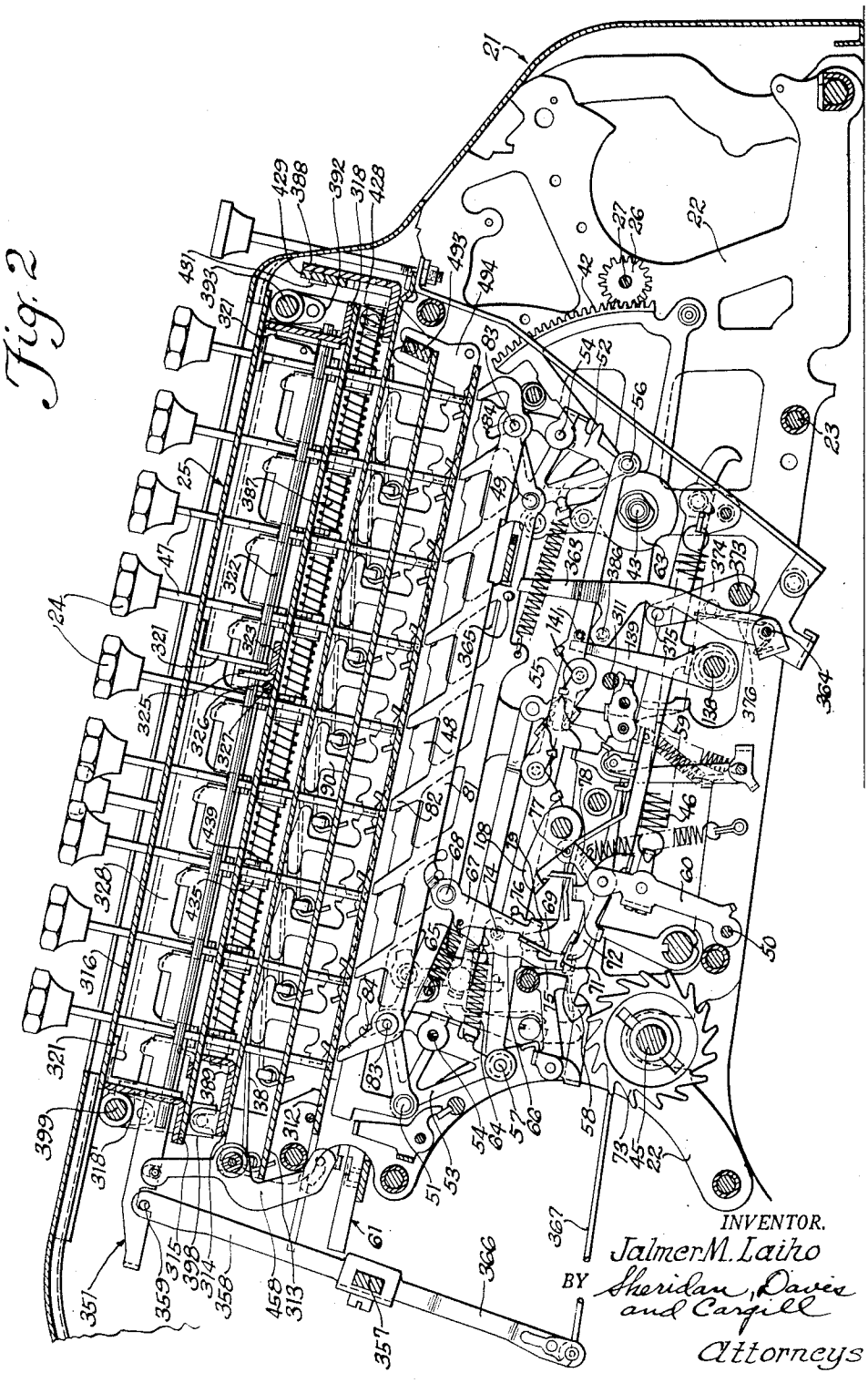
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Fig. 2



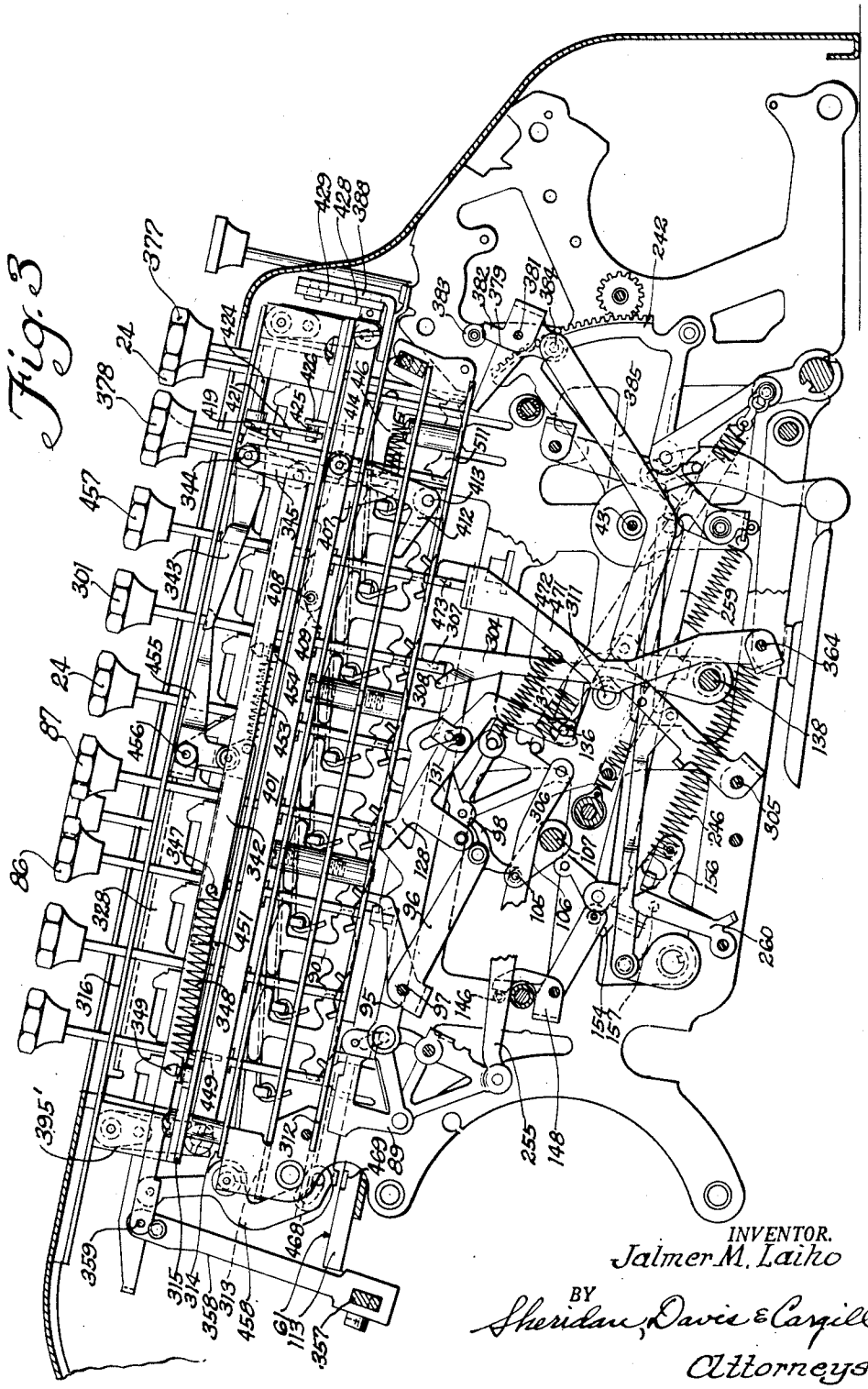
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Fig. 3



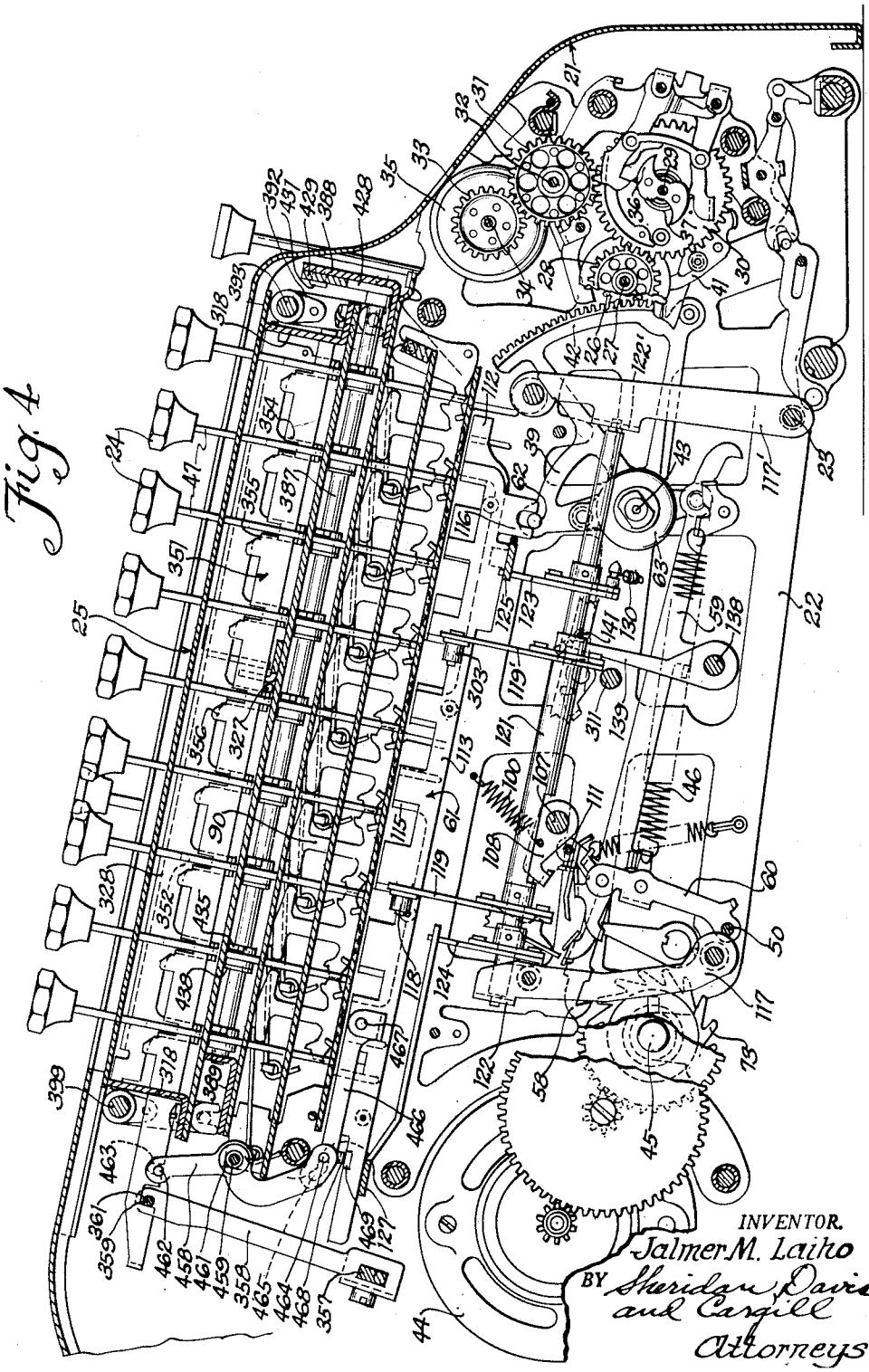
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Fig. 4



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Fig. 5a

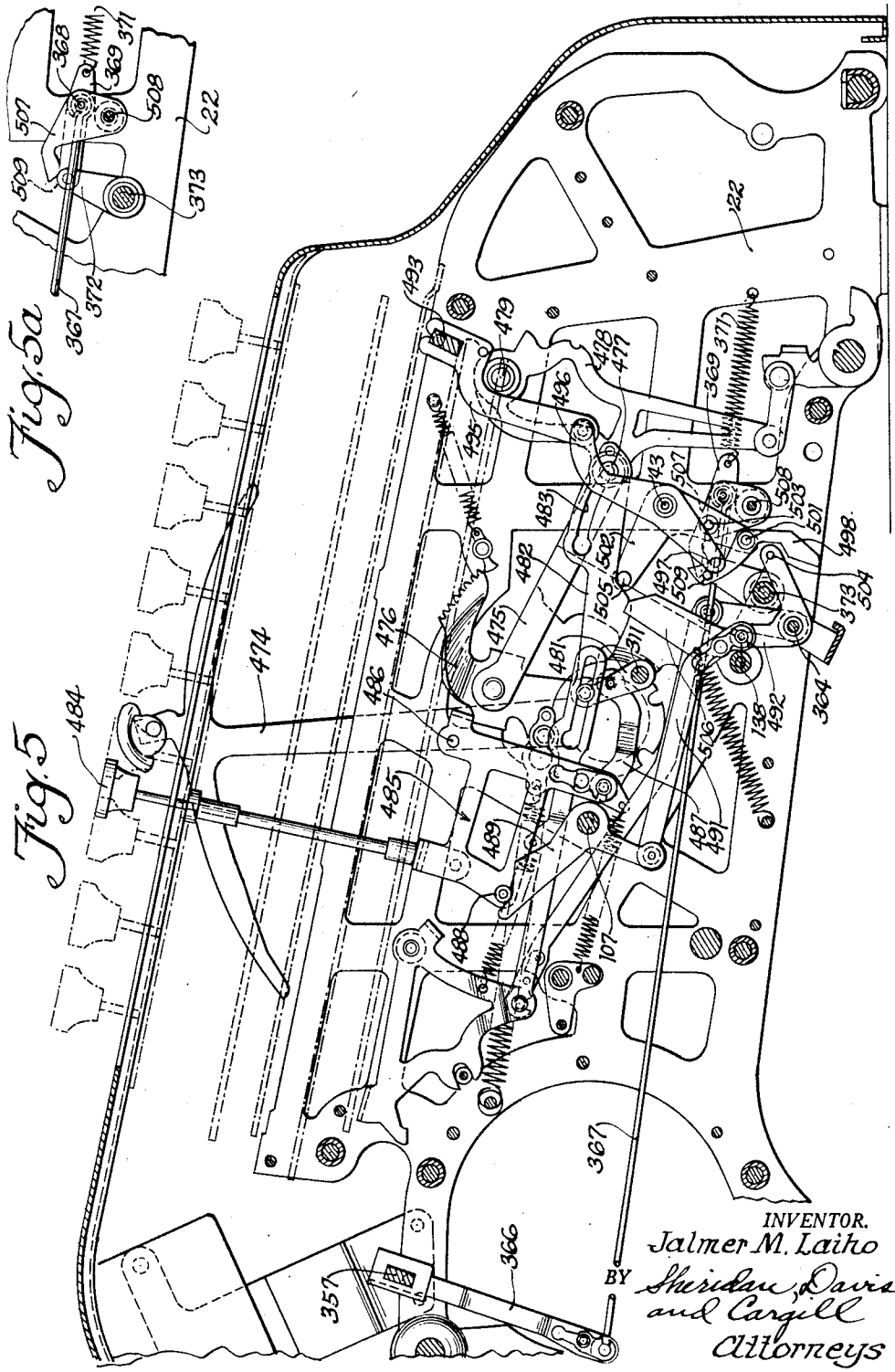


Fig. 5

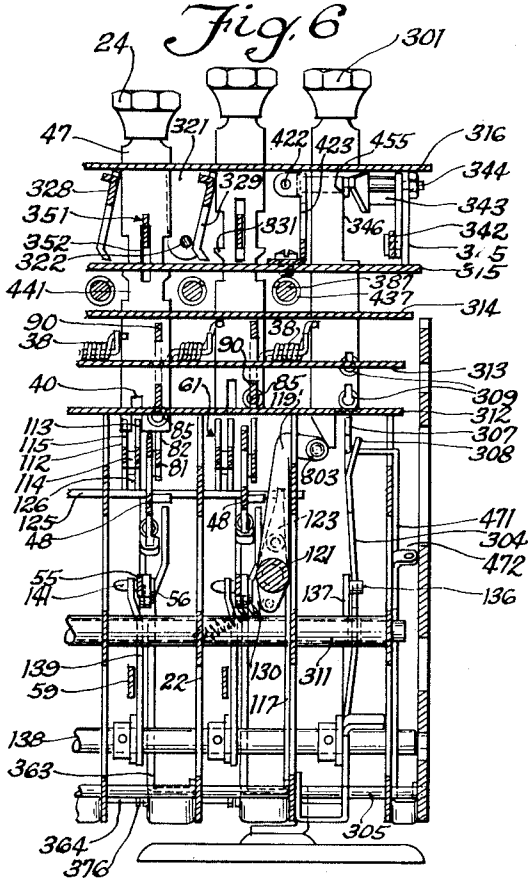
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Fig. 6



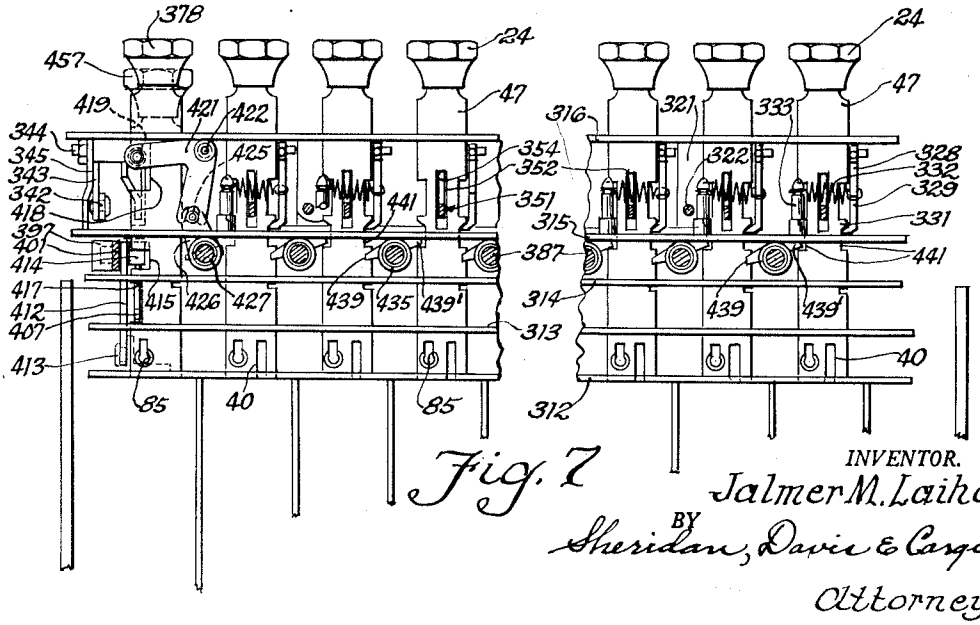


Fig. 7

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Fig. 8

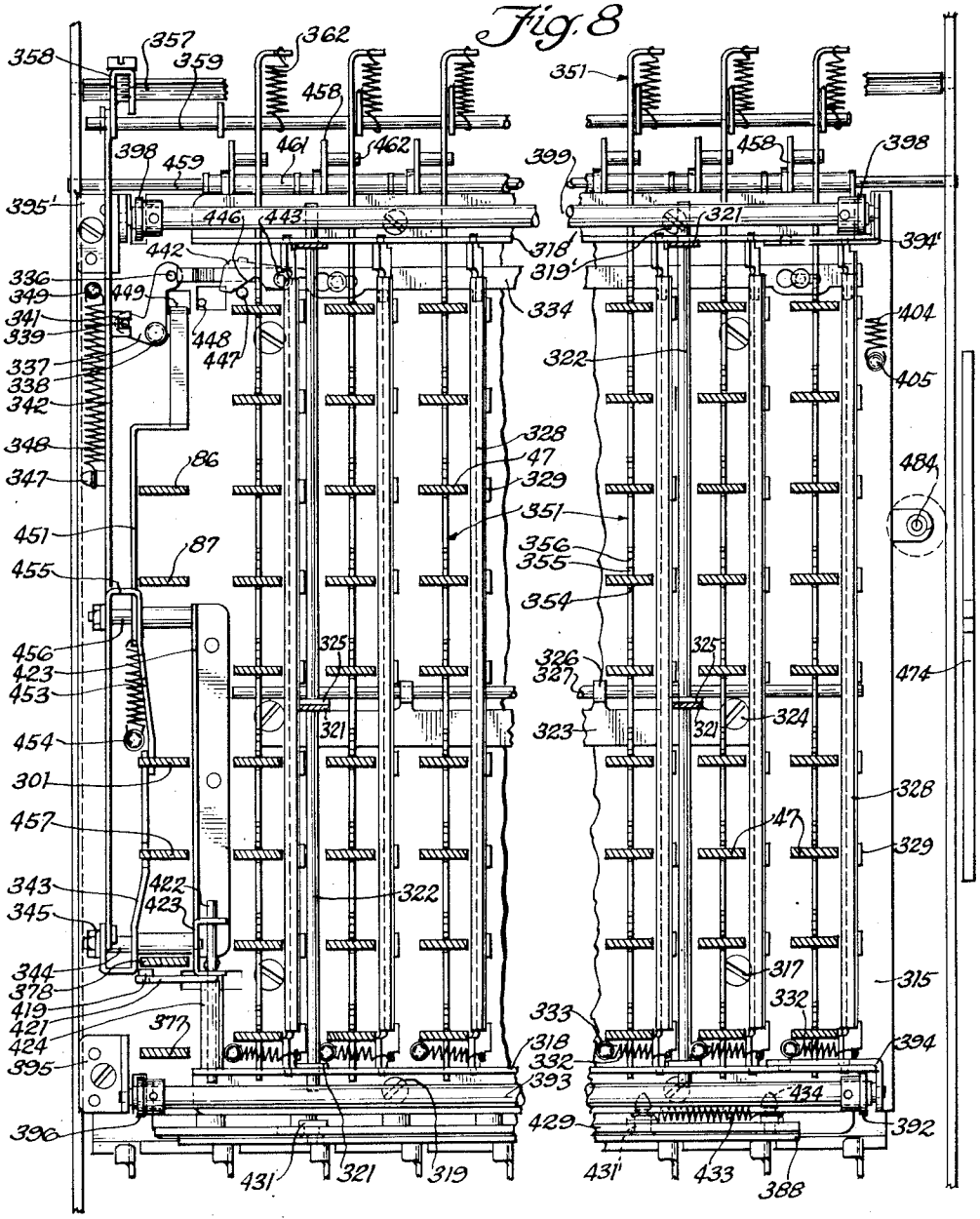
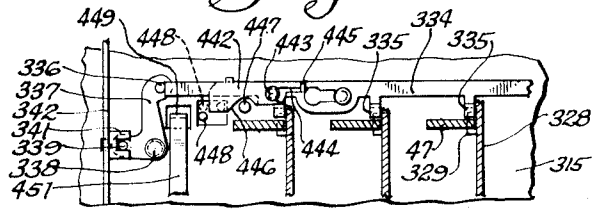


Fig. 8a



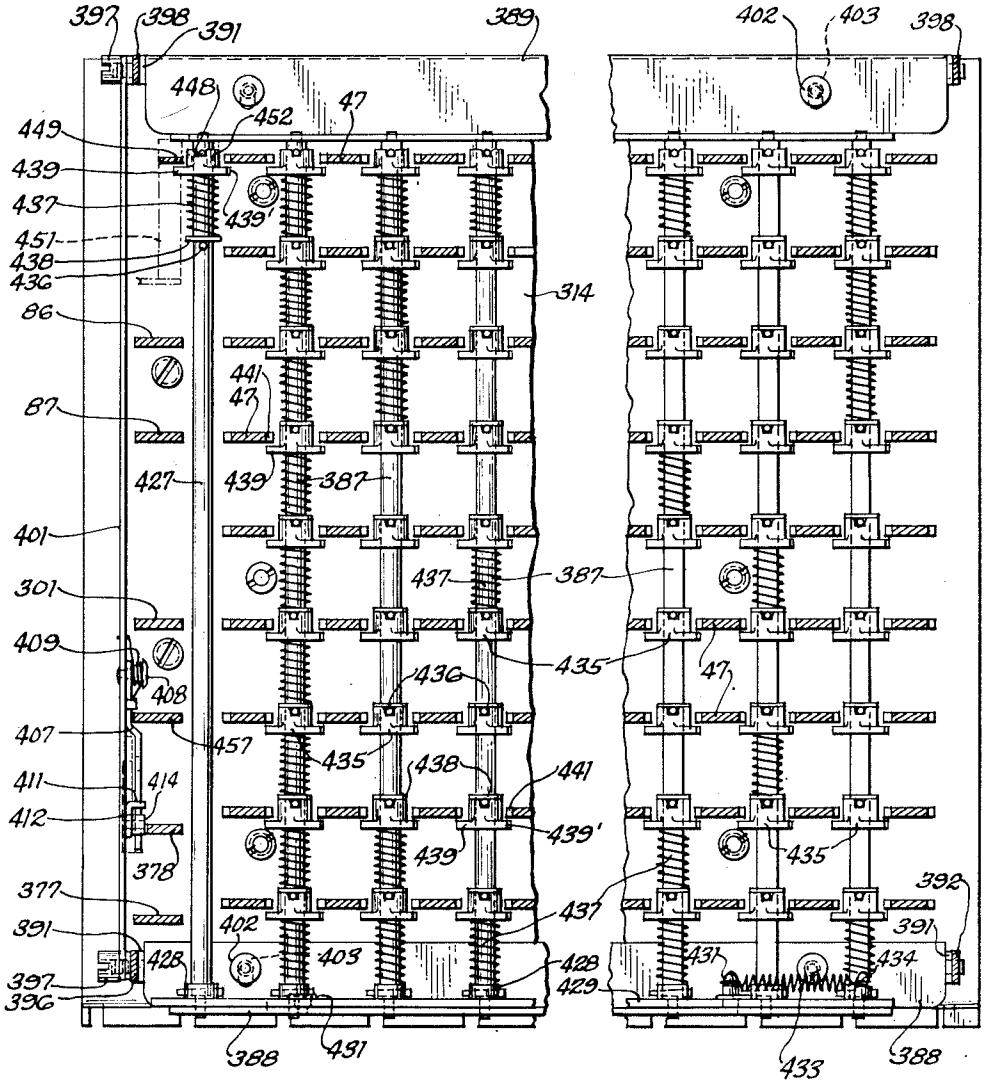
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Fig. 9



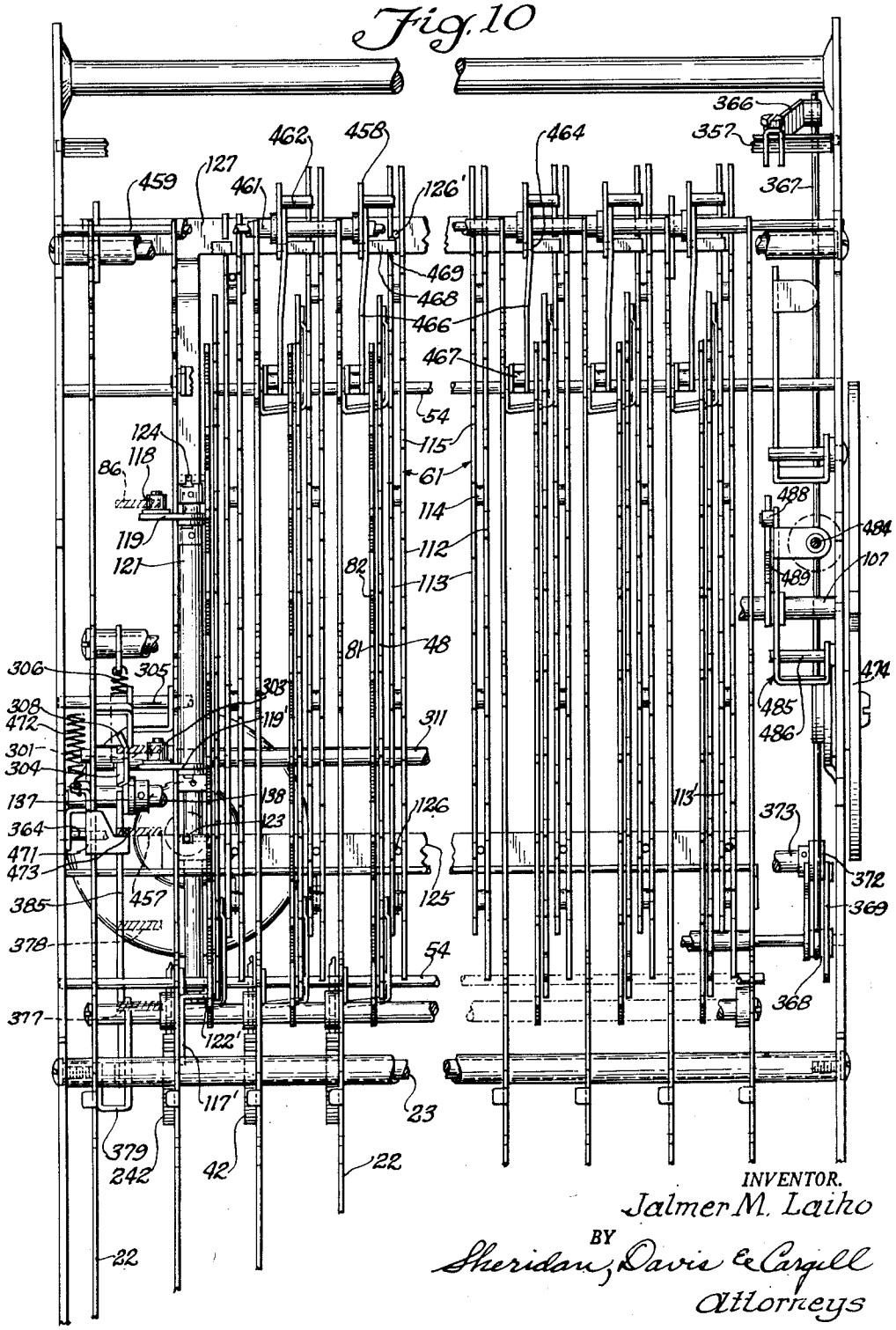
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CALCULATING MACHINE

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Fig. 10



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Fig. 11

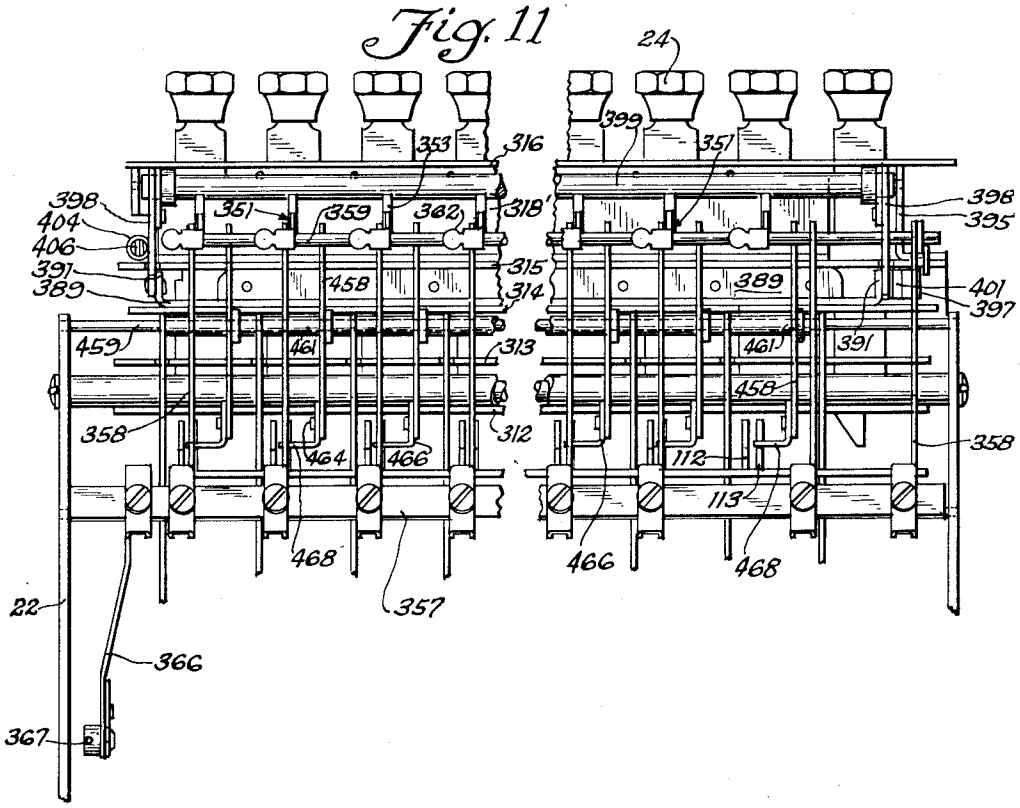
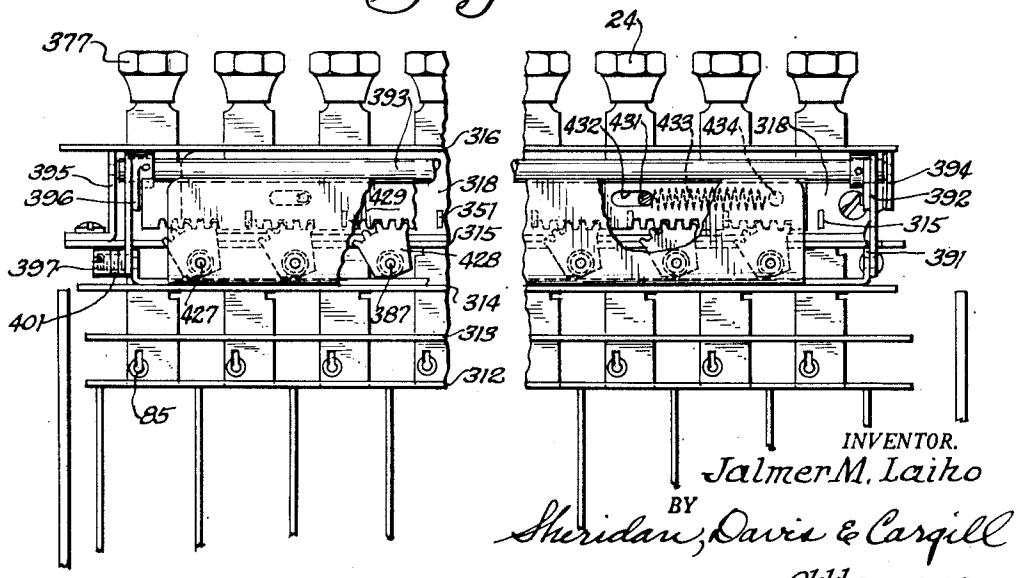


Fig. 12



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Patented May 4, 1954

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UNITED STATES PATENT OFFICE

2,677,500

CALCULATING MACHINE

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Application December 5, 1951, Serial No. 259,929

30 Claims. (Cl. 235—82)

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This invention relates in general to calculating machines, and more particularly to normally key-responsive calculating machines having unidirectional accumulator actuating mechanism.

Briefly, the principal object of the instant invention is to facilitate the performance of all types of calculations with such machines, and particularly the repeat forms of calculation, such as division and multiplication.

With prior machines of this type, such as that shown in United States Letters Patent No. 2,063,962, issued December 15, 1936, and generally in substantially all machines having actuating mechanism adapted to drive the register or accumulator mechanism in one direction only, subtraction is performed by a process of complemental addition, the digit keys being provided with suitable indicia designating both their true values and the nine's complements thereof, and selectively operable carry cut-out mechanism being included, as is well understood in the art, to enable such operations. Multiplication is accomplished with such machines by repeated depressions of digit keys representing the multiplicand, with the necessary lateral shifting of such operation to the denominational orders dictated by the multiplier, and the performance of division requires generally similar operations, using the complemental digit indicia, and governed by somewhat more complicated rules of procedure.

The performance of subtraction with such machines has been simplified by the mechanism disclosed in my prior United States Letters Patent No. 2,410,823, issued November 12, 1946, wherein the complemental marking of the digit keys is dispensed with, and the operator may proceed in a manner similar to that employed in longhand subtraction and with machines having reversible actuator mechanism. This is accomplished in the machine of Patent No. 2,410,823 by the provision of normally inoperative complemental stop bars, subtraction control means including a "minus" key settable to render the complemental stop bars operative and to render the normally key-responsive actuating mechanism key-set, and another control means manually operable by depression of an "equals key," after the depression of those digit keys representing a subtrahend, to cause actuation of the machine to enter the true complement of such subtrahend in the accumulator, including the automatic entry of "9's" in all denominational orders in which no digit keys were depressed and of "10" in the units order if no digit key was depressed therein. Since depression of this

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"equals" key also causes automatic return of the subtraction control means and the "minus" key to normal inoperative position, to condition the machine for additive actuations, the performance of problems in division is not facilitated with the machine of Patent No. 2,410,823.

Simplified means for performing division therefore were incorporated in such a calculating machine, in addition to the subtraction mechanism of Patent No. 2,410,823, as fully illustrated and disclosed in my prior United States Letters Patent No. 2,492,703, issued December 27, 1949, and No. 2,430,575, issued November 11, 1947. These latter machines include division mechanism settable to cause the entry of the true complement of a divisor into the accumulator, upon depression of the digit keys representing the actual figures of the same, as well as a resultant automatic entry of "9's" in all denominational orders where no keys were depressed to the right only of the leftmost or highest order of the divisor, except in the units order, in which "10" is added if no digit key was depressed therein. However, they require repeated manual depressions of those digit keys representing the divisor, including the lateral or trans-denominational shifting by the machine operator of the particular "finger-holding" corresponding to such divisor, as determined by the specific problem being performed. Similar repeated depressions of a plurality of digit keys representing a multiplicand, in accordance with the digital values of a multiplier, including lateral or trans-denominational shifting of the particular finger-holding arrangement dictated by the specific multiplicand, likewise are required in performing multiplication problems in all of the prior machines hereinbefore enumerated.

In my prior United States Letters Patent No. 2,430,574, issued November 11, 1947, I have provided means to facilitate the performance of repeat types of calculations, namely, multiplication and division, in key-responsive machines, which comprises manually settable mechanism for conditioning the machine for key-set crank operation, whereby those digit keys which are depressed to represent a multiplicand or divisor are retained in partially depressed position for subsequent complete depression, for the desired number of times, in response to actuation of an operating crank. In this prior machine of Patent No. 2,430,574, manual control members also are provided which are selectively operable to effect lateral shifting of the divisor or multiplicand "key-setting" from one denominational position

on the keyboard to a denominationally adjacent position thereon in either direction, depending upon whether division or multiplication is being performed. However, since the machine of Patent No. 2,430,574 has no complemental stop bar or digital control mechanism, it requires division to be performed in similar manner to its performance with the older mechanism of Patent No. 2,063,962, dispensing only with the previously required "finger-holding" of the divisor complement.

A principal object of the instant invention is to provide a calculating machine of the normally key-responsive type, having unidirectional actuating mechanism, in which the performance of repeat types of calculations is greatly facilitated, and this is accomplished by employing some of the mechanism of the prior machines referred to hereinbefore and by adding other novel mechanisms which both make possible the use of such old mechanisms and further simplify the work of the operator. More specifically, the performance of problems of addition and subtraction is accomplished in the same manner as in my prior Patent No. 2,410,823, but the performance of problems in multiplication and division has been greatly simplified in comparison with the methods required to be used in any of the machines of the cited patents. With the machine of the instant invention, multiplication is performed simply by conditioning the machine for such operation by depressing a suitable multiplication control key, entering the multiplicand on the keyboard, and repeatedly adding the multiplicand into the accumulator in response to repeated depressions of an operations control key and of a single shifter key for shifting the multiplicand keyboard setting to different denominational positions, both as dictated by the value of the multiplier. Problems in division similarly may be performed by use of a division control key, instead of the multiplication control key, and the same operations control key and shifter key.

Another important object of the invention is to eliminate the possibility of misoperation of an optionally key-responsive or key-set calculating machine by providing normally inoperative ordinal slide bars that are moved to operative position, in response to the setting of the machine for key-set operation, to positively block and limit the degree of movement which subsequently may be imparted to any digit key to an extent insufficient to effect key-responsive actuation of the machine thereby.

In my prior Patent No. 2,410,823, no such key-blocking means is employed when the machine is set for key-set actuation, the digit keys then being permitted their normal full extent of depressive movement. The function of preventing resultant digital actuation of the accumulator in that prior machine is performed by rotation of a transverse shaft by the "minus" key, which shaft carries a locking arm in each denominational order thus engaged with the actuator hook in that order that otherwise would be engaged with the constantly rotating toothed wheel of the actuator mechanism, upon digit key depression, so as to prevent such hook and wheel engagement when a digit key is depressed. The machine of my prior Patent No. 2,430,574 is always key-responsive in operation. Even though depressed digit keys are latched in partially depressed or key-set position for multiple types of calculation in the latter machine, subsequent operation of the actuating mechanism is effected by complete depression of such keys, which is accomplished by rotating the operations crank. In my other cited prior Patents No. 2,430,575 and No. 2,492,703, the key-latching mechanism of No. 2,410,823 is employed for subtraction calculations, and the machines are key-responsive in operation when performing problems in division.

In the instant machine, however, the above-mentioned normally inoperative ordinal slide bars are moved to operative position by depression of a multiple operations control key (either the "division" or the "multiplication" key), and then positively limit depressive movement of any digit key to an extent less than that required to effect operation of the actuating mechanism. At the same time, normally inoperative key-latching means are rendered operative to retain depressed digit keys in key-set position to determine the digital extent of subsequent operations of the actuating mechanism. The latter operations are effected by a manually depressible operations key.

Another object of this invention is to positively prevent operation of the actuating mechanism in such a machine, when the same is conditioned for key-set operation, in response to excessively sharp or hard depression of the digit keys. Despite the positive limiting of the permissible extent of movement of the digit keys by the ordinal slide bars, as enumerated above, which prevents key-responsive actuation in normal operation of the keys when the machine is conditioned for key-set operations, the nature of the mechanism of this type of machine is such that the application of an excessively sharp depressive force to a digit key can impart sufficient momentum to its associated parallel motion mechanism, or accumulator actuation initiating member, as to effect operation of the accumulator actuating mechanism. Consequently, this object of the invention is attained by providing a normally inoperative member in each denominational order, all of which are moved to operative position in response to depression of a multiple operations control key for conditioning the machine for repeat forms of calculations, whereby such members are disposed in movement-blocking relationship relative to their associated accumulator actuation-initiating members or parallel motion mechanism.

A further object of the invention is the provision of means for rendering these movement-blocking members ineffective in response to subsequent actuation of the operations control key, in order to permit proper operation of the accumulator actuating mechanism in response to depression of the operations control key.

Another object of this invention is the provision of such a calculating machine in which multiple or repeated accumulator actuations may be effected to perform both division and multiplication problems, after the specific multiplicand or dividend and divisor have been set up in the machine, by use only of a depressible operations control key and, when required, lateral or transordinal shifting of the keyboard setting representing the divisor or the multiplicand by depression of a shifter key, and in which these same two keys are used in both of these types of multiple calculations. The resulting simplification of the performance of both positive and negative repeat forms of calculations in a machine having a uni-directional actuator is accomplished to a large extent by having each depression of such operations control key effect operation of the power trip bars in all denominational orders,

while rendering such operation of the power trip bars ineffective to actuate the accumulator during the performance of multiplication problems only, except in those denominational orders in which a digit key has been depressed and latched in key-set position.

Thus a further object of the invention is the provision, in a calculating machine having a yieldable clutch interposed between a power actuated member and a movement controlling member or stop bar and accumulator actuator in each denominational order, the digital extent of movement of the stop bar being determined by the digit keys, of means actuated by depression of a multiplication control key for locking all of the movement controlling members or ordinal stop bars against movement, such locking means thereafter being released in any denominational order in which a digit key is depressed. More specifically, these stop bar locking means are connected to the ordinal slide bars which limit depressive movements of the digit keys, and are engaged with their associated stop bars upon movement of the ordinal slide bars in one direction to operative position by the multiplication control key, and disengaged from the stop bars upon movement of the ordinal slide bars in the opposite direction in lesser degree by subsequent depression of an associated digit key. And, while depression of the division control key also moves the ordinal slide bars to an intermediate position, such movement thereof is less than that effected by the multiplication control key and insufficient to cause engagement of this locking means with the stop bars or movement controlling members.

A further object of the instant invention, therefore, is the provision in such a calculating machine of normally inoperative ordinal slide bars that are moved in one direction to an intermediate operative position by depression of a division control key to positively limit subsequent depressive movements of the digit keys, and that are moved in the same direction to a further extent to a second or full operative position by depression of a multiplication control key, wherein subsequent depression of the digit keys will move their associated ordinal slide bars in the opposite direction to such intermediate operative position.

Another object of this invention is to insure proper registration of the quotient in the accumulator in such a calculating machine when division problems are being performed. With the instant mechanism, as so far described herein, each subtraction of a divisor during a division calculation is accomplished by the depression of the operations control key and comprises the addition to the dividend registration in the accumulator of the nine's complement of each digit of the divisor, as set in the keyboard, and the ten's complement of the lowest or unitary digit of such divisor, together with the entry of "9's" in all denominational orders of the machine higher than that in which the highest denominational digit of the divisor is located in such keybaord setting and in those orders in which no digit keys are depressed corresponding to zeros in the divisor. This is accomplished by automatically entering "9's" in all denominational orders of the machine, except those in which digit keys are set representing digital values of the divisor, and except in the units order of the machine in which "10" is added or the ten's complement of the corresponding value of any digit key which may be depressed in the units order. The result of such operation would be the accumulation in the overflow order of the accumulator of the total number of times that the operations control key is depressed to effect a division calculation. Consequently, in order to register a proper quotient in the accumulator, it is necessary to prevent such automatic entry of "9" in the highest denominational order of the machine following the first depression of the shifter key, and in each successively lower denominational order following each subsequent successive depression of the shifter key. This object of the invention therefore is attained by providing mechanism which is moved to operative position upon depression of the division key and which causes each subsequent depression of the shifter key to effect depression of the "nine" digit key in the highest denominational order of the machine.

Another object of the invention, which is attained with this same mechanism, is to cause the quotient always to be registered in the leftmost portion or highest denominational orders of the accumulator, with its highest ordinal digit in the overflow order, regardless of the particular ordinal location of the dividend in the accumulator. Accurate and rapid reading of the quotient by the machine operator is thus facilitated, and maximum ordinal separation of the remainder therefrom may best be obtained to further insure the greatest possible accuracy in such reading of the quotient and the remainder, both during, and upon completion of, any division calculation.

A further object is to improve the keyboard setting shifting mechanism in such a machine so as to reduce the resistance offered thereby to the depression of the shifter key by the machine operator.

Another object of the invention is to insure proper operation of the machine in all types of calculations by providing novel interlocking mechanisms requiring that sequence of operation peculiar to each type of calculation upon actuation of the particular control member that conditions the machine for use for each particular type of calculation.

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 the features of the instant invention;

Fig. 2 is a longitudinal, vertical section taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal, vertical section, as seen from the left side of the machine and taken substantially on the line 3—3 of Fig. 1, and showing the several operation control keys;

Fig. 4 is a sectional view similar to Fig. 3, taken substantially on the line 4—4 of Fig. 1, showing the highest denominational order of the keyboard mechanism and the actuator and accumulator mechanisms;

Fig. 5 is a longitudinal, vertical section taken substantially on the line 5—5 of Fig. 1 at the right side of the machine, and showing the cancelling crank or zeroizing lever and the key-set interlocking mechanism associated therewith;

Fig. 5a is a detail view of a portion of the mechanism shown in Fig. 5 illustrating the connection between the key-set conditioning mechanism and the power trip bar blocking means rendered operative thereby;

Fig. 6 is a transverse sectional view taken substantially on the line 6—6 of Fig. 1, and showing the division control key and associated mechanism, as seen from the rear of the machine;

Fig. 7 is a transverse vertical section taken substantially on the line 7—7 of Fig. 1, and showing the keyboard mechanism as seen from the front of the machine from a point adjacent the #1 digit keys;

Fig. 8 is a top plan view of the keyboard mechanism, with parts broken away and the key stems shown in section, as seen from a point directly below the uppermost key plate;

Fig. 8a is a detail plan view of part of the control mechanism of Fig. 8, showing the same in the position assumed with the machine set for the performance of multiplication or division;

Fig. 9 is a view similar to Fig. 8, as seen from below the second-from-the-top key plate, showing the digit key setting shifter mechanism;

Fig. 10 is a plan view, similar to Fig. 8, as seen from the top of the machine with the keyboard mechanism removed;

Fig. 11 is an elevational view of the keyboard and associated control mechanism, with parts broken away, as seen from the rear of the machine; and

Fig. 12 is an elevational view of the keyboard mechanism, with parts broken away, as seen from the front of the machine at a point disposed forwardly from the plane of Fig. 7.

Referring more particularly to the drawings, the present invention is illustrated as being incorporated in a power driven, key-responsive calculating machine generally similar to those of the prior patents referred to hereinbefore. As in Patent No. 2,063,962, the calculating machine is shown as having an outer casing 21 within which its various instrumentalities 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 (Fig. 2). A plurality of columns of digital keys 24, normally held in raised position by means of individually associated springs 38, are arranged to extend through the keyboard, indicated generally by reference numeral 25. The digit keys 24 are adapted for depression to determine the digital degree of actuation to be imparted to their associated denominational orders of the accumulator mechanism. Each column of keys 24 thus controls the rotation of an accumulator actuating pinion 26 (Fig. 2) journaled upon a transverse shaft 27 that extends across the machine and is supported by the skeleton frame members 22. Rotation of each of the actuating pinions 26 is transmitted through an internal ratchet mechanism to a combined lantern wheel and accumulator gear 28 (Fig. 4) which is also journaled on the shaft 27. The gear of the lantern wheel 28 meshes with a carrying gear 30 journaled on a shaft 29 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 intermediate gear in turn meshes with a numeral wheel pinion 33 journaled on a transverse shaft 34 and fixed to a numeral wheel 35.

Carrying mechanism is provided in each denominational order of the accumulator 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 is more fully disclosed in United States Letters Patent No. 1,357,747 and No. 1,357,748, issued November 2, 1920, and includes a carrying-cam member 36 (Fig. 4) 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 Fig. 4. Such swinging of the carrying-lever causes a carrying pawl 41 (Fig. 4) 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 actuation of each accumulator actuating pinion 26 normally is accomplished upon depression of a digit key 24 in the corresponding denominational order by a gear sector 42 (Figs. 2 and 4) meshing with the pinion 26. The gear sectors and the control and actuating mechanism for them are duplicated for each denominational order of the calculating machine, so that a general description of a single set of such mechanism will be sufficient for an understanding of all of them. The several gear sectors 42 are rotatably mounted upon a transverse shaft 43, and are adapted to be moved downwardly on an idle or setting stroke to an extent normally determined by the value of the particular digital key 24 of the associated column which is depressed. In addition to their function of determining the extent of digital actuation to be imparted to their associated gear sectors 42, the digit keys 24 normally act through a power trip mechanism to effect a connection whereby power supplied by an electric motor, indicated generally at 44 (Fig. 4), through a power shaft 45, which is connected to the motor in any desired manner, is effective to extend a power spring 46 associated with the particular order with which the depressed key 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 digit accumulation to the adding mechanism upon its return movement, which is accomplished by the associated spring 46.

In such normal key-responsive operation of this machine, depression of a key 24 causes its stem 47 to engage a parallel motion bar 48 (Fig. 2) which is pivoted at the front of the machine 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 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 Patent No. 2,063,962. Each of the gear sectors 42 is articulately connected to a hook 58 by a link 59 through a yielding clutch 63, the hook 58 and the link 59 being articulately connected to a substantially vertical guide member 60, which, in turn, is pivotally mounted on a transverse shaft 50. Each gear sector 42 also is articulately connected to a movement controlling bar, generally indicated by reference numeral 61 (Fig. 4) by a pin 62 fixed to an arm

39 of the gear sector 42. A spring 64 (Fig. 2), attached to lever 53 and a tail piece 65 of a latch member 66 carried by the bar 55, normally contributes toward holding the parallel motion device in elevated position, and also holds the latch member 66 in a forward position for a purpose which will be explained presently. 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 shelf 71 on a spring lifted lever 72 pivotally mounted on the guide member 60 with the hook 58. The operation of these parts is such normally that upon depression of a key 24, its stem 47 engages and depresses the bar 48 to impart motion to the parallel motion device, which carries dog 67 downwardly to depress the 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 (left end in Fig. 2) downwardly, so that it will normally cause engagement of the hook 58 with a toothed wheel 73 upon depression of lever 72. However, this spring connection between hook 58 and lever 72 will permit movement of the latter by the dog 67 relative to the hook, if the hook is restrained in its normal raised position of Fig. 2 in a manner to be later described. The toothed wheel 73 is secured to the power shaft 45, which continually turns in a counter-clockwise direction (viewing Fig. 2). 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 vertically therefrom, as will be more fully described hereafter, is stopped by the stem 47 of the depressed key 24.

The rearward motion of hook 58 and link 59 causes the guide arm 60 to swing in a counter-clockwise direction from its normal position of Fig. 2 to extend the spring 46, one end of which is connected to this guide arm and the other end to a transverse shaft extending through the partition plates 22. The link 59 moves the gear sector 42 downwardly on an idle stroke in response to such swinging of the guide arm 60 and into position to impart an adding movement to the accumulator upon release of the hook 58 and contraction of the spring 46. The downward movement of gear sector 42 normally is under the control of the digital control bar 61 (Fig. 4), 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 24 depressed. The yielding clutch 63 permits the continuation of the rearward movement of 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 from the toothed wheel 73. The release of 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 42, the yielding clutch 63 permits relative movement of the parts in reverse direction to that at 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 normally 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 73, which means comprises latch member 66 (Fig. 2) which is pivoted at 74 on link 55. This latch member 66 has an arm 75 which is adapted to engage upon a laterally projecting end 76 of the dog 67 to hold the dog down against upward return movement and also to hold 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 the vertical guide member 60, which through its connection with hook 58 has been carried rearwardly, engages a finger 79 of latch member 66 and frees the dog 67 so that the parallel motion device may return to normal raised position.

In this operation, the digit key 24 which has been operated is held depressed until release of the hook 58 from the toothed wheel 73, when the key will be released and returned to normal raised position by its spring 38. A bar 81 (Fig. 2) having rearwardly extending, pointed locking lugs or teeth 82, is pivoted upon studs 83 extending through slots 84 in bars 48 in each denominational order of the machine. Consequently, upon depression of a key 24, the bar 81 is moved rearwardly (to the left viewing Fig. 2) relative to the stems 47 of its associated digit keys 24. Referring more particularly to Fig. 7, it will be seen that each key stem 47 is provided adjacent its lower end with an aperture 85 extending therethrough which is vertically aligned with the associated bar 81 (Fig. 6) and into which a tooth 82 enters in such rearward movement of the bar 81, thus holding the key down until the parallel motion device is released and the parts are returned to normal elevated position. It will be understood that no two digit keys 24 of the same column or denominational order may be operated simultaneously by virtue of a plurality of anchor-shaped locking members 90 (Figs. 2 and 6), which are disposed between adjacent key stems 47 in each denominational order and are rocked into locking engagement with the adjacent keys through the medium of the apertures 85, upon depression of any one key in that order. This key locking mechanism is fully described and illustrated in United States Letters Patent No. 2,043,021, issued June 2, 1936. Full depression of any other key in the same order, until the depressed key is returned to normal position to release these locking members, is thus prevented. Very limited downward movement of a key 24 is allowed, however, even though another key of that order is in a partially depressed position, for a purpose which will be explained in detail hereinafter. It will be understood, of course, that any digit key 24 of one order may be operated at the same time as any other desired key of any other denominational order or orders.

Rather than being key-responsive in operation, as above described for performing addition, the instant mechanism is optionally operable as a key-set machine for the performance of subtraction problems. The means for rendering the machine key-set for subtraction also provides for automatically entering the ten's complement of the subtrahend into the accumulator, since the instant accumulator actuator is uni-direc-

tional only in operation, and this subtraction mechanism is the same as that fully illustrated and described in my previously cited Patent No. 2,410,823. As shown in detail therein, the subtraction control mechanism comprises a "minus" control key 86 and an "equals" control key 87 (Figs. 1 and 3). After entry of the minuend into the numeral wheels 35 of the accumulator in response to depression of the proper digit keys 24, or whenever it is desired to subtract some value from that registered in the accumulator, it is necessary only to depress the "minus" key 86, set the subtrahend into the keyboard by depressing the proper digit keys 24, and actuate the "equals" key 87. Means are provided, which are fully illustrated and described in Patent No. 2,410,823, for insuring proper sequential operation of these parts by latching or holding the "minus" key in depressed position, causing its automatic release upon actuation of the "equals" key 87, and preventing depression of the latter unless the "minus" key 86 first is depressed.

Upon depression of the "minus" key 86, a lever 95 (Fig. 3) is swung in a clockwise direction about its pivot 97 to move a pawl 93 carried thereby downwardly, which acts upon a pin 105 in an arm 106 secured to a transverse rock shaft 107 to impart a counterclockwise movement to this shaft 107. Securely fastened to rock shaft 107 in each denominational order of the machine is a lock arm 108 (Fig. 4) which, upon such counterclockwise rotation of shaft 107, is adapted to engage an associated vertical lug 111, one of which is formed on each of the hook members 58. The lock arms 108 normally are held in their upper disengaged position of Fig. 4 by a spring 109. But they are maintained in engagement with the lugs 111 of the hooks 58 upon depression of the "minus" key 86 and until release thereof in response to actuation of the "equals" key 87. While lock arms 108 are so engaged with lugs 111, the depression of any of the digit keys 24 obviously cannot cause engagement of the associated hook 58 with its rotating toothed wheel 73, but any digit key then depressed will be latched and retained in such depressed or key-set position until released in response to actuation of the "equals" key 87. As previously explained, depression of a digit key 24 will cause its associated dog 67 to depress lever 72, and the spring connection between the latter and its hook 58 will enable such operation to take place without causing engagement of hook 58 with toothed wheel 73 when the hook is restrained by its lock arm 108. However, the depressed key 24 will be latched in key-set position by virtue of latch member 66 engaging dog 67 to hold the associated parallel motion device in depressed position, which maintains the associated tooth 82 of its bar 81 engaged in the aperture 85 of the depressed key stem. It will thus be seen that those digit keys 24 depressed in entering a subtrahend will be maintained in such key-set position until their respective hooks 58 are released from the lock arms 108 and allowed to drop into engagement with the toothed wheel 73, whereupon the pins 77 will move latch members 66 to release dogs 67 and permit spring return of the parallel motion devices of the depressed keys 24 to normal elevated position.

As in Patent No. 2,410,823, depression or actuation of the "minus" key 86 also renders operative normally inoperative complemental stop mechanism for subsequently automatically controlling the digital actuation of the adding mechanism in accordance with the nine's complemental value of any key 24 depressed in entering a subtrahend in all denominational orders except the units order, and for causing the entering of the ten's complement of any key depressed in the units order. As previously described, the mechanism normally controlling the digital actuation of the adding mechanism in each denominational order comprises the movement controlling bar indicated generally by reference numeral 61 (Fig. 4). Each of these bars 61 comprises a regular stop bar 112 and a complemental stop bar 113, secured together and spaced relative to each other by means of studs 114 (Figs. 6 and 10). The bars 112 and 113 have formed thereon vertically projecting stop lugs 115, the lugs 115 of the stop bar 112 being spaced progressively further back of the key stems 47 from the front to the rear of the machine, and the lugs 115 of stop bar 113 being spaced progressively further back of the key stems from the rear to the front of the machine (as shown in Figs. 4 and 10). The stop lug 115 of the regular stop bar 112 just to the rear of the "1" key is spaced one step back of the stem of the "1" key, and the distance from each succeeding stop lug to its associated key stem to the rear of the machine graduatedly increases until the rearmost lug is spaced nine steps back of the "9" key. The stop lug 115 of the complemental stop bar 113 just to the rear of the "1" key is spaced eight steps back of the stem of the "1" key, and the spacing graduatedly decreases until the lug back of the "8" key is spaced one step therefrom and the last stop lug is just even with the "9" key. In the units order, the complemental stop bar, which is designated by reference numeral 113', differs from these nine's complemental stop bars 113 in all other orders in that the stops 115 thereon are spaced progressively one step further back than are the stops 115 on the nine's complemental stop bar 113. In other words, the complemental stop bar 113' of the units order is adapted to control the entry of the ten's complement of any key depressed in that order. The complemental stop bars 113 and 113' are each provided at their forward ends with depending arms 116 (Fig. 4) having a bifurcated portion adapted to embrace the pin 62 located in the upwardly extending arm 39 of the associated gear sector 42. As has been described hereinbefore, in normal key-responsive operation, upon depression of a digit key 24 and engagement of its associated clutch hook 58 with its toothed wheel 73, there is a downward movement of the gear sector 42 in that denominational order which, through its connection with the digital control bar 61, as just explained, is halted by engagement of the associated stop lug 115 on the stop bar 112 with the stem 47 of the depressed key. The resulting movement is thus just sufficient to add into the accumulator, upon subsequent release of hook 58 from toothed wheel 73 and return of the parts to normal by spring 46, an amount represented by the value of the key depressed.

When it is desired to enter the complement of a subtrahend into the accumulator during a subtractive operation, the complemental stop bars 113 and 113' are shifted into operative relation with the stems 47 of the digit keys 24, so that upon depression of a digit key and subsequent downward movement of the gear sector 42, the complemental value of the key depressed will be added into the accumulator, as distinguished

from the actual value of the key depressed when the regular stop bar 112 is in operative relation therewith. The lower end of the stem of the "minus" key 86 is provided with an angular surface engaging a roll 118 (Figs. 4 and 10) which is rotatably secured to an upright arm 119. The arm 119 is fixedly secured to a rock shaft 121 running from front to rear of the machine, and having a bearing at opposite ends in lateral faces 122 and 122' provided at the upper portions of vertical support pieces 117 and 117', which are in turn supported at their lower ends on tie rods 23. Also securely fixed to the rock shaft 21 are upright arms 123 and 124 (Fig. 4) located adjacent the front and rear of the machine, respectively. The upper free portion of the arm 123 is disposed in a small slotted portion of a transverse support bar 125 positioned near the front of the machine (Fig. 10), which is slidably mounted in the intermediate frame plates 22 and is provided with a plurality of laterally spaced, upstanding pins 126 fixed therein. A similar transverse support bar 127 is mounted at the rear of the machine, which likewise is provided with such upstanding pins 126', and has a small slotted portion in which is positioned the upper portion of the upright arm 124. The pins 126 and 126' on the bars 125 and 127, respectively, are adapted to enter the open portion between the stop bars 112 and 113 (or 113') of each of the digital control bars 61 to maintain proper alignment thereof with their respective key stems 47. The rock shaft 121 and the support bars 125 and 127 and digital control bars 61 are normally maintained in the position of Fig. 6 under tension of a spring 130 interconnected between the lower end of the arm 123 (Fig. 4) and a frame plate 22 to retain the regular stop bars 112 in operative relationship with their associated digital key stems.

Upon depression of the "minus" control key 96, the resulting inward movement of the roll 118 will swing the upper end of the arm 119 to the left, viewing Fig. 6, which will cause shaft 121 to be rocked to shift the support bars 125 and 127 and all of the digital control bars 61 (to the left from their positions of Fig. 6) to dispose the stop bars 113 and 113' in operative relation with the lower ends of the key stems 47. As seen from this figure, these complemental stop bars 113 and 113' normally are disposed in vertical alignment with the slots 49 in the lower end of the key stems 47, so as to be inoperative, but such shifting upon depression of the "minus" key 86 moves the regular stop bars 112 inwardly out of alignment with the key stems 47 while moving the complemental stop bars into vertical alignment with the inner edge portions of the lower ends of the key stems.

As fully described in Patent No. 2,410,823, the "minus" key 86 is maintained in depressed position, when actuated, until the "equals" key 87 subsequently is depressed, so that rock arms 108 are maintained in engagement with their associated lugs 111 of hooks 58 to prevent engagement of the latter with toothed wheels 73 in response to depression of digit keys 24 in setting up a subtrahend. The digit keys 24 depressed in entering the subtrahend are maintained in such depressed or key-set position following depression of the "minus" key 86, and the parallel motion bars of the respective orders of depressed keys cannot return to normal position, because of the lateral ends of their dogs 67 having been engaged by the associated latch members 66, which remain in such engaged position until a power action takes place, as previously described. Means are provided, therefore, for releasing the clutch hooks 58, after the subtrahend has been set upon the keyboard, to enable their engagement with the toothed wheels 73 to allow the complement of the subtrahend so set up to be added into the accumulator to complete a subtractive calculation. The means for accomplishing this is under the control of the "equals" key 87, the lower end of the stem of which engages one arm of a lever 128 (Fig. 3) which is pivoted intermediate its ends on a short shaft 131 fixed to an intermediate frame plate 22. A downwardly extending arm at the rear end of lever 128 is provided with a laterally extending pin adapted for engagement with the forwardly extending arm of the three-armed pawl 98. Depression of the "equals" key 87 thus results in clockwise rocking of pawl 98 (viewing Fig. 3) to cause its lower arm to be swung rearwardly to be disengaged from the pin 105, allowing the shaft 107 to be rocked clockwise under the tension of its spring 109. The rock arms 108 are thus removed from locking engagement with the lugs 111 formed on the hooks 58, being returned to their normal positions of Fig. 4, thereby allowing those hooks 58 in the denominational orders in which digit keys 24 have been depressed in the previous setting of the subtrahend into the keyboard to drop into engagement with their toothed wheels 73.

It is necessary, however, that "9's" be added in all denominational orders in which no digit key 24 has been depressed, and that "10" be added in the units order if no key has been depressed therein. This is accomplished, at the same time that rock arms 108 are returned to normal position, upon depression of the "equals" key 87, the forward arm of lever 128 engaging a pin 136 fixed in the curved upper end of a lever 137 to rock the latter in a clockwise direction, viewing Fig. 3. The lower end of lever 137 is securely fixed to a transverse rock shaft 138 and is spring-urged toward its rearward or normal position of Fig. 3. Also securely fixed to the rock shaft 138 are a plurality of upright arms 139 (Figs. 2, 4 and 6) spaced transversely across the machine in each denominational order thereof, the upper extremities of said arms being in engageable relationship with laterally extending pins 141 mounted in the links 55. Depression of the "equals" key 87 thus swings the upper ends of all of the arms 139 forwardly to urge the links 55 in a forward direction. Movement of any of the links 55 in this manner imparts motion to the associated parallel motion device, in the same manner as though caused by depression of a digit key in that denominational order, to cause depression of hook 58 controlled thereby into the path of its associated toothed wheel 73, which results in an adding actuation in that denominational order. Movement of the parallel motion device, however, not having resulted from depression of a digital key 24 in such order, it will be apparent that bar 61 which controls the digital setting of the gear sector 42 will receive a full forward movement, with a consequent maximum downward movement of the gear sector sufficient to add "9" into the accumulator upon the upstroke of the sector under tension of spring 43. When no key has been depressed in the units order, that is, when a zero occurs in the units order of the subtrahend, forward swinging of the arm 139 therein likewise will cause maximum downward movement of the gear sector 42, but the resultant

upstroke by the spring 46 will add "10" into the units order of the accumulator, rather than the "9's" added in the other orders in which no keys were depressed.

In machines of this type, it is customary to provide an "overflow" numeral wheel, indicated at 150 in Fig. 1, to which is transferred the carry of the "10's" resulting from operation of the actuating mechanism in the last or highest denominational order. The instant machine provides actuating mechanism in the overflow order for automatically adding the value of "9" to the accumulator mechanism of that order to bring to zero position the numeral wheel 150 when a "1" has been carried thereto by the entering of the complemental value of the subtrahend and the subsequent carrying of the "10's" across the register, as just described. To this end, there is provided a gear sector 242 (Fig. 3) similar to the sectors 42 already described and mounted on the shaft 43, but directly connected to a guide member 260 by means of a link 259 which is pivotally interconnected between sector 242 and guide member 260. A spring 246, similar to the springs 46, is connected to this overflow guide member 260 to maintain the latter and the gear sector 242 in their normal position of Fig. 3. Rearward movement of the guide member 260 thus will cause downward movement of the gear sector 242 in an idle or setting stroke, and the spring 246 will return it to normal raised position in an adding movement in the same manner previously explained relative to the regular sectors 42. Such rearward movement of the guide member 260 is accomplished through connection with the guide member 60 of the next adjacent or highest denominational order. The keys 86 and 87 are provided with a short modified parallel motion device, similar to those in the several denominational orders previously described, which includes a link 255 (Fig. 3) having a pin 146 fixed therein. Depression of the "minus" key 86 thus causes forward movement of this link 255 and its pin 146, and the latter rocks a spring urged lever 148 clockwise (viewing Fig. 3) against the action of its spring to depress the rear end of a hook or lock piece 154, which is pivotally mounted on a horizontal arm 153 of the guide member 260 of the overflow order, so as to engage this lock piece 154 with a pin 157 secured to the guide member 60 of the next adjacent or highest denominational order. Upon engagement, therefore, of hook member 53 with toothed wheel 73 in this highest denominational order to the right of the overflow order, either resulting from the setting of a digital key 24 therein and/or depression of the "equals" control key 87 and release of lock arms 138 as previously explained, the guide member 60 in that order will be pulled rearwardly and, by such connection with the guide member 260 of the overflow order through lock piece 154, the gear sector 242 of the overflow order will be given a maximum downward movement to add "9" upon its subsequent upward movement under the action of the spring 246. Such rearward movement of the overflow order guide member 260 will release the parallel motion mechanism in the overflow order to enable automatic return of the keys 86 and 87 in the same manner as the parallel motion devices in the other orders of the machine are released, as previously explained. A subtractive calculation thus is completed upon the depression of the "equals" key 87, and the several parts moved to operative position by the previous depression of the "minus" key 86 automatically are returned to inoperative position to reset the machine for normal key-responsive operation.

Addition and subtraction problems thus are performed with the instant machine in the same manner as with that of Patent No. 2,410,823, and the reference numerals so far referred to herein are the same as those employed in Patent No. 2,410,823 to designate similar parts. On the other hand, problems of division and multiplication are performed on the present machine by means of mechanism different from that disclosed in any of my prior patents hereinbefore referred to, and in the case of division, in an entirely different manner. To perform a problem in division, after entry of the dividend into the accumulator, a "division" control key 301 is depressed which moves the complemental stop bars 113 and 113' into operative position, in the same manner as does depression of the "minus" key 86, and also conditions the machine for subsequent key-set operation, but not by means of the lock arms 138, which remain inoperative. Instead, depression of key 301 moves a normally inoperative ordinal slide bar in each denominational order into an intermediate operative position to positively limit the extent of downward movement of the digit keys 24 thereafter depressed to set up the desired divisor in the keyboard. Any keys 24 depressed to set up the divisor are retained in such key-set position by ordinal key-latching bails like those in my prior Patent No. 2,430,574, but the ordinal slide bars prevent such setting of the digit keys from effecting operation of the accumulator actuating mechanism and limit downward movement of the keys to a degree only sufficient subsequently to control the extent of movement of the gear sectors 42 in the associated denominational orders by limiting movement of the complemental stop bars 113 and 113'. Subsequent depression of an operations key will effect engagement of all the hooks 58 with their rotating toothed wheels 73, through the agency of the operations shaft 138 and the rock arms 139, to cause operation of all of the gear sectors 42, but not of the gear sector 242 in the overflow order. The result of each such depression of the operations control key, therefore, will be to enter into the accumulator the "nine's" complement of each digit key 24 depressed in setting up the divisor, except in the units order in which the "ten's" complement of any depressed key will be entered, and to enter "9" in each denominational order in which no digit key has been depressed and "10" in the units order, if no key has been depressed therein. As a result, the overflow numeral wheel 150 will register "1" and the remaining orders of the accumulator will register the "intermediate remainder," comprising the dividend with the divisor subtracted from its corresponding highest orders, the divisor initially having been set up in those denominational orders of the keyboard corresponding to the highest denominational orders of the accumulator containing the dividend where such ordinal values of the dividend are equal to or larger than those of the divisor. The operations control key then is repeatedly depressed until the ordinal values registered in the denominational orders of the accumulator corresponding with those orders of the keyboard in which the divisor is set are thereby reduced to less than the divisor. Each such depression of

the operations control key will result in the addition of "1" to the registration of the overflow numeral wheel 150. The keyboard setting of the divisor then is shifted automatically one denominational order to the right by depression of a keyboard setting shift key and, if the ordinal values registered in the corresponding orders of the "intermediate remainder" equal or are greater than the divisor, such previously described actuation of the operations control key is repeated; or if such values of the corresponding orders of the "intermediate remainder" are less than the divisor, the shift key is depressed again. These operations are repeated until the "remainder" is less than the divisor. If, as is normally the case, the dividend was entered in the lowermost denominational orders of the accumulator, the final result of such division operation will be the registration of the quotient in the highest denominational orders of the accumulator, with its highest order digit being indicated by the overflow numeral wheel 150, and with the remainder, if any, being registered the maximum possible distance therefrom in the lowest denominational orders of the accumulator.

Referring particularly to Figs. 1, 3, 4, 6 and 10, the "division" key 301 is located to the left of the highest denominational order of digit keys 24 in front-to-rear alignment with the keys 36 and 37. The lower end of the stem of key 301 has an angular portion (Fig. 6) in engagement with a roll 303 (Figs. 4 and 10) rotatably secured to an upright arm 119', similar to arm 119 previously described, and likewise secured at its lower end to the rock shaft 121. Depression of key 301 thus shifts all of the digital control bars 51 laterally, in the same manner as does depression of the "minus" key 39, to move the complemental stop bars 113 and 113' from their inoperative to their operative positions relative to the digital key stems 47. In order to maintain the "division" key 301 in depressed position during the subsequent operations performed in a division calculation, as above described, a vertical latch or lock lever 304 (Figs. 3 and 6) is provided which is substantially identical to the lock lever 305 employed in my prior Patent No. 2,492,703. This lock lever 304 is pivotally mounted at its lower end at 305 and urged in a counterclockwise direction (viewing Fig. 3) by a suitable spring 306. The upper end of the lock lever 305 is provided with a rearwardly extending projection 307 having an angularly disposed upper surface, and an outwardly displaced cam finger 308, these portions of the lock lever being similar to the projection 332 and cam finger 333 of the lever 325 of Patent No. 2,492,703. As best seen in Fig. 6, the outer, lower end of the stem of key 301 is cut away to a point just above the upper end of the lock lever 304, and this key stem is provided with a pair of vertically spaced apertures 309, similar to the apertures 95 in the digital stems 47, which are aligned vertically with the lock lever 304. Thus, depression of "division" key 301 causes the bottom surface of its key stem to engage the angular surface of the projection 307 to swing the lock lever 305 in a clockwise direction (viewing Fig. 3) against the action of its spring 306, and complete depression of the key 301 permits counterclockwise return of the lock lever 304 by its spring to normal position which engages the nose portion of the projection 307 in the lower aperture 309 to prevent upward return of the key 301. As best seen in Fig. 6, the key 301 is provided with a spring 38 similar to those associated with each of the digit keys 24 for normally urging the key to its raised position. Intermediate its ends, the lock lever 304 normally engages in a flat or notched portion of a transverse shaft 311 which is similar to the shaft 343 of Patent No. 2,492,703. This shaft 311, as will be more fully explained hereinafter, is rotated upon depression or actuation of either a release key or the zeroizing lever, and such rotation of the shaft will rock the lock lever 304 against the action of its spring 306 to release the projection 307 from the aperture 309 to permit return of the "division" key 301 to its normal upper position by its spring 38. At the same time, the cam finger 308 on the lock lever 304 will engage the lower end of the stem of key 301 when the projection 307 is removed from the aperture 309 to cam the key 301 upwardly, if there is any tendency for the key to stick or bind.

As in Patent No. 2,430,574, the keyboard 25 herein comprises a control unit mounted on the vertically disposed skeleton plate 22 above the accumulator actuating mechanism, and it includes five substantially horizontal frame plates numbered 312 through 316, from bottom to top of the machine (Fig. 2), in parallel spaced relationship. The three lowermost keyboard plates 312, 313 and 314 are mounted on the skeleton plates 22 as in my prior machines and are suitably slotted, not only to receive and guide the various key stems, but also to retain the anchor locks 93 therebetween, and the springs 38 are mounted on suitable lugs struck up from the plate 313. The remaining parts of the keyboard mechanism, to be described hereinafter, are mounted between the middle plate 314 and the added two top plates 315 and 316, plate 315 being secured to, and spaced from, plate 314 by suitable threaded spacing collars secured to the latter and screws 317 (Fig. 8). Transversely extending angle bars 318 and 318' (Figs. 2, 8, 11 and 12) are disposed across the front and rear edge portions, respectively, of plate 315 and are secured thereto in any suitable manner, as by means of screws 319 and 319' (Fig. 8). A plurality of angle brackets 321 (Figs. 2, 6, 7 and 8) have their horizontal feet secured in any desired manner to the under side of the top keyplate 316 and are aligned from front to rear of the machine in groups of three, with the depending vertical legs of the front and rear end brackets of each group slidably engaging the inner surfaces of the vertical faces of the transverse bars 318 and 318'. These vertical faces of the bars 318 and 318' and brackets 321 are provided with suitable aligned apertures for receiving rods or shafts 322 which thereby retain the upper keyplate 316 in place and prevent lateral movement thereof, one such rod 322 being provided for each such group of three brackets 321. The end brackets 321 in turn prevent front-to-rear movement of the keyplate 316. As shown in Figs. 2 and 8, a transversely extending bracket 323 secured to the keyplate 315, as by means of screws 324, is provided with upstanding apertured ears or lugs 325 adjacent each of the intermediate brackets 321 for receiving the rods 322 to secure the central portion of the upper keyplate 316. The bracket 323 also is formed with rearwardly extending curved fingers 326 for receiving a transverse rod or shaft 327, for a purpose presently to be explained. As best seen in Fig. 2, removal of the various digital

and control keys from the keyboard will permit lifting and removal of the top keyplate 316, upon rearward withdrawal of the several retaining rods 322 from their engagement with the angle bars 318 and 318', brackets 321 and ears 325, which may be accomplished following removal of the casing 21 of the machine.

In addition to rendering the regular stop bars inoperative and the complemental stop bars 113 and 113' operative, as previously described, depression of the "division" key 301 also renders the normally key-responsive instant machine key-set, so that any digit keys 24 subsequently depressed to set up a divisor in the keyboard 25 will remain latched in a partially depressed position. The mechanism now to be described for rendering the machine key-set is not that rendered operative by depression of the "minus" key 36, since actuation of key 301 does not rock shaft 107 to engage lock arms 103 with lugs 111 of the hooks 58, but it includes ordinal key latches 328 somewhat similar to the key latch bars 114 of Patent No. 2,430,574. One of these latches 328 is provided in the form of a longitudinal bar or bail in each denominational order of the machine adjacent, and at the right side of, each row of stems 47 of the digit keys 24 (Figs. 2, 3, 6, 7, 8 and 8a). Each latch bar or bail 328 is journaled for pivotal movement on suitable trunnion studs, formed integrally therewith at each end adjacent its upper edge, which extend through apertures provided in the vertical portions of the front and rear transverse angle bars 318 and 318'. Formed on each latch bar 328 are a plurality of depending latch arms 329 each terminating in an inwardly extending lower end adapted to engage below, be cammed outwardly by, or engage above a projection 331 formed on each of the stems 47 of the digit keys 24 (Fig. 7). As best seen in Figs. 7 and 8, the latch arms 329 of each bar or bail 328 are urged toward engagement with their associated digital key stems 47 by a spring 332 connected between the forward arm 329 and a stud pin 333 secured to, and upstanding from, the keyplate 315.

Adjacent the rear of the machine (Fig. 8), a transversely extending bar 334 is slidably mounted on the keyplate 315, by means of suitable pin and slot connections, which is provided with a forwardly and upwardly extending finger or projection 335 in contacting relation with the rearmost arm 329 of each latch bar 328 (Fig 8a). The left end of this bar 334 is urged by the several latch bar springs 332, through the agency of the rearmost arms 329 of the bars and the fingers 335, outwardly into abutting engagement with a pin 336 upstanding from the rear arm of a bell crank lever 337 pivotally mounted intermediate its ends at 338 on the keyplate 315. The other arm of lever 337 is provided with a similar upstanding pin 339 engaging in a vertical slot in a stud 341 secured to the inner side of a longitudinally extending link 342. At its forward end (Figs. 3 and 8) this link 342 is pivotally connected to the depending arm of a bell crank lever 343 which is pivotally supported intermediate its ends at 344 by a suitable bracket 345 extending upwardly from the keyplate 315. The rear end of the other or substantially horizontal arm of the bell crank lever 343 is disposed below and in engagement with a shoulder formed on the stem of the "division" key 301 by means of a cut-out portion 346 provided in the outer edge of this key stem, as best seen in Fig. 6. Intermediate its ends, the link 342 (Figs. 3 and 8) is provided with an outwardly extending stud 347 to which one end of a coil spring 348 is connected, the other end of this spring being anchored to the keyplate 315 by an upstanding stud pin 349.

When the machine is in its normal key-responsive condition with the "division" key 301 in raised position, the spring 348 maintains the link 342, bell crank lever 337 and transverse bar 334 in their positions of Fig. 8, wherein the fingers 335 maintain the several latch bars or bails 328 in their inoperative position of Fig. 6. As therein illustrated, the latch arms 329 thus are maintained out of operative association with the projections 331 on the digital key stems 47. Upon depression of the "division" key 301, however, the rearwardly extending arm of bell crank 343 is depressed by the shoulder of the key stem to move the link 342 forwardly against the action of spring 348, which swings the bell crank lever 337 from its position of Fig. 8 to that of Fig. 8a. The springs 332 of the several ordinal key latches 328 thereby are permitted to swing the latch arms 329 from their position of Fig. 6 to that of Fig. 7 to engage their lower ends with the digital key stems 47 below their lateral projections 331. Subsequent depression of any digit key 24 thus results in its associated latch bar or bail 328 being swung outwardly against its spring 332 by the resulting cam action of the projection 331 against the lower end of its associated latch arm 329. Continued depression of the digit key 24 in sufficient degree to dispose the projection 331 below the lower end of the latch arm 329 will permit spring 332 to return the latch bar 328 to its active position of Fig. 7 with the lower end of the latch arm 329 disposed above the projection 331 to retain such depressed digit key against return upwardly to normal position by its spring 38. Obviously, if any other digit key 24 in the same denominational order subsequently is depressed while such first depressed digit key is so retained in partially depressed position by its latch bar 328, the latter will be released from latching engagement with the projection 331 of the first depressed key to permit return thereof by its spring 38. Such depression by another digit key in the same denominational order in which a previously depressed key is latched in partially depressed position is permitted, as previously explained, by the upper slotted portion of the apertures 85 (Fig. 7) in the digital key stems 47. This slotted portion of each aperture 85 is of sufficient length to enable depression of a digit key to the point at which its projection 331 will release the associated latch 328, to permit return of any other key in the same order previously latched in partially depressed or key-set position by its latch arm 329, before actuating the adjacently disposed anchor locks 90, which the key stem does thereafter in the lower portion of its movement to key-set position.

Depression of the "division" key 301, as well as rendering the instant machine key-set, also renders mechanism operative to positively prevent machine actuation in response to subsequent depression of any digit key 24. This key-blocking mechanism comprises a normally inoperative ordinal slide bar 351 mounted in each denominational order of the machine and extending through vertical slots 352 in the associated key stems 47 (Fig. 7). The forward end of each of these ordinal slide bars 351 is reduced

in vertical dimension and extends through a suitable aperture in the vertical portion of the transverse angle bar 318 (Figs. 4 and 12) for sliding support thereof. The rear portions of each of these slide bars 351 are similarly supported by the transverse angle bar 318' at the rear of the machine, apertures 353 (Fig. 11) being provided in this rear bar 318' of sufficient height to permit longitudinal withdrawal of the bars 351 rearwardly therethrough. As best seen in Fig. 4, each of these ordinal slide bars 351 is provided with a slot or notch 354 normally transversely aligned with each of its associated digital key stems 47, these slots 354 being of sufficient depth to permit normal complete depression of the digit keys 24. In other words, the upper edge of the slot 352 in each ordinal key stem 47 normally will not contact the associated slide bar 351 during depression of the digit key to effect key-responsive operation of the machine, but will be moved downwardly into this clearance slot 354. At the rear edge of each clearance slot 354, each ordinal slide bar 351 is provided with a short horizontal surface in the form of a shoulder 355 which, when disposed in the associated slot 352 of a digital key stem 47, will limit downward or depressive movement of the digit key to that extent required for the same to be latched in partially depressed position by the associated key latch bar 328, as above described. Each of the ordinal slide bars 351 also is provided directly to the rear of each of these horizontal surfaces or shoulders 355 with an upward projection 356 having a forwardly and downwardly sloping front cam surface. The specific function of these cam projections 356 will be described hereinafter in detail in connection with the multiplication mechanism.

Mounted at the rear of the machine is transverse rock bar 357 (Figs. 4 and 11) which is pivotally supported at each end in the outer frame plates 22. A plurality of vertically extending supporting bars 358 are rigidly secured in any suitable manner at their lower ends to this rock bar 357 and support a transverse rod 359 at their upper ends. The rear end of the link 342 is pivotally connected to this transverse rod 359 (Fig. 3), so that the rod normally is maintained in its rearward position of Figs. 3 and 4 by the spring 343. Each of the ordinal slide bars 351 is provided adjacent its rear end with a notch 361 in its lower edge through which the transverse rod 359 extends. The rear end of each slide bar 351 is formed as a transversely extending ear to which the rear end of a coil spring 362 (Fig. 8) is attached, the forward end of the spring being secured to the transverse rod 359. Thus each ordinal slide bar 351 is retained in its normal position of Fig. 4 by its spring 362 maintaining the rear vertical edge of notch 361 in engagement with the transverse rod 359. As noted above, the several ordinal slide bars 351 normally are in their inoperative positions of Figs. 3 and 4, wherein they will not interfere with depression of the digit keys 24 to effect key-responsive actuation of the machine by virtue of the clearance slots or notches 354 being disposed in alignment with the associated key stems 47, whereby the upper edges of the slots 352 in the key stems 47 will not contact or engage the slide bars 351 at any point in the depressive movements of the digit keys 24. Actuation or depression of the "division" key 301, through the resulting forward movement of the link 342 as previously described, will correspondingly move the transverse rod 359 forwardly from its position of Fig. 4 to render the ordinal slide bars 351 operative by permitting their springs 362 (Fig. 8) to move them forwardly in corresponding degree, the springs 362 functioning at all times to maintain the rear edges of the notches 361 in the slide bars 351 in contacting engagement with the transverse rod 359. Such resulting forward movement of the slide bars 351 will bring the same into an "intermediate" operative position in which the shoulders 355 will be disposed in the key stem slots 352 in alignment with the upper edges of these slots. Consequently, subsequent depression of any digit key 24 is limited positively by engagement of the upper edge of its slot 352 with the associated shoulder 355 of the slide bar 351 in that denominational order. The extent of downward movement thus permitted the digit keys 24 by the ordinal slide bars 351 in operative position is only sufficient to enable a depressed digit key to be retained in key-set position by its associated latch bar 328. Movement of any digit key 24 in this key-set position is insufficient to effect depression of the associated parallel motion bar 48 (Fig. 2), so that key-responsive actuation of the machine cannot be effected thereby, but is of sufficient extent to result in the lower end of the depressed key being latched in the path of movement of the associated stop lug 115 (Fig. 4) of the digital control bar 61.

However, in order to enable the use of the old digital control and key-responsive actuating mechanisms, the extent of this downward movement of a digit key to such key-set position must result in its lower end being depressed substantially into contact with the associated parallel motion bar 48. Consequently, despite the provision of the positive movement limiting ordinal slide bars, an exceptionally sharp or flicking depression of a digit key into key-set position can sometimes impart undesirable movement to the associated parallel motion or power trip bar 48. Applicant therefore has provided additional means for blocking any possible movement of the parallel motion or power trip mechanism in response to depression of the digit keys to key-set position. This means comprises a blocking lever 363 (Figs. 2 and 6) in each denominational order of the machine, each of which blocking levers is pivotally mounted at its lower end on a transverse shaft 364 extending across the machine and supported by the several skeleton plates 22. The upper end of each of these blocking levers 363 is laterally offset to directly underlie a pin 365 extending laterally from the associated parallel motion or power trip bar 48, when the upper end of the blocking lever is swung rearwardly from its normal position of Fig. 2. At the right side of the machine the rock bar 357 is provided with a depending lever 366 (Figs. 2, 5, 10 and 11) which is mounted at its upper end thereon. The lower end of this lever 366 is pivotally connected in any suitable manner to the rear end of a rod 367 extending forwardly adjacent the righthand end plate 22 of the machine and terminating at its forward end in an integral eye portion rotatively engaging a shouldered stud 368 (Figs. 5a and 10). This stud 368 is carried by a link 369 between the forward end of which and the adjacent skeleton frame plate 22 is interconnected a coil spring 371. The rear end of the link 369 is pivotally connected in any suitable manner to the upper end of an arm 372 rigidly secured at its lower end to a transverse shaft 373 extending across the machine and suit-

ably journaled at each end in the outer frame plates 22. In each denominational order of the machine an upstanding arm 374 is fixedly mounted in any suitable manner at its lower end on this transverse rock shaft 373 and is provided at its upper end with a transversely extending pin 375 (Fig. 2) engageable with the rear edge of the associated blocking lever 363. Intermediate its ends, each of these rock arms 374 is provided with a suitable stud for engagement by one end of a grasshopper spring 376 which is coiled intermediate its ends about the shaft 364. The other end of each of these springs 376 engages the lower portion of the associated blocking lever 363, so that the spring 376 functions to urge the upper end of the blocking lever in a rearward direction. Such movement of the blocking levers 363 normally is prevented by the pins 375 in the rock arms 374 which, in turn, normally are maintained in their position of Fig. 2 by the spring 371 and the spring 348 (Fig. 3) through the agency of the link 342, shaft 359, rock bar 357, lever 366, rod 367 (Figs. 2, 5 and 5a), link 369 and arm 372. As will readily be apparent, these last recited members will function in response to depression of the "division" key 301 to swing the upper ends of the rock arms 374 and their pins 375 rearwardly from their position of Fig. 2, which will permit the grasshopper springs 376 to correspondingly swing the blocking levers 363 to dispose their upper ends below the pins 365 on the associated parallel motion or power trip bars 48. Thus subsequent depression of the power trip bars 48 is positively prevented by the blocking levers 363 in response to conditioning of the machine for key-set operation by depression of the "division" key 301.

The machine thus having been conditioned for key-set operation by depression of the "division" key 301, the divisor may be set into the keyboard by depression of the proper digit keys 24, and the latter are latched in key-set position. It will be understood that digit keys 24 representing the true value of the divisor are depressed in the denominational orders corresponding to those of the accumulator in which the highest ordinal digits of the dividend are registered, if the apparent value of the latter is greater than the divisor, or if the divisor is larger than the figure comprising the corresponding highest ordinal portion of the dividend, the setting of the keys 24 is done in the next lower denominational orders. For example, if "6789" is to be divided by "45," the "4" and "5" digit keys 24 are depressed in the orders corresponding to the "67" registration of the dividend; but if the divisor is "456" and the dividend is "236789," the "4," "5," and "6" keys 24 are depressed in those orders corresponding with the "367" in the accumulator. The divisor so set into the keyboard then is subtracted from the dividend in the accumulator to complete the performance of a division problem in similar manner to that in which the same would be solved by longhand division, as previously outlined herein. This is accomplished with the instant machine merely by depressing an operations control key 377 at the front lefthand corner of the keyboard each time that a subtraction of the divisor from the dividend is desired, and by depressing a shift key 378, located directly to the rear of the key 377, each time that it is desired to shift the keyboard divisor setting to the next adjacent lower denominational orders.

Depression of the operations control key 377 causes an automatic actuation of each of the links 59, but not of the link 259 in the overflow order, by engaging each hook 58 with its toothed wheel 73 through the agency of the same rock shaft 138 and the arms 139 as are actuated by the "equals" key 87 previously described. As illustrated in Figs. 3 and 10, the lower end of the stem of the operations control key 377 overlies the rearwardly extending arm of a bell crank lever 379 which is pivotally mounted intermediate its ends on a transverse shaft 381 (Fig. 3). This lever 379 is provided with an upstanding arm 382 on its outer leg which slidably engages between the inner surface of the adjacent skeleton frame plate 22 and the head of a shouldered stud 383 at its upper end to prevent lateral movement of the lever 379 on the shaft 381. The bell crank lever 379 also is provided with a depending arm to which is pivotally secured at 384 the upper, forward end of an angular link 385, and the other end of this link is pivotally connected in any suitable manner to the arm 137. Consequently, depression of the operations control key 377 will swing the bell crank lever 379 in a counterclockwise direction (viewing Fig. 3) to pull the link 385 forwardly and rock the lever 137 forwardly or in a clockwise direction, in the same manner as this lever and the shaft 138 are rocked by depression of the "equals" key 87. As a result of such rocking of the shaft 138, each of the arms 139 is similarly rocked to cause the upper ends thereof to engage the pins 141 to urge all of the links 55 forwardly. Such movement of the links 55 imparts motion to the associated parallel motion device to cause depression of the hooks 58 into the path of their associated toothed wheels 73. However, since such actuation of the parallel motion devices would be prevented by the upper ends of the blocking levers 363 being disposed under the pins 365, means are provided for simultaneously moving the upper ends of the blocking levers 363 forwardly to their normal position of Fig. 2 to permit such actuation of the parallel motion devices. This means comprises a rearward extension formed on each of the blocking levers 363 intermediate the ends thereof and a laterally extending pin 386 mounted therein which is moved rearwardly into engagement with the forward edge of the associated arm 139 upon movement of the blocking levers 363 to operative position, as previously described, in response to conditioning of the machine for key-set operation. The grasshopper springs 376 permit such forward displacement of the blocking levers 363 by their associated arms 139 without effecting displacement of the arms 374, and these springs also function automatically to return the blocking levers 363 to operative position upon return of the arms 139 when the operations control key 377 is released. Consequently, each time that the operations control key 377 is depressed, the links 59 in all denominational orders of the machine will be actuated to effect a full forward movement of each gear sector 42 in those denominational orders in which no digit key 24 is retained in key-set position, and to effect an operation of the gear sector 42 in each denominational order in which a digit key is latched in key-set position to an extent determined by the value of the particular digit key depressed and the corresponding negative stop bar 113 or 113'. The net result is that the true ten's complement of the divisor, as set up in the keyboard, will be entered in the accumulator in response to depression of the operations

control key 377, which comprises the entry of the nine's complement in each order in which a digit key is latched in key-set position, except in the units order in which the ten's complement of any depressed key will be entered, and the entry of "9" in each other denominational order in which no digit key is depressed, except in the units order in which "10" will be entered if no key is latched in key-set position therein. The resulting ten's transfer across the machine will cause "1" to be entered in the overflow numeral wheel 150.

The operations control key 377 is similarly repeatedly depressed until the remainder in those denominational orders of the accumulator corresponding to the orders of the keyboard in which the divisor is set has been reduced to a value less than that of the divisor. The transordinal keyboard setting shift key 378 then is depressed to shift the keyboard setting of the divisor to the next lower denominational orders. This is accomplished through the agency of a plurality of longitudinally extending rock shafts 387 disposed between adjacent rows of digital key stems 47 (Fig. 9) and located in the keyboard unit between the keyplates 314 and 315 (Fig. 7), these shafts 387 each having a two-part movement imparted thereto by depression of the shift key 378 which comprises a slight rearward movement of the shaft relative to the key stems 47 followed by a rotative movement thereof in a clockwise direction, as viewed from the front of the machine. As best seen in Figs. 2 and 9, the forward ends of these rock shafts 387 are journaled in suitable holes in the vertical portion of an angle bracket 388 extending across the front portion of the machine forwardly of the keyboard unit, and the rear ends of the shafts are similarly journaled in a transversely extending angle bracket 389 disposed between the keyplates 314 and 315 at the rear portion of the keyboard unit. The right end of the lower or horizontal portion of the front bracket 388 terminates in an upwardly bent ear 391 (Figs. 9 and 12) to which the lower end of a hanger bracket 392 is pivotally connected in any desired manner. The upper end of this hanger bracket 392 is mounted upon, and rigidly attached by means of a suitable pin connection to, a transverse shaft 393 journaled at its right end (Figs. 8 and 12) in a supporting bracket 394 secured to, and extending forwardly from, front angle bar 318 of the keyboard unit. The left end of this shaft 393 is similarly journaled in a supporting bracket 395 (Figs. 3, 8 and 12) which is secured to the keyboard plate 315. These support brackets 394 and 395, and particularly the right-hand one 394, are so arranged to permit ready removal and attachment to facilitate mounting and disassembly of the shaft 393. A depending hanger bracket 396, like the bracket 392, is similarly mounted at its upper end upon the shaft 393 adjacent the left-hand end thereof and is pivotally connected at its lower end to an upstanding ear 391 of the angle bracket 388 by a shouldered stud 397 secured to this ear 391. The horizontal or lower portion of the rear angle bracket 389 is likewise provided at its outer ends with upstanding ears pivotally connected to hanger brackets 392, in turn secured to, and depending from, a transverse shaft 399 at their upper ends which is journaled at its outer ends in supporting brackets 394' and 395'. The left-hand hanger bracket 398 for this rear angle bracket 389 is pivotally connected at its lower end thereto by a shouldered stud 397 (Fig. 9) in the same manner as the previously described connection between the left end of the front angle bracket 388 and hanger bracket 396. Also pivotally mounted on these two shouldered studs 397, at its opposite ends, is a longitudinally extending bar or link 401. Consequently, it will be seen that longitudinal movement of this bar 401 will result in identical movements being imparted to the front and rear angle brackets 388 and 389 and to the plurality of longitudinal rock shafts 387. In order to further insure such movement of the several longitudinal rock shafts 387 being limited to axial movement thereof, each of the angle brackets 388 and 389 are provided with suitable slots 403 through which extend stud pins 402 (Fig. 9) which are secured to the immediately adjacent keyplate 314 therebelow. The several rock shafts 387 and their supporting angle brackets 388 and 389 normally are retained in their forward positions of the drawings, with these guide pins or studs 402 in engagement with the rear ends of the slots 403, by a coil spring 404 (Figs. 8 and 11) connected at its forward end to an upstanding pin 405 mounted in the keyplate 315 and at its rear end to a shouldered pin 406 provided in the righthand hangar bracket 398 at the rear of the machine connected to the rear angle bracket 389.

The means for moving this rock shaft assemblage rearwardly against the action of this spring 404 is operative in the initial portion of downward movement of the shift key 378, and is best illustrated in Figs. 3, 7 and 9. A pawl 407 is pivotally mounted at its rear end on a shouldered stud pin 408 (Fig. 9) riveted or otherwise suitably secured to the link or bar 401 intermediate the ends thereof and extending inwardly therefrom. A grasshopper spring 409 is coiled about the inner enlarged portion of this shouldered stud 408 with its rear end engaging under the link 401 and its forward end engaging under a suitable inwardly extending lug on the upper edge of the pawl 407 to urge the pawl in a counter-clockwise direction (viewing Fig. 3) and normally maintain the same in engagement with the under surface of the keyplate 315. This pawl 407 is bent downwardly intermediate its ends to provide a vertical shoulder 411 (Fig. 9), and terminates at its rear end in a substantially horizontally extending tail portion for a purpose to be later described. A lever 412 pivotally mounted at 413 (Figs. 3 and 7) on a suitable bracket secured to, and upstanding from, the keyplate 312, is provided with a rearwardly extending arm normally engaging against the under surface of the keyplate 313 and an upstanding arm having a roll 414 rotatably mounted thereon and terminating in a forwardly and inwardly bent end portion engaging the shoulder 411 of pawl 407. The roll 414 on this lever 412 is held in engagement with the upper cam edge of an intermediate slot 415 provided in the outer edge of the stem of the shift key 378 (Fig. 7) by a spring 416 (Fig. 3) interconnected between the lever 412 and a suitable pin upstanding from the keyplate 313. Consequently, depression of shift key 378 will result in the upper cam edge of this slot 415 moving the roll 414 rearwardly to swing the lever 412 which, through the interposed pawl 407, will correspondingly move the link 401 rearwardly to shift all of the rock shafts 387 a corresponding amount to the rear of the machine axially of these shafts. Since continued downward movement of shift key 378 is required to subsequently perform the function of rocking the several shafts 387, the rock shaft assemblage is held in such rearward position by engagement of roll 414 with the rear sur-

face of the stem of key 378. This might result, upon release of shift key 378, in sticking of the key or failure of its spring to return it upwardly to normal position, so means are provided for relieving the roll 414 of such pressure against the key stem (derived from the spring 404), which comprises a shoulder 417 (Fig. 7) formed on the outer edge of the stem of key 378, by a suitable slot disposed below the intermediate slot 415, which contacts the forwardly extending tail piece of pawl 407, as the key reaches its lowermost position, to depress pawl 407 against the action of grasshopper spring 409 to disengage shoulder 411 from the upper end of lever 412. Consequently, the rock shaft assemblage will be returned forwardly to normal position by spring 404 as shift key 378 reaches its lowermost position, and the upper end of lever 412 will be re-engaged with shoulder 411 on pawl 407 only upon subsequent return of key 378 to its uppermost normal position, such re-engagement being accomplished by springs 409 and 416.

The stem of shifter key 378 also is provided with an upper slot 418 (Fig. 7), the upper edge of which normally is disposed in spaced relationship above a roll 419 rotatably mounted on, and extending rearwardly from, the outer end of a laterally extending arm of a bell crank lever 421, the roll 419 extending rearwardly into the key stem slot 418. Intermediate its ends, the bell crank lever 421 is pivotally mounted on a shaft 422 supported by the vertical portion of the front angle bar 313 at its front end and at its rear end by suitably formed inwardly extending ears provided at the upper end of a bracket 423 removably secured at its lower end to the key plate 315 (Figs. 6 and 8). The bell crank lever 421 is secured to a hub 424 in order to maintain proper alignment of roll 419 with the stem of key 378, and this assembly of lever 421 and hub 424 is pivotally mounted on the shaft 422 (Fig. 8). As will be seen from Fig. 7, the depending arm of this bell crank lever 421 is notched or bifurcated to engage a pin 425 mounted in the upper end of a crank arm 426 and extending rearwardly therefrom. This crank arm 426 is spaced forwardly from lever 421 (Fig. 3) and is mounted at its lower end upon, and suitably pinned to, a rock shaft 427 (Fig. 7). This rock shaft 427 is journaled at its ends in the angle brackets 388 and 389 (Fig. 9) in the same manner as the rock shafts 387 and is disposed in parallel relationship therewith between the key stems 47 of the highest denominational order and the stems of the several operations control keys. Directly adjacent the vertical portion of the front angle bracket 388, each of the several rock shafts 387 and 427 are provided with gear segments 428 (Fig. 12) each of which has a suitable collar portion mounted on its associated shaft and pinned thereto (Fig. 9) to prevent movement thereof relative to the shaft. The several gear segments 428 mesh with suitable teeth formed in the bottom edge of a rack bar 429 (Figs. 2, 3, 8, 9 and 12) which is mounted for limited horizontal sliding movement on the inner side of the vertical portion of the front angle bracket 388 by means of shouldered stud pins 431 extending rearwardly from bracket 388 through horizontal slots 432 (Fig. 12) formed in the rack bar 429. A coil spring 433 is interconnected between the rightmost pin 431 and a pin 434 extending rearwardly from the rack bar 429 to normally maintain the rack bar in its leftmost position with the right ends of slots 432 in engagement with the pins 431.

As previously described, the initial portion of a downward movement of the shifter key 378 results in rearward movement of the rock shaft assemblage in response to rearward movement of roll 414 by the upper cam edge of the intermediate slot 415 in the key stem. As such rearward movement of roll 414 is completed in this initial portion of a downward movement of key 378, the shoulder comprising the upper edge of slot 418 in the stem of key 378 comes in contact with roll 419, and the remaining portion of the downward movement of key 378 results in counter-clockwise swinging of bell crank 421, as viewed from the front of the machine in Fig. 7, to rock shaft 427 to the right or in a clockwise direction, as seen from the front of the machine. The gear segment 428 mounted on this rock shaft 427 will thereby move the rack bar 429 to the right (Fig. 12) against the action of spring 433 to correspondingly rock all of the shafts 387.

As best seen in Figs. 7 and 9, each of the longitudinal rock shafts 387 is provided with a plurality of key shifter collars 435 rotatably mounted thereon adjacent each pair of associated digital key stems 47. A pin 436 is mounted in each shaft 387, slightly to the rear of each associated pair of digital key stems, which normally is embraced or engaged by suitable slots in the rear edge of the hub portion of each associated collar 435. The collars 435 are resiliently maintained in such engagement with their pins 436 by coil springs 437 mounted on the shafts 387, each such spring being disposed between its collar 435 and a ring or spring collar 438 held against the next forward pin 436 by the spring. The front spring 437 on each shaft merely abuts at its forward end against the hub portion of the associated gear segment 428. Each of these shifter collars 435 is provided at its forward end with a laterally and normally downwardly extending finger 439 (Fig. 7) and a similar finger or projection 439' in lateral alignment therewith and extending slightly upwardly from the horizontal. The stems 47 of the digit keys 24 are each provided just below their projections 351 with a notch 441 in each lateral edge thereof. When the digit keys are in their normal raised position, as seen in Fig. 7, the righthand fingers 439' on the key shifter collars 435 are in vertical alignment with the lower portions of the notches 441 in the adjacent key stems 47 to the right thereof, but the fingers 439 extending to the left of the shifter collars 435 are disposed below the notches 441 in the key stems to the left thereof. However, depression of any digit key 24 to its key-set position, wherein it is retained by its latch bar 328, will bring the lower portion of the notch 441 in the right side of its stem into vertical or clearance alignment with the associate shifter finger 439. Consequently, rearward movement of the rock shafts 387 during the initial portion of actuation or depression of shift key 378, will result in the positioning of all of the fingers 439 in their associated notches 441 of any digit keys that are latched in key-set position. The immediate subsequent rocking of the shafts 387, will, therefore, result in depression of the corresponding digit keys in the adjacent lower denominational orders, since the fingers 439' of each shifter collar 435 which has been so moved rearwardly into alignment with the associated key stems 47 will be engaged with the lower ends of their associated notches 441 to depress such next lower denominational keys into key-set position, where the keys will be retained by their latch bars 328. On

the other hand, if a digit key **24** is in its normal raised position upon operation of the shift key **378**, the resulting rearward movement of the associated rock shaft **387** will engage the finger **439** of the associated shifter collar **435** with the forward surface of such raised digit key and disengage this shifter collar from its pin **436**, the springs **437** permitting such disengagement in the case of any shifter collar **435** disposed to the right of a non-depressed digit key.

As the corresponding digit key **24** in the next lowest denominational order from that in which a previously depressed key has been latched in key-set position is thus depressed in response to operation of the shifter key **378**, its associated latching bar **328** will be swung to inoperative position by its projection **331** to release any other previously depressed key in that next lower denominational order. However, such release will be accomplished at the same time that any key in that next lower denominational order is being depressed, if a key also were in key-set position therein. The keyboard setting as a whole thus is shifted transordinally to the next lower denominational orders in response to each depression of the shift key **378**. 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 in that order must be provided for causing such swinging of the associated latch bar **328** to remove its latch arm **329** from engagement with the partially depressed key. Rocking of the latch bars **328** to release a partially depressed key in orders to which no figure of value has been transferred by depression of the shifter key **378** is timed to occur simultaneously with the rocking of the latch bars **328** by depression of a key caused by rotation of the active shifter collars **435**. To this end, the key bail actuating bar **334** (Figs. 3 and 8*a*) is provided with a pawl **442** adjacent its left end which is pivotally mounted thereon in any suitable manner at **443**. The rear edge of this pawl **442** is provided with a suitable downwardly bent finger for engagement with the rear edge of bar **334**, and the pawl is urged in a counter-clockwise direction, limited by such engagement of the depending finger thereon with the bar **334**, by a spring **444** coiled intermediate its ends about the pivot **443** and having one end engaging the leftmost finger **335** and its other end disposed in a suitable notch in an upwardly extending ear **445** at the right end of pawl **442**. The forward edge of this pawl **442** is cut away to provide a cam surface **446** normally engaged by a pin **447** to retain the pawl in its position of Fig. 8 when the machine is conditioned for key-responsive operation. During the setting of the machine for key-set operation, as in response to depression of "division" key **301** in the manner previously described, the resulting movement of bar **334** to the left to its position of Fig. 8*a* permits spring **444** to swing the pawl **442** in a counter-clockwise direction to its active position of this figure. The rock shaft **427** (Fig. 9) is provided adjacent its rear end with an upstanding pin **448** similar to the pins **436** mounted in the rock shafts **387**. This pin **448** extends upwardly through a suitable aperture in the keyplate **315**, and normally is in its full line position of Figs. 8 and 8*a*. The first portion of downward movement imparted to the shifter key **378**, as previously described, results in rearward movement of the rock shaft assemblage which moves the pin **448** from this normal full line position directly rearwardly into transverse alignment with the left end of pawl **442** (as shown in broken lines in Fig. 8*a*) when the pawl is in its active position. The remaining portion of a complete downward movement imparted to the shifter key **378**, which results in rocking of shaft **427** as previously described, causes pin **448** to be moved to the right against the end of pawl **442** to slide bar **334** to its key latch bail releasing position of Fig. 8. The resulting simultaneous release of all of the key latch bails **328** is thus timed to correspond with the rocking of these bails by depression of any digit keys caused by rotation of the shifter collars **435**. During such lateral movement of pawl **442** by the pin **448**, pin **447** acts against the cam edge **446** of the pawl to disengage the pawl from pin **448**. Return movement of bar **334** and the key latching bails **328** by their springs **332** thus is enabled to take place before release of any keys moved to key-set position by the active fingers **439'** of the shifter collars **435**.

With the mechanism so far described, the performance of a problem in division in the manner outlined would result in a continuous accumulation in the overflow numeral wheel **150** of the number of times that the operations control key **377** is depressed, regardless of any transordinal shifting of the keyboard divisor setting in response to actuation of the shifter key **378**, because "9's" would be entered in each higher denominational order of the accumulator in which no digit keys were depressed. Consequently, means are provided for serially accumulating the number of times that the operations control key **377** is depressed in the successively lower denominational orders of the accumulator below the overflow numeral wheel **150** corresponding with the transordinal shifting of the keyboard divisor setting accomplished by actuation of the shifter key **378**. This means, which normally is inoperative, is rendered operative automatically in response to depression of the "division" key **301**, and thereafter functions to effect depression of the "9" digit key **24** in the highest denominational order of the machine each time that the shifter key **378** is depressed. A depending finger **449** (Figs. 3 and 9) of a slide bar **451** (Figs. 3 and 8) extends downwardly through a suitable aperture in the keyplate **315** to the left of the rock shaft **427** in lateral alignment with the stems **47** of the "9" keys **24**. As shown in Fig. 9, a key shifter collar **452** similar to the collars **435** is rotatably mounted upon the rock shaft **427** and resiliently maintained in engagement with the pin **448** by a coil spring **437** abutting against a collar **438** restrained against forward movement by a pin **436**. These parts are the same as the key shifter mechanisms mounted upon the rock shafts **387**. Like the shifter collars **435**, collar **452** is provided with shifter fingers **439** and **439'**. With the finger **449** of slide bar **451** in its normal position of Figs. 8 and 9, rearward movement of the key shifter collar **452** in response to rearward movement of shaft **427** will be blocked, so that the key shifter collar **452** will be inoperative in response to depression of the shifter key **378**. Referring again to Figs. 3 and 8, it will be seen that slide bar **451** normally is maintained in this forward operative position by a spring **453** interconnected between its forward end and a suitable pin **454** upstanding from the plate **315**. The slide bar **451** is pivotally connected adjacent its forward end to the depending arm of a bell crank lever **455**. This lever **455** is pivotally sup-

ported intermediate its ends on a transverse shaft 458, which extends outwardly from, and is suitably supported by, the rear portion of the bracket 423. The bell crank lever 455 also comprises a substantially horizontal arm extending forwardly through the cut out portion 346 (Fig. 6) provided in the stem of the "division" key 301. Consequently, upon depression of "division" key 301, bell crank lever 455 will be rocked in a clockwise direction (viewing Fig. 3) to move the slide bar 451 rearwardly against the action of its spring 453 and dispose the rear end thereof in its inoperative position of Fig. 8a wherein its finger 449 will be beyond the path of movement of the finger 439 of key shifter collar 452. Therefore, depression of shifter key 378, whenever "division" key 301 is in depressed position, will result in collar 452 depressing the "9" digit key 24 in the highest denominational order into key-set position. As a result, each subsequent operation of the shifter key 378 will result in the automatic depression into key-set position of the "9" keys of the next successively lower denominational orders. As will be appreciated from the previous description of the digital control mechanism, such latching of these "9" digit keys 24 will result in no accumulative action of their associated gear sectors 42 by virtue of the blocking of the associated complemental digit stops 113 by the stems of these keys. Consequently, the number of initial depressions of the operations control key 377, following depression of the "division" key 301 and setting of the divisor in the keyboard, will be registered in the overflow numeral wheel 150. Thereafter, the number of actuations of the operations control key 377, following transordinal shifting of the divisor in response to depression of the shifter key 378, will be registered in the highest denominational order numeral wheel 35, and each succeeding actuation of the shifter key 378 will cause registration of the following actuations of the operations control key 377 in the next succeeding lower denominational orders of the accumulator. The quotient resulting from the performance of any problem in division therefore will always be registered in the left-hand portion of the accumulator, with its highest ordinal figures indicated by the overflow numeral wheel 150. And, as previously explained, the remainder, if any, will be registered in those denominational orders of the accumulator in which the lowest ordinal values of the dividend originally were entered. Upon completion of a division problem, the "division" key 301, the mechanism retained in operative position thereby, and any digit keys 24 remaining in key-set position will be returned to their normal positions and the machine conditioned for key-responsive actuation upon zeroizing of the accumulator, in a manner to be described in detail hereinafter.

The performance of multiplication problems may be accomplished in the manner customary in key-responsive machines, but preferably is accomplished in the instant machine with less effort on the part of the operator by use of the operations control key 377 and the transordinal keyboard setting shifter key 378 in similar manner to that in which these same control keys are employed in performing problems in division, in order to simplify the operation of the machine as much as possible. To thus employ the instant mechanism whenever a problem in multiplication is to be performed, a "multiplication" control key 457 first is depressed, which is located at the left side of the machine between the "division" key 301 and the shifter key 378, the multiplicand is set up in the keyboard by depression of the proper digit keys 24, and the operations control key 377 and the shifter key 378 are successively actuated as dictated by the particular multiplier of the problem to be performed. After the multiplicand has been set up on the keyboard, the operations control key 377 is depressed a number of times corresponding to the digital value of the highest ordinal figure of the multiplier. The shifter key 378 then is depressed to transordinally shift the multiplicand keyboard setting to the next adjacent lower denominational orders. The operations control key 377 then is depressed a number of times corresponding to the digital value of the next lower figure of the multiplier, and such operations of the control keys 377 and 378 are continued in accordance with the digital values of the successively lower ordinal figures of the multiplier, the product being registered in the accumulator.

In order to condition the machine for such key-set operation, depression of the "multiplication" key 457 renders operative the normally inoperative ordinal slide bars 351 and key latching bails 328. This is accomplished by virtue of a cutout portion in the outer edge of the stem of key 457, similar to the cutout portion 346 in the stem of "division" key 301, the upper edge of which overlies the rearwardly extending, horizontal arm of bell crank lever 343 (Figs. 3 and 8). It will be understood, of course, that depression of the "multiplication" key 457 does not actuate either roll 303 or bell crank lever 453, as operated by key 301 in the manner previously described, so that the regular digital stop bars 112 remain in active position and the finger 449 of slide bar 451 remains in its normally operative position. However, since "multiplication" key 457 is disposed closer to the pivot 344 of bell crank lever 343 than is "division" key 301, and the downward travel of these two control keys is the same, depression of key 457 will result in a correspondingly greater swinging of bell crank lever 343 than is effected by depression of "division" key 301. As a result of such greater movement being imparted to lever 343 by key 457, link 342 and the transverse rod 359 are moved forwardly a correspondingly greater distance than that previously described, and the ordinal side bars 351 are similarly carried forward by their springs 362 beyond their previously described "intermediate" operative position to a "full" operative position spaced substantially the thickness of the stems 47 of the digit keys 24 forwardly from such intermediate position. The forwardly and downwardly sloping cam surfaces of the projections 356 (Fig. 4) of the ordinal slide bars 351 thus are disposed within the slots 352 (Fig. 6) in their associated digital key stems 47, when the "multiplication" key 457 is in depressed or operative position. Such additional movement of the ordinal slide bars 351 from their intermediate to their full operative positions is employed to lock their associated digital control bars 61 against any subsequent movement, so long as the slide bars 351 remain in such forward operative position. This result is accomplished by means of cam levers 456 (Figs. 4, 8 and 11), one of which is disposed in each denominational order of the machine. Each cam lever 456 is pivotally mounted intermediate its ends on a suitable transverse shaft 459 and held in proper lateral alignment thereon by means of suitable spacer sleeves, which contact the skeleton frame plates

22, in the form of a sleeve 461 (Fig. 11) extending through and rigidly secured to each lever 458 and functioning as a hub portion thereof. At its upper end, each of these cam levers 458 is provided with a transversely extending pin 462 engaging within a notch 463 (Fig. 4) provided in the edge of the associated ordinal slide bar 351. The lower end of each lever 458 is provided with a laterally extending cam pin 464 slidably disposed within a cam slot 465 formed in the rear end of an associated digital control bar locking lever 466. Each locking lever 466 is pivotally supported at its forward end on a transversely extending stub shaft 467 secured to the adjacent skeleton frame plate 22. The lower edge portion of the rear end of each locking lever 466 is formed to provide a laterally extending finger or lug 468 normally disposed above a notch 469 provided in the upper edge of each associated complemental stop bar 113 and 113' (Fig. 10). The cam levers 458 and locking levers 466 normally are disposed in their inoperative positions, as best illustrated in Fig. 4, and are retained therein by spring 348 (Fig. 8) when the machine is set for key-responsive operation. Upon depression of the "multiplier" key 457, the ordinal slide bars 351 are moved forwardly to their full operative positions, as previously described, in which the sloping cam edges of their projections 350 are disposed in transverse alignment with the digital key stems 47 in the slots 352 therein. In response to such full forward movement of each ordinal slide bar 351, its associated cam lever 458 is swung clockwise (viewing Fig. 4) to move the lower pin 464 therein rearwardly. This pin 464 being disposed in the cam slot 465 in the rear end of the associated locking lever 466, such rearward movement of the cam pin depresses the rear end of the lever 466 to dispose its lug 468 in the notch 469 of the complemental stop bar 113 in that denominational order, or 113' in the lowest order. Since each pair of stop bars 113 and 113 are secured together as previously described to form the gear sector movement controlling bar 61 in each denominational order of the machine, all of these digital stop bars 61 thus are locked against forward movement to prevent movement of their gear sectors 42 in response to subsequent actuation of the operations control key 377. However, whenever a digit key 24 subsequently is depressed in the setting up of a multiplicand on the keybord, the initial portion of its downward movement toward key-set position will effect release of its associated digital control bar locking lever 466, so that subsequent engagement of the hook 53 with the rotating toothed wheel 73 in that denominational order in response to depression of the operations control key 377 will result in an accumulative actuation of the gear sector 42 in that order to an extent determined by the digit key 24 so depressed to key-set position. Such release of the digital control bar 61 is accomplished by the upper edge of the slot 352 in the stem 47 of the depressed digit key 24 acting upon the sloping cam edge of the associated projection 356 to move the ordinal slide bar 351 rearwardly to its intermediate active position. In other words, depression of a digit key to key-set position effects rearward movement of its ordinal slide bar 351 from it full operative to its intermediate operative position, which swings the cam lever 458 associated therewith counterclockwise (viewing Fig. 4) a sufficient distance to cause its lower pin 464 to lift the rear end of locking lever 466 to disengage its lug 468 from the notch 469. It will be understood that the cam slot 465 provided in the rear end of each digital control bar locking lever 466 is so shaped that movement of cam lever 458 in response to depression of the "division" key 301 will not depress the locking lever 466. Consequently, the same key-set mechanism may be employed for both positive and negative forms of multiple calculations, and regardless of whether "division" key 301 or the "multiplication" key 457 is depressed, the shoulders 355 of the ordinal slide bars 351 will positively limit subsequent depressive movements of the digit keys 24 as the dividend or multiplicand is set into the keyboard. Depression of the "multiplication" key 457 also renders operative the normally inoperative movement controlling bar blocking levers 363 (Fig. 2), in the same manner as previously described as occurring in response to depression of the "division" key 301. The additional incremental movement imparted to rod 357 upon depression of key 457, over that resulting from depression of key 301, will be ineffective to permit rearward swinging of the upper ends of blocking levers 363 beyond their associated pins 365, since their pins 386 will limit such movement of the blocking levers to active position by engagement with their associated operations control arms 139. And actuation of the operations control key 377 following depression of the "multiplication" key 457 will result in all of the blocking levers 363 being swung forwardly to inoperative position by their associated arms 139 to permit responsive accumulative actuation in those denominational orders in which the locking levers 466 have been released from their digital control bars 61 by depression of a digit key 24 to key-set position.

Since it is necessary that the "multiplication" key 457 be retained in active or depressed position throughout a multiplication operation, means are provided for latching this key in depressed position. This means comprises a lock lever 471 (Figs. 3, 6 and 10) which is pivotally mounted at its lower end on the transverse shaft 364 and is urged in a counterclockwise direction (viewing Fig. 3) against a flat provided on the rock shaft 311 by a spring 472. The upper end of this lever 471 is displaced inwardly and terminates in an upstanding portion having a rearwardly extending projection 473 (Fig. 3) with an angularly disposed upper edge surface similar to the projection 307 of lock lever 304. This projection 473 is disposed directly below the lower end of the stem of "multiplication" key 457 so that depression of the latter will swing the upper end of lock lever 471 forwardly against the action of its spring 472, and the stem of key 457 is provided adjacent its rear end with an aperture, similar to the aperture 309 (Fig. 6) in the stem of "division" key 301, within which the nose portion of the projection 473 will be engaged by spring 472, when the "multiplication" key 457 reaches its lowermost position, to latch the key therein. Key 457 thus will be locked in depressed position until shaft 311 is rocked, in a manner to be described hereinafter.

It should be noted that notch 361 in the lower edge of the rear end portion of each of the ordinal slide bars 351 (Fig. 4) is made longer, from front to rear of the machine, than the diameter of the transverse rod 359 extending therethrough to permit retractive movement of an ordinal slide bar from its forward full operative position to its intermediate operative position in response to depression of an associated digit key 24, following setting of the "multiplication" key 457. In other

words, depression of the "multiplication" key 457 moves the transverse rod 359 to its foremost position against the action of spring 348 (Figs. 3 and 8), and the rod is retained in such position by this spring constraining the rearwardly extending arm of bell crank lever 343 upwardly into engagement with the upper edge of the associated notch in the stem of the latched-down "multiplication" key 457. Subsequent depression of any digit key 24 to key-set position will cam the associated ordinal slide bar 351 rearwardly a distance substantially equal to the thickness of the digital key stems 47. This movement of the ordinal slide bar 351 from its foremost operative position to its intermediate operative position will take place against the action of the associated spring 362 (Fig. 8) and, as noted, is permitted because the notch 361 (Fig. 4) is at least that much longer than the diameter of rod 359. It will also be understood that subsequent transordinal shifting of the multiplicand keyboard setting in response to depression of the shifter key 378 will permit automatic return of any ordinal slide bar 351 from its intermediate position to its forward active position, by its spring 362, whenever the associated digit key 24 that was latched in key-set position is released and no other digit key in the same denominational order at the same time is depressed to key-set position. Consequently, after a multiplicand is set up in the three highest denominational orders of the keyboard, for example, and the shifter key 378 is depressed to transordinally shift such multiplicand setting to the second, third and fourth highest denominational orders, the ordinal slide bar 351 in the highest denominational order will automatically be returned forwardly by its spring 362 to full operative position to relock the associated digital control bar 61 by engaging the lug 468 in that order in the notch 469 of that digital control bar. Subsequent depression of the operations control key 377, therefore, will result, in such example, in accumulative actuations in the second, third and fourth from the highest denominational orders of the machine only.

Additional control and interlocking mechanisms are provided in the instant machine to facilitate the above-described operations, and to prevent misoperation of the previously described control members by a careless operator, which are similar to those illustrated in the several prior patents earlier referred to, and particularly as shown in my Patent No. 2,492,703. These additional control mechanisms include a zeroizing lever 474 (Figs. 1, 5, 8 and 10) pivotally mounted at its lower end in the same manner as the zeroizing lever 335 of Patent No. 2,492,703, as best seen in Fig. 15 therein. The means for zeroizing the accumulator in response to forward swinging movement of the upper end of this lever or crank 474 are the same as those fully illustrated and described in Patent No. 1,357,748, and include a link 475 articulately connected at its rear end to a segment 476 which is fixedly mounted on the same shaft as the lower end of the zeroizing crank 474 and rotatable with it. At its forward end, the link 475 is pivotally connected to a stud 477 mounted in a depending lever 478 (Fig. 5) pivotally mounted at its upper end at 479. Also at the right hand side of the machine (as shown in Fig. 5), is an arm 481 rigidly mounted at its lower end on the transverse rock shaft 311 and pivotally secured at its upper end to the rear end of a link 482 which is provided with a slot 483 in its forward end that engages the stud 477. Consequently, as the zeroizing lever or crank 474 is pulled forwardly to effect clearing of the accumulator, shaft 311 is rotated in a clockwise direction (viewing Fig. 5) which, as previously described, will swing the upper ends of the lock levers 304 and 471 (Fig. 3) forwardly to release the "divison" key 301 or the "multiplication" key 457, if either of these control keys is latched thereby in depressed or active position. As will be readily understood from the previous description, such release of either of these control keys will permit the digital key latching bars 328 to be returned automatically to inoperative position, so that any keys 24 then latched in key-set position will be returned to their normal positions by their associated springs 38.

A release key 484 (similar to release key 371 of Patent No. 2,492,703) also is provided for accomplishing such digital and control key release without an accompanying zeroizing of the accumulator. This release key 484 is located at the right side of the machine adjacent the zeroizing crank 474 (Figs. 7, 8 and 10), and rests at its lower end (Fig. 5) on a suitable horizontally disposed shelf of a lever 485 which is pivotally mounted on a stud 486. A link 487 forms a connection between the forward portion of this lever 485 and the arm 481 which is mounted on the shaft 311. Consequently, depression of release key 484 will result in clockwise rocking of shaft 311 (viewing Figs. 3 and 5), in the same manner as effected by operation of zeroizing crank 474, to release either of the control keys 301 or 457 that may be locked in depressed position. As in Patent No. 2,492,703, means also are provided for enabling release of the digit keys 24 from depressed position in the event that an error has been made in setting up the subtrahend on the keys, after depression of the "minus" key 86 preparatory to a subtractive operation, which means is operable in response to depression of the release key 484. The lever 485 is provided at its rear end with a roll 488 engaging the upper end of a lever 489 which is rigidly mounted on the transverse rock shaft 107 on which lock arms 108 also are mounted (Fig. 4). As shown in Fig. 5, the lower end of this lever 489 is pivotally connected to the rear end of a link 491, the forward end of which in turn is pivotally connected to the rear arm of a bell crank lever 492 mounted on the transverse shaft 364. Depression of release key 484 will, through the agency of lever 485 and roll 488, swing lever 489 in a counterclockwise direction (viewing Fig. 5) to rotate the shaft 107 farther than it has been rotated by depression of the "minus" key 86 to force elevation of the hooks 58 from the positions which they have assumed in proximity to the toothed wheels 73. As is also more fully described in Patent No. 2,492,703, such operation in response to depression of the release key 484 is accompanied by rotation of shaft 311, in the manner previously noted, to cause release of the dogs 67 from the latches 66 in each denominational order in which a digit key 24 has been depressed, thereby allowing the keys 24 to raise to their normal elevated position.

Interlocking mechanism also is included in the instant machine, similar to that disclosed in my prior Patent No. 2,492,703, which includes means for preventing simultaneous operation of the zeorizing crank 474 or the release key 484 at the same time that the operations effecting control keys 87 or 377 are being operated. These interlocking mechanisms also include means for pre-

venting simultaneous operation of the zeroizing crank 474 or the release key 484 and any of the digit keys 24. Journalled in the end skeleton frames of the machine is a transverse rectangular rock bar 493 having a latch piece 494 (Fig. 2) clinched thereon in each denominational order of the machine adapted to enter the aperture 85 of the associated "1" digit keys 24 for engageable relationship with the anchor locks 90. Whenever a digit key 24 is depressed, including its final movement to key-set position, to actuate the anchor locks 90 in the same denominational order, as previously described, the lower portion of the associated latch piece 494 will be swung forwardly to rock the bar 493 in a counterclockwise direction, as viewed from the left side of the machine. At the right side of the machine, a depending arm 495 (Fig. 5) is mounted at its upper end on the rock bar 493 and is connected at its lower end, by a suitable pin and slot arrangement, with the upper end of a lever 496. This lever 496 is rotatably mounted intermediate its ends upon the transverse shaft 43 and is provided at its lower end with a pin 497 normally in engagement with a hook formed in the upper arm of a two-armed pawl 498 mounted for rotation on a stud 501 fixed in the lower extremity of a depending arm of a bell crank lever 502, in turn also rotatably mounted on the transverse shaft 43. A limit stud 503 is mounted in the lower arm of bell crank lever 502 which is normally in engagement with the forward edge of the lower portion of lever 496 to prevent clockwise movement of bell crank 502 relative to lever 496, or counterclockwise movement of lever 496 relative to bell crank 502. The lower arm of the pawl 498 is provided with a suitable bevelled or angular portion adapted to be engaged by a pin 504 mounted in the forward arm of bell crank lever 492. The upper arm of bell crank lever 502 is provided with a roll 505 adapted to cooperate with a cam surface provided on the lower edge of link 482 and also with the upper end of an upright cam arm 506 fixedly mounted at its lower end on the transverse rock shaft 138.

As has been described hereinbefore, depression of the "equals" key 87 or the operations control key 377 effects rocking of shaft 138 in a clockwise direction, as viewed from the left side of the machine, and such rocking of shaft 138 will dispose the upper end of the cam arm 506 (Fig. 5) under the roll 505 to prevent downward movement of the latter. Since the forward swinging of the zeroizing crank 474 and depression of the release key 484 will be accompanied by movement of link 482 to the right of its normal position of Fig. 5, operation of the zeroizing crank 474 or of the release key 484 thus will be prevented during operation of either the "equals" key 87 or the operations control key 377, as movement of link 482 to the right of its position of Fig. 5 must cause depression of the roll 505 by the associated cam edge on the link, and such movement of roll 505 will be prevented by the upper end of arm 506 during operation of either of the control keys 87 or 377. Conversely, since operation of the zeroizing crank 474 or of the release key 484 will move roll 505 downwardly from its position of Fig. 5, this roll will block forward movement of the upper end of cam arm 506 during operation of the zeroizing crank or release key 484, so that neither of the control keys 87 nor 377 may be actuated during operation of the zeroizing crank 474 or of the release key 484.

As previously described, depression of any of the digit keys 24, either to effect key-responsive actuation of the machine or into key-set position in the entry of a subtrahend, divisor or multiplicand into the keyboard, will move the lower end of the associated latch piece 494 forwardly (Fig. 2) in response to the resulting actuation of the anchor locks 90 in that denominational order. Rock bar 493 thus will be moved from its normal position of Fig. 5 to swing the arm 495 in a counter-clockwise direction, which moves the lever 496 a short distance clockwise from its normal position of Fig. 5. The resulting movement of the pin 497 in the lower end of lever 496, through the agency of pawl 498, will swing bell crank lever 502 slightly in a clockwise direction to move roll 505 into engagement with the lower edge of link 482. The link 482 thus is prevented from moving to the right or forwardly to prevent operation of either the zeroizing crank 474 or the release key 484. Means are provided, however, as described in detail in my prior Patent No. 2,492,703, to permit operation of the release key 484 to enable an operator to effect the release and return of any digit keys 24 which have been erroneously depressed in the setting up of a subtrahend. As earlier described, depression of the "minus" control key 86 (Fig. 3) causes counter-clockwise rotation of shaft 107, and such rotary movement of the shaft 107 is transmitted to the bell crank lever 492 (Fig. 5) by means of the link 491 and lever 489. The resulting clockwise movement of bell crank lever 492 is sufficient to cause disengagement of the pawl 498 from pin 497 through the agency of pin 504.

Additional release mechanism has been incorporated in the instant machine to enable actuation of the zeroizing crank 474 when any digit keys are latched in key-set position, since the above-described blocking of movement of lever 482, except when "minus" key 86 is in depressed position, otherwise would prevent clearing of the machine upon completion of a problem in division or multiplication. This additional release means, as illustrated in Figs. 5 and 5a, comprises a bell crank lever 507 pivotally mounted on a shaft 508 extending across the machine, and having rod 367 pivotably secured to it by stud 368. The upper end of bell crank lever 507 extends rearwardly of the machine and terminates in a nose portion that normally is disposed in the position illustrated in the drawings in engagement with a pin 509 mounted in, and extending outwardly from, the upper hooked arm of pawl 498. Consequently, rearward movement of rod 367 in response to depression of either the "division" key 301 or the "multiplication" key 457 will rock bell crank lever 507 about its pivot 508 to depress pin 509 to disengage pawl 498 from pin 497. Bell crank lever 502 thereafter is free to rotate in response to forward movement of link 482, so that the zeroizing crank 474 may be operated, despite the previous rocking of bar 493 in response to depression of any of the digit keys 24. In other words, operation of bell crank lever 507 in response to depression of either of the keys 301 or 457 disables the otherwise operative interlocking mechanism which normally prevents actuation of the zeroizing crank while any digit key is in depressed position.

Another additional interlock is provided in the instant machine for the purpose of preventing simultaneous operation of shifter key 378 and operations control key 377. This interlock comprises an anchor-shaped key-blocking member 511 (Fig. 3) which is similar to the ordinal anchor

locks 90 and is mounted for cooperation with the stems of the control keys 377 and 378, the latter being provided with the same apertures 85 adjacent their lower ends (Fig. 7) as are disposed in the digital key stems 47.

It is thought that the invention and many of 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 being merely a preferred embodiment thereof.

I claim:

1. In a key-responsive calculating machine having an accumulator, actuating mechanism for said accumulator, and digit keys depressible a predetermined distance to cause actuation of said accumulator by said actuating mechanism and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, means settable in response to operation of said control key for positively limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent actuation of said accumulator by said actuating mechanism in response to depression of said digit keys, and normally inoperative means rendered operable in response to operation of said control key to latch any depressed digit key in key-set position, when the digit key is moved downward said limited distance, to maintain the same operative to determine the digital extent of subsequent actuation of the accumulator by said actuating mechanism, and selectively operable means for effecting operation of said actuating mechanism.

2. A calculating machine according to claim 1, in which said last recited selectively operable means comprises a depressible operations control key.

3. In a key-responsive calculating machine having a multi-denominational accumulator, actuating mechanism for each denominational order of said accumulator, and denominational orders of digit keys depressible a predetermined distance to cause actuation of said accumulator by said actuating mechanism in the associated denominational order and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, a first means settable in response to operation of said control key for positively limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent actuation of said accumulator by said actuating mechanisms in response to depression of said digit keys, and normally inoperative means rendered operable in response to operation of said control key to latch any depressed digit key in key-set position, when the digit key is moved downward said limited distance, to maintain the same operative to determine the digital extent of subsequent actuation of the accumulator by the associated said actuating mechanism, and selectively operable means for effecting operation of all of said actuating mechanisms.

4. In a calculating machine according to claim 3, normally inoperative means in each denominational order of the machine rendered operative in response to the setting of said first means to prevent actuation of the accumulator in response to subsequent operation of the denominationally associated actuating mechanism, said last means being rendered inoperative in response to depression of a denominationally associated digit key to key-set position.

5. In a normally key-responsive calculating machine having a keyboard with denominational orders of digit keys, an accumulator, denominational mechanisms for actuating said accumulator in accordance with the values, and in response to the depression, of the denominationally associated keys, subtraction control means for rendering said key-responsive mechanisms key-set and for latching said keys subsequently depressed in fully depressed position, normally inoperative means operable by said subtraction control means for conditioning said actuating mechanisms to actuate said accumulator in accordance with the complemental values of the keys depressed, and selectively operable means for effecting operation of all of said actuating mechanisms to add to the accumulator the complement of a subtrahend set into the keyboard by previous depression of digit keys to key-set position; division control means for rendering operable said normally inoperative means, a normally inoperative member associated with each denominational order of digit keys operable in response to said division control means to positively limit depression of the digit keys to an intermediate key-set position insufficient to effect operation of the associated said actuating mechanism, means operable in response to said division control means for latching depressed digit keys in said intermediate key-set position to cooperate with said normally inoperative means, and an operations control key for actuating said selectively operable means for effecting operation of all of said actuating mechanisms to add to the accumulator the complement of a divisor set into the keyboard by previous depression of digit keys to said intermediate key-set position.

6. A calculating machine according to claim 5, wherein said accumulator includes an overflow numeral wheel, a normally inoperative overflow actuating mechanism for accumulatively actuating said overflow numeral wheel, and means operable by said subtraction control means only for conditioning said overflow actuating mechanism for operation in response to subsequent operation of the actuating mechanism in the highest denominational order of the machine effected by operation of said selectively operable means.

7. In a calculating machine according to claim 6, selectively operable means for transordinally shifting the keyboard divisor setting to the next lower denominational orders of digit keys, and normally inoperative key-setting means conditioned for operation by said division control means and operable by said keyboard setting shifting means to depress the "9" digit key in the highest denominational order of the machine into its intermediate key-set position.

8. A calculating machine according to claim 7, wherein said keyboard setting shifting means comprises a depressible shifter key, and normally inoperative blocking means operable in response to said division control means to block operation of said actuating mechanism to prevent accidental operation thereof in response to staccato depressions of said shifter key, said blocking means being movable to inoperative position in response to actuation of said operations control key.

9. In a normally key-responsive calculating machine having a keyboard with denominational orders of digit keys, an accumulator, denominational mechanisms for actuating said accumulator in accordance with the values, and in response to the depression, of the denominationally associated keys, subtraction control means for rendering said key-responsive mechanisms key-set and for latching said keys subsequently depressed in fully depressed position, normally inoperative means operable by said subtraction control means for conditioning said actuating mechanisms to actuate said accumulator in accordance with the complemental values of the keys depressed, and selectively operable means for effecting operation of all of said actuating mechanisms to add to the accumulator the complement of a subtrahend set into the keyboard by previous depression of digit keys to key-set position; division control means for rendering operable said normally inoperative means, a normally inoperative member associated with each denominational order of digit keys movable to an intermediate operative position in response to said division control means to positively limit depression of the digit keys to an intermediate key-set position insufficient to effect operation of the associated said actuating mechanism, means operable in response to said division control means for latching depressed digit keys in said intermediate key-set position to cooperate with said normally inoperative means, an operations control key for actuating said selectively operable means for effecting operation of all of said actuating mechanisms to add to the accumulator the complement of a diviser set into the keyboard by previous depression of digit keys to said intermediate key-set position, multiplication control means for causing operation of said digit key latching means and movement of said normally inoperative members to a full operative position, and normally inoperative locking means in each denominational order rendered operative by movement of the associated last recited member to full operative position for preventing actuation of the accumulator in response to subsequent operation of the denominationally associated actuating mechanism, said members being moved to said intermediate operative position in response to subsequent depression of an associated digit key to said intermediate key-set position in setting a multiplicand into the keyboard to disable the denominationally associated said locking means, whereby subsequent actuation of said operations control key effects the addition to the accumulator of such multiplicand.

10. In a calculating machine according to claim 9, selectively operable means for transordinally shifting the divisor or multiplicand keyboard setting to the next lower denominational orders by releasing those keys latched in said intermediate key-set position and depressing the corresponding digit keys in the next lower adjacent orders into intermediate key-set position.

11. A calculating machine according to claim 10, wherein said keyboard setting shifting means comprises a depressible shifter key, and normally inoperative blocking means operable in response to said division or said multiplication control means to block operation of said actuating mechanisms to prevent accidental operation thereof in response to staccato depressions of said shifter key, said blocking means being movable to inoperative position in response to actuation of said operations control key.

12. In a key-responsive calculating machine having an accumulator, actuating mechanism for said accumulator, and digit keys depressible a predetermined distance to cause actuation of said accumulator by said actuating mechanism and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, means settable in response to operation of said control key for positively limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent actuation of said accumulator by said actuating mechanism in response to depression of said digit keys, and normally inoperative means rendered operable in response to operation of said control key to latch any depressed digit key in key-set position, when the digit key is moved downward said limited distance, to maintain the same operative to determine the digital extent of subsequent actuation of the accumulator by said actuating mechanism, selectively operable means for effecting operation of said actuation mechanism, and transordinal shifter means for releasing those digit keys latched in key-set position and depressing the corresponding digit keys in the next adjacent lower denominational orders into key-set position.

13. In a calculating machine according to claim 12, normally inoperative blocking means operable in response to operation of said control key to block operation of said actuating mechanism in response to staccato depression of said digit keys into key-set position, said blocking means being movable to inoperative position in response to each actuation of said selectively operable means for effecting operation of said actuating mechanism.

14. In a key-responsive calculating machine having a multi-denominational accumulator, actuating mechanisms for each denominational order of said accumulator, and denominational orders of digit keys depressible to cause actuation of said accumulator by said actuating mechanism in the associated denominational orders and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, and a normally inoperative ordinal slide bar mounted in each denominational order of the machine for movement in response to operation of said control key into operative position for cooperation with the stems of the associated said digit keys to positively limit downward movement of said keys to a distance insufficient to cause actuation of said accumulator by the denominationally associated said actuating mechanism, the limited downward movement of digit keys permitted by the associated said ordinal slide bars being sufficient to determine the digital extent of subsequent actuation of the accumulator by the denominationally associated said actuating mechanism.

15. A calculating machine according to claim 14, wherein the stem of each digit key is provided with a slot through which the associated said ordinal slide bar extends, and each of said slide bars is provided with a relief portion normally disposed in each of said key stem slots to permit full key-responsive depression of the digit keys and a key-blocking portion adjacent each

said relief portion movable into the associated key stem slot to limit downward movement of the digit keys.

16. In a key-responsive calculating machine having an accumulator, actuating mechanism for said accumulator, and denominational orders of digit keys depressible to cause actuation of said accumulator by said actuating mechanism and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a division control key, a multiplication control key, and a normally inoperative ordinal slide bar mounted in each denominational order of the machine for movement in response to operation of said division control key into an intermediate operative position for cooperation with the stems of the associated said digit keys to positively limit downward movement of said keys to a distance insufficient to cause actuation of said accumulator by said actuation mechanism, the limited downward movement of digit keys permitted by the associated said ordinal slide bars being sufficient to determine the digital extent of subsequent actuation of the accumulator by said actuating mechanism, and said ordinal slide bars being moved a greater distance in response to operation of said multiplication control key into a full operative position, wherein subsequent depression of a digit key will return the associated said slide bar to said intermediate operative position.

17. A calculating machine according to claim 16, wherein the stem of each digit key is provided with aslot through which the associated said ordinal slide bar extends, and each of said slide bars is provided with a relief portion normally disposed in each of said key stem slots to permit full key-responsive depression of the digit keys, a key-blocking portion adjacent each said relief portion movable into the associated key stem slot to cooperate with the upper edge of said slot to limit downward movement of the digit keys when the slide bar is disposed in said intermediate operative position, and a cam portion adjacent each said key-blocking portion movable into cooperative association with the upper edge of the associated key stem slot when the slide bar is moved into said full operative position to enable return movement of the slide bar to said intermediate operative position in response to subsequent depression of an associated digit key.

18. In a key-responsive calculating machine having a multi-denominational accumulator, actuating mechanisms for each denominational order of said accumulator, and denominational orders of digit keys depressible to cause actuation of said accumulator in the associated denominational order and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a division control key, a multiplication control key, and a normally inoperative ordinal slide bar mounted in each denominational order of the machine for movement in response to operation of said division control key into an intermediate operative position for cooperation with the associated said digit keys to positively limit downward movement of said keys to a distance insufficient to cause actuation of said accumulator by the denominationally associated said actuating mechanism, the limited downward movement of digit keys permitted by the associated said ordinal slide bars being sufficient to determine the digital extent of subsequent actuation of the accumulator by the denominationally associated said actuating mechanism, said ordinal slide bars being moved a greater distance in response to operation of said multiplication control key into a full operative position wherein subsequent depression of a digit key will return the associated said slide bar to said intermediate operative position, and normally inoperative locking means in each denominational order of the machine rendered operative in response to movement of the denominationally associated said slide bar from intermediate to full operative position to prevent operation of the accumulator in response to subsequent operation of the denominationally associated actuating mechanism, said locking means being rendered inoperative in response to movement of the associated said slide bar from said full operative position to said intermediate operative position.

19. A calculating machine according to claim 18, wherein each of said locking means comprises a locking lever for preventing effective actuation of the denominationally associated said actuating mechanism, and a second lever for actuating said locking lever and pivotally connected to the denominationally associated said ordinal slide bar.

20. In a key-responsive calculating machine having a multi-denominational accumulator, actuating mechanisms for each denominational order of said accumulator, and denominational orders of digit keys depressible a predetermined distance to cause actuation of said accumulator by said actuating mechanism in the associated denominational order and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, a first means settable in response to operation of said control key for positively limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent actuation of said accumulator by said actuating mechanisms in response to depression of said digit keys, and normally inoperative means rendered operable in response to operation of said control key to latch any depressed digit key in key-set position, when the digit key is moved downward said limited distance, to maintain the same operative to determine the digital extent of subsequent actuation of the accumulator by the associated said actuating mechanism, selectively operable means for effecting operation of all of said actuating mechanisms, normally inoperative locking means in each denominational order of the machine rendered operative in response to the setting of said first means to prevent actuation of the accumulator in response to subsequent operation of the denominationally associated actuating mechanism, said locking means being rendered inoperative in response to depression of a denominationally associated digit key to key-set position, selectively operable means for releasing those digit keys latched in key-set position and depressing the corresponding digit keys in the next adjacent lower denominational orders into key-set position, and means for automatically rendering said locking means operative upon release and return of all denominationally associated digit keys to normal raised position.

21. In a calcuating machine having an accumulator, a unidirectional actuator for said accumulator, and a keyboard comprising a plurality of denominational orders of digit keys; a division control key, a multiplication control

slide bar, and transordinal means extending transversely of the machine for slidably supporting the central portions of said ordinal slide bars to prevent bending thereof in response to depression of said digit keys.

29. A calculating machine comprising an accumulator, actuating mechanism for said accumulator, a keyboard including denominational orders of digit keys depressible to key-set position to determine the digital extent of actuation of said accumulator by said actuating mechanism, selectively operable multiple operations control means for causing actuation of said accumulator by said actuating mechanism in accordance with the keyboard setting represented by digit keys in key-set position, and transordinal keyboard setting shifter mechanism, comprising a depressible shifter key spring-urged to raised position, a rock shaft interposed between each adjacent denominational order of digit keys, spring means for urging all of said rock shafts axially to inoperative position, means operable by initial downward movement of said shifter key to shift said rock shafts axially to operative position against the action of said spring means and for maintaining the same therein during substantially complete downward movement of the shifter key, including a force-transmitting member normally interposed between said rock shafts and said shifter key, means operable by said shifter key, during the remainder of its downward movement following such axial shifting of said rock shafts, to rock said shafts to release all of those digit keys in key-set position and to depress the corresponding digit keys in the next adjacent denominational orders into key-set position, and means comprising an extension of said force-transmitting member operable by said shifter key in its final downward movement to displace said member to break the operating connecting between said shaft shifting means and the shifter key to relieve the latter of the pressure of said spring means to prevent binding of the shifter key during its return to raised position.

30. In a key-responsive calculating machine having an accumulator, actuating mechanism for said accumulator, digit keys depressible to cause actuation of said accumulator by said actuating mechanism and operable to determine the digital extent of such actuation, means for zeroizing the accumulator including a zeroizing lever, and interlocking means operable to prevent simultaneous operation of said zeroizing lever and said digit keys; selectively settable means for conditioning the machine for key-set operation by preventing actuation of said accumulator in response to depression of said digit keys and for latching depressed digit keys in key-set position, including a multiple calculation control key, and means operable in response to said multiple calculation control key for disabling said interlocking means to permit operation of said zeroizing lever when said digit keys are in key-set position.

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key, latching means operable in response to depression of said control keys for latching said digit keys in depressed position to control the digital extent of movement of said accumulator by said actuator, means operable by said division control key for conditioning said actuator to actuate said accumulator in accordance with the complemental values of the digit keys depressed, selectively operable means for effecting operation of said actuator in all denominational orders, whereby the complement of a divisor set in said keyboard by the digit keys depressed is added into said accumulator, and locking means operable in response to depression of said multiplication control key for preventing actuation of said accumulator by said actuator in response to actuation of said selectively operable means, said locking means being rendered inoperative in each denominational order of the machine in response to depression of a digit key in the corresponding order in the setting up of a multiplicand in the keyboard.

22. In a calculating machine according to claim 21, transordinal keyboard setting shifter means operable to release those digit keys latched in depressed position and to depress the corresponding digit keys in the next adjacent lower denominational orders, and means operative whenever said multiplication control key is depressed for automatically rendering said locking means operative in any denominational order in which any previously depressed digit key is released by said shifter means without depressing any other digit key therein.

23. In a key-responsive calculating machine having an accumulator, actuating mechanism for said accumulator, and digit keys depressible a predetermined distance to cause actuation of said accumulator by said actuating mechanism and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, means settable in response to operation of said control key for positively limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent actuation of said accumulator by said actuating mechanism in response to depression of said digit keys, and normally inoperative means rendered operable in response to operation of said control key to latch any depressed digit key in key-set position, when the digit key is moved downward said limited distance, to maintain the same operative to determine the digital extent of subsequent actuation of the accumulator by said actuating mechanism, selectively operable means for effecting operation of said actuating mechanism, transordinal shifter means for releasing any digit keys latched in key-set position and depressing the corresponding digit keys in the next adjacent lower denominational orders into key-set position, and normally inoperative key-setting means conditioned for operation by said control key and operable by said shifter means to depress the "9" digit key in the highest denominational order of the machine into key-set position.

24. In a key-responsive calculating machine having a multidenominational accumulator, actuating mechanism for each denominational order of said accumulator, power trip mechanism in each denominational order for effecting actuation of the corresponding actuating mechanism, digital control means in each denominational order for determining the digital extent of actuation of the accumulator by the corresponding actuating mechanism, and denominational orders of digit keys cooperating with the corresponding digital control means and depressible a predetermined distance to effect operation of the corresponding power trip mechanism; selectively settable means for conditioning the machine for key-set operation, comprising a calculation control key, normally inoperative key-blocking means movable to operative position in response to depression of said control key for limiting downward movement of said digit keys to a distance less than said predetermined distance to prevent key-responsive operation of said power trip mechanisms, and normally inoperative key-latching means operable in response to depression of said control key for latching any digit key depressed said limited distance in key-set position to maintain the same operative to cooperate with the corresponding digital control means, and operations control means selectively operable to effect operation of all of said power trip mechanisms.

25. In a calculating machine according to claim 24, normally inoperative power trip blocking means movable to operative position in response to depression of said control key to block operation of said power trip mechanisms and movable to inoperative position by said operations control means.

26. A calculating machine according to claim 25, wherein said key-blocking means comprises an ordinal slide bar mounted in each denominational order for cooperation with the stems of the digit keys in the corresponding denominational order.

27. In a calculating machine according to claim 26, digital control locking means, comprising a normally inoperative lever mounted in each denominational order for movement to operative position, in response to movement of the corresponding ordinal slide bar to operative position, to lock the denominationally associated digital control means against movement and movable to inoperative position in response to depression of a denominationally associated digit key to key-set position.

28. In a key-responsive calculating machine having a multi-denominational accumulator, actuating mechanisms for each denominational order of said accumulator, and denominational orders of digit keys depressible to cause actuation of said accumulator by said actuating mechanisms and operable to determine the digital extent of such actuation; selectively settable means for conditioning the machine for key-set operation, comprising a calculating control key, and a normally inoperative ordinal slide bar mounted in each denominational order of the machine for movement in response to operation of said control key into operative position for cooperation with the stems of the associated said digit keys to positively limit downward movement of said keys to a distance insufficient to cause actuation of said accumulator by the denominationally associated said actuating mechanism, the limited downward movement of digit keys permitted by the associated said ordinal slide bars being sufficient to determine the digital extent of subsequent actuation of the accumulator by the denominationally associated said actuating mechanism, operations control means selectively operable to effect operation of said actuating mechanisms, means for slidably supporting and guiding each end of each said ordinal