Oct. 28, 1952 F. J. FURMAN ET AL 2,615,633

TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

Filed Nov. 16, 1950 5 Sheets-Sheet 1

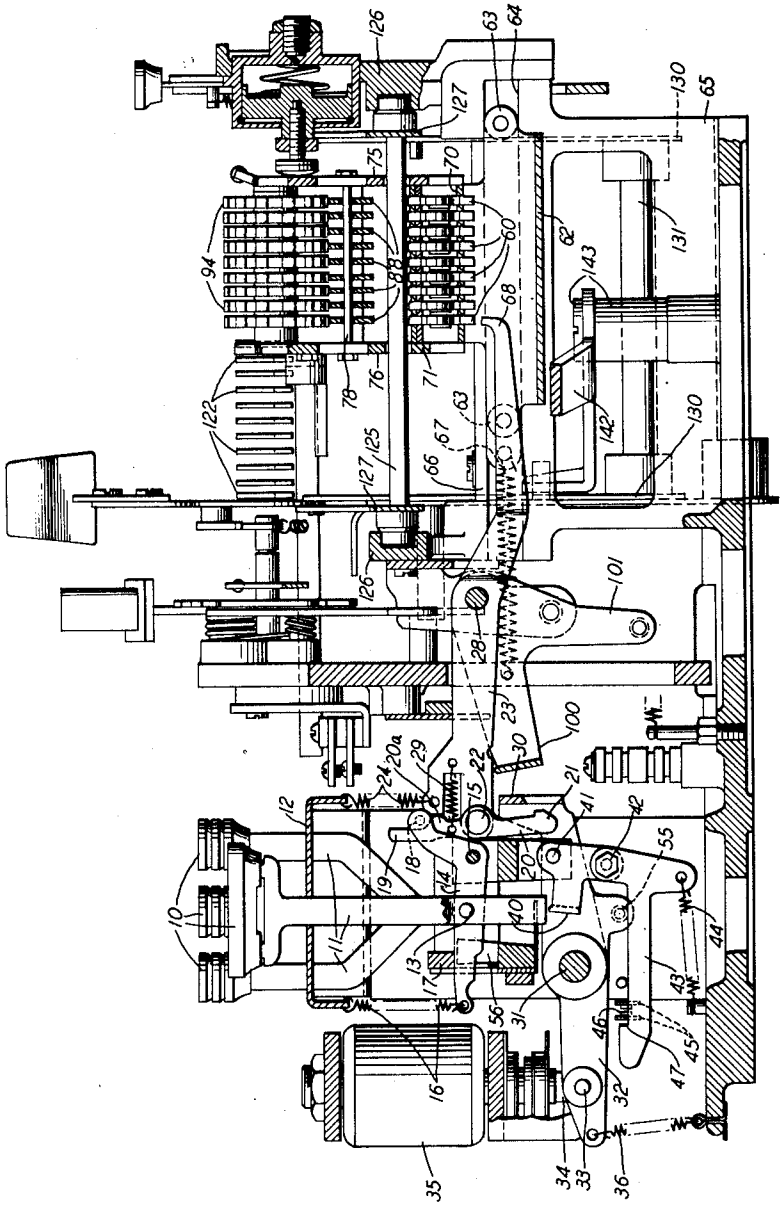


FIG. 1.

INVENTORS
FRANK J. FURMAN
HAROLD L. READ
HAROLD J. KISTNER

BY J. W. Lowmitzer
ATTORNEY

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TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

Filed Nov. 16, 1950 5 Sheets-Sheet 2

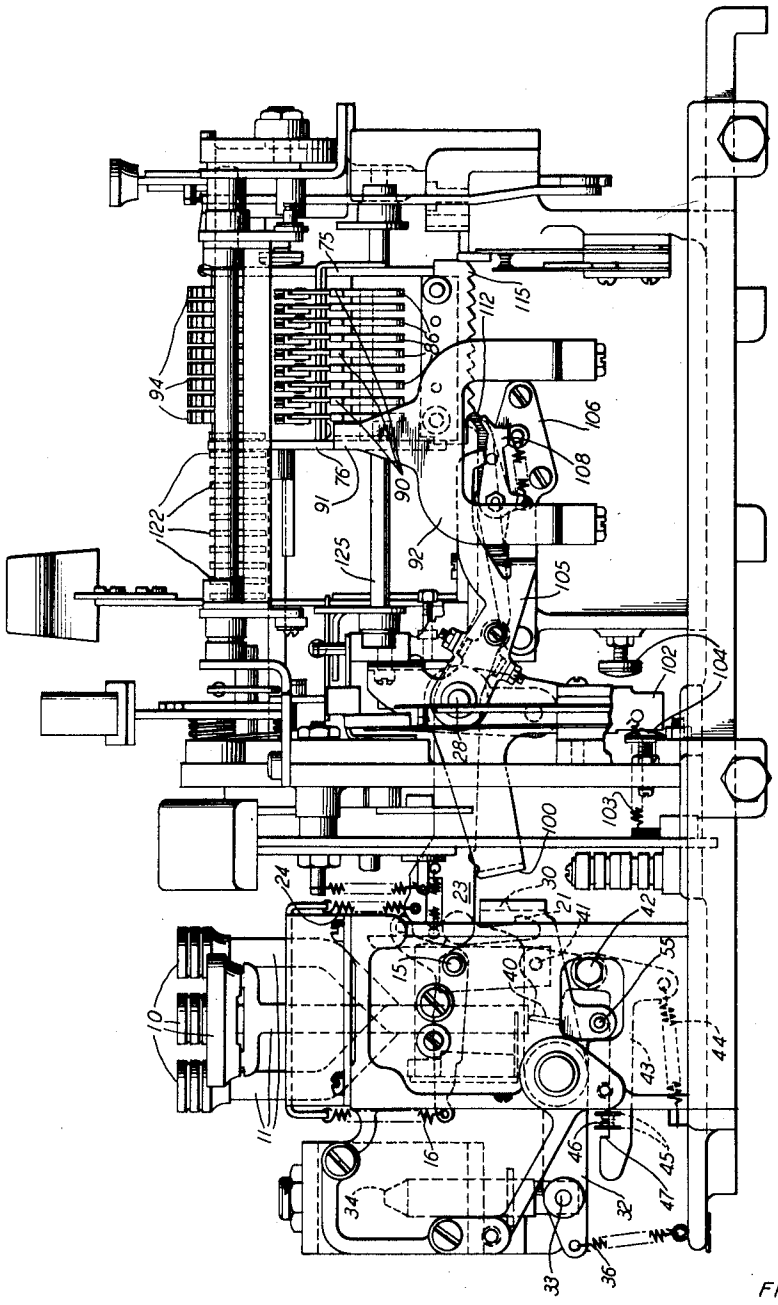


FIG. 2.

INVENTORS
FRANK J. FURMAN
HAROLD L. READ
HAROLD J. KISTNER

BY J. W. Kommitzer
ATTORNEY

Oct. 28, 1952 F. J. FURMAN ET AL 2,615,633

TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

Filed Nov. 16, 1950 5 Sheets-Sheet 3

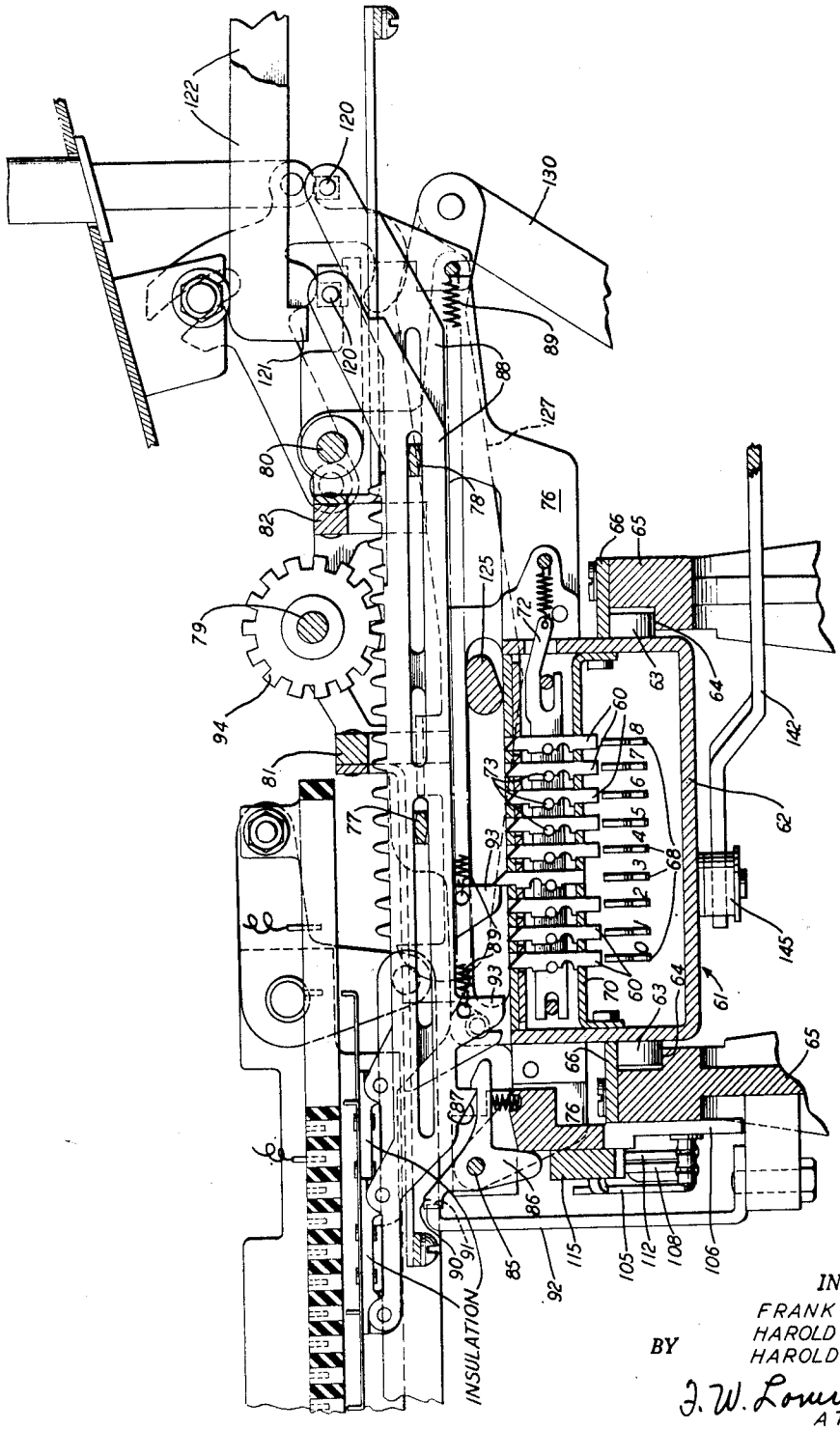


FIG. 3.

INVENTORS
FRANK J. FURMAN
HAROLD L. READ
HAROLD J. KISTNER

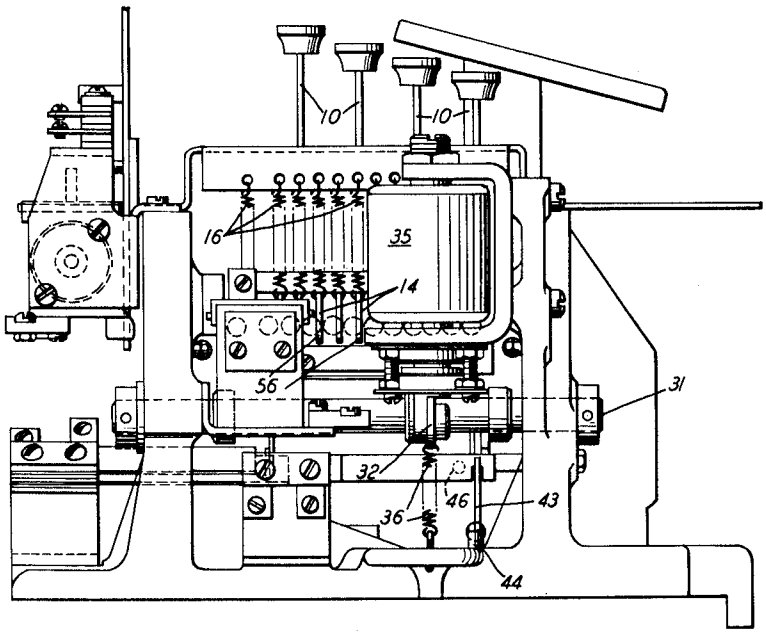
BY J. W. Lonnitzer
ATTORNEY

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TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

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FIG. 4.



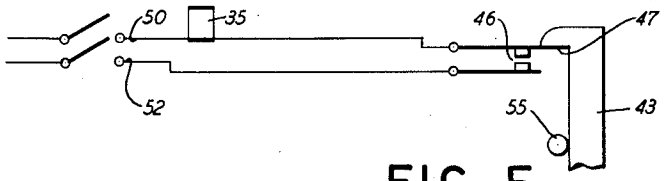


FIG. 5.

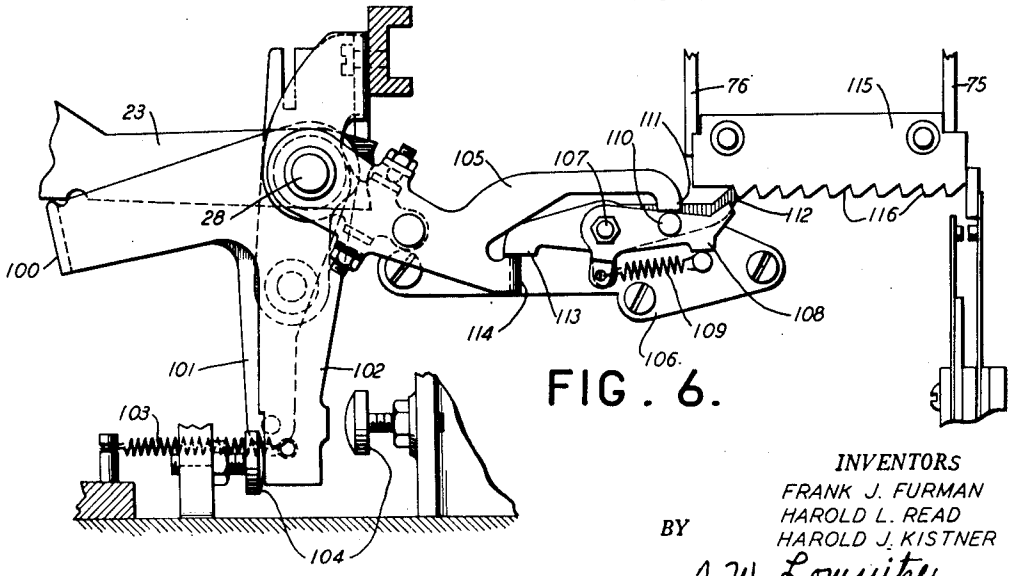


FIG. 6.

INVENTORS
FRANK J. FURMAN
HAROLD L. READ
HAROLD J. KISTNER
BY
J. W. Lowenstein
ATTORNEY

Oct. 28, 1952 F. J. FURMAN ET AL 2,615,633

TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

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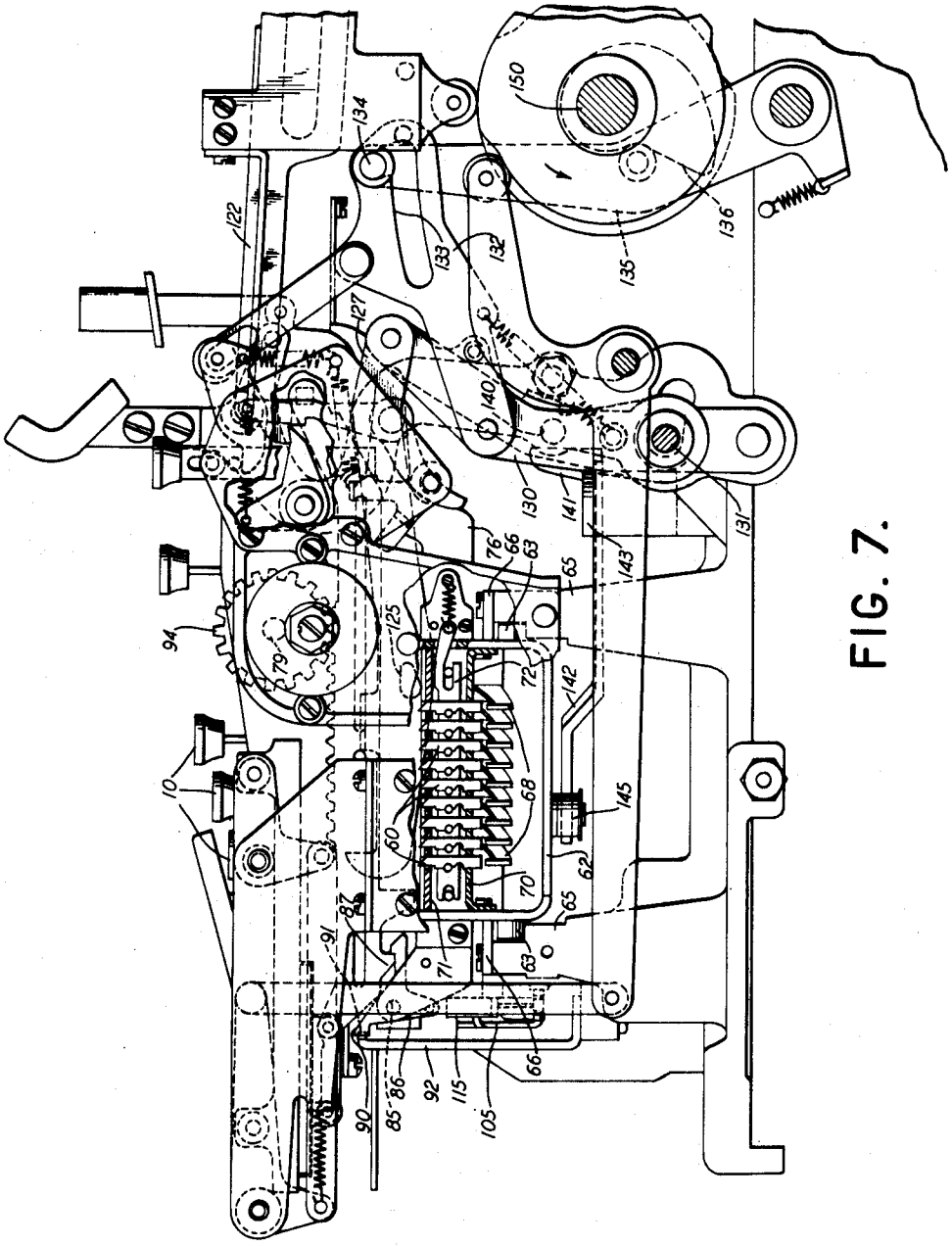


FIG. 7.

INVENTORS
FRANK J. FURMAN
HAROLD L. READ
HAROLD J. KISTNER

BY J. W. Lowmiller
ATTORNEY

Patented Oct. 28, 1952

2,615,633

UNITED STATES PATENT OFFICE

2,615,633

TEN-KEY KEYBOARD MECHANISM FOR ACCOUNTING MACHINES

Frank J. Furman, Endicott, Harold L. Read, Vestal, and Harold J. Kistner, Endicott, N. Y., assignors to International Business Machines Corporation, New York, N. Y., a corporation of New York

Application November 16, 1950, Serial No. 195,956

2 Claims. (Cl. 235—145)

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This invention relates to key controlled differential mechanisms for adding machines and more specifically to the type controlled by the ten digit keys.

The main object of the present invention is to devise a ten-key mechanism for incorporation in an adding machine which has a complete electrical power operation, is simple in construction and reliable in operation and by an efficient touch operation requires a minimum of expenditure of manual power in operating the keys.

More specifically it is an object of the present invention to improve the construction of the ten-key keyboard mechanism of the pin stop carriage type to the end that the key strokes are lighter in operation, resulting in more key strokes for a given time than has been possible heretofore, thus enabling faster digit setup operations and reducing operator fatigue.

In former ten-key keyboard arrangements of the pin stop carriage type the setting of a digit pin to a stop position was directly effected by the depression of each key, which placed a considerable load on the operator's finger. Again the operation of the escapement mechanism placed an additional load so that some force had to be exerted in the key depression to effect these functions. With the present improvement the positioning of the pin to a stopping position is performed by power means acting independently of the key depression but initiated in operation thereby. A further improvement causes the power operation of the escapement mechanism and also acting independently of the key depression. With the power operation of the pin raising devices and the escapement mechanism, both of these function independently of the key depressions so that timing of their operations is completely independent of the keys. This has given the added advantage that the operator need no longer take extreme care in the key depressions to give ample time for their operations.

In carrying out the above improvements the only operations now effected directly by a key depression is to move a hook-shaped member under a bail to select a pin stop raising device and close contacts to energize a solenoid. Very little power is required to do either or both. The energization of the solenoid reciprocates the bail which causes the operation of the escapement mechanism and the seelcted pin stop raising devices. The design is such that maintained depression of a key cannot effect a repeat operation, necessitating a restoration of a key before another pin setting operation can be performed.

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Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 is a transverse sectional view of the improved ten-key mechanism.

Fig. 2 is a view in front elevation of the improved ten-key mechanism.

Fig. 3 is a longitudinal sectional view showing the manner of raising the stops in the ten-key pin carriage and for controlling the differential movement of actuating members.

Fig. 4 is a view in side elevation of a part of the left side of the ten-key keyboard mechanism.

Fig. 5 is a wiring diagram of the electrical instrumentalities.

Fig. 6 is a detail view of the escapement mechanism.

Fig. 7 is a view in side elevation of the right-hand side of the ten-key keyboard mechanism.

The ten-key keyboard unit has ten numeral keys 10 (Fig. 1) which are arranged in a conventional ten-key keyboard arangement and upon the upper protruding ends of the slidable keys stems 11 there are mounted the key caps which designate the digital value of each key. The key stems slide in a slotted guide plate 12 and at their lower ends they are each articulated by a pin 13 to a hook operating arm 14, all ten of which are pivoted on a rod 15, each arm 14 being urged by an associated spring 16 against a stop bar 17, said spring 16 also normally functioning to return each key after it has been depressed, as well as to return the associated arm 14 against the stop bar 17. Each arm 14 carries a stud 18 projecting against a finger 19 of an associated arm 20 having a hooked end 21. Each arm 20 is pivotally mounted by a stud 22 on the associated stop pin raising arm 23. Each arm 23 is urged by a spring 24 to normal position, shown in Fig. 1 and all of said arms 23, of which there are ten, one for each key 10, are pivoted on a rod 28. It will also be seen that a spring 29 connected between a stud carried by the pin raising arm 23 and related arm 20 holds a portion 20a above the pivot stud 22 against end of arm 23, as is shown in Fig. 1.

So far it is evident that when a key 10 is depressed by the finger of the operator it will rock hook operating arm 14 counterclockwise against the action of the spring 16, causing stud 18 to act against the finger 19 to rock the arm 20 slightly counterclockwise to bring the hook-shaped end

21 underneath a power-operated bail 30. It is evident, therefore, that the only load upon the operator in depressing a key is that required to rock the arm 20 so as to place the hook-shaped end 21 beneath the bail 30, the power required to do so being very slight due to the weak springs 29 and 16. After the hook-shaped end 21 is caught underneath the bail 30 there is a power operation of the bail 30 by electrical power means initiated in operation by the following described mechanism. Bail 30 is secured to a rock shaft 31 and secured to said shaft 31 there is an arm 32 which is articulated by a stud 33 to the core 34 of a power solenoid 35. The bail 30 is normally held in the position shown in Fig. 1 by means of a spring 36 connected to said arm 32.

Extending beneath each of the key stems 11, which are so bent that they are in a single line at their lower extremities, is a bail 40 which is pivoted upon a rod 41. One arm of said bail 40 is connected by a stud 42 to a contact operating member 43 which is urged by a spring 44 so that its left-hand extension fits in slots 45 of the blades of contacts 46. The spring 44 also retains contact operating member 43 so that its shoulder 47 is adjacent the left-hand contact blade.

When said bail 40 is rocked counterclockwise it will, through its pivot stud 42 move contact operating member 43 slightly to the right, as viewed in Fig. 1, so that shoulder 47 bearing against said left-hand contact blade will close contacts 46. It should be noted that closure of contacts 46 is timed to take place after the hook-shaped end 21 of the arm 20 associated with the depressed key is beneath the bail 30 and also that the additional load placed upon the finger of the operator to close such contacts 46 is not great because of the weak spring 44 and the slight power required to close the contacts 46.

Thereafter, a circuit (see Fig. 5) is completed from line side 50, through solenoid 35, contacts 46, line side 52 to energize said solenoid 35 which thereupon attract its core 34 (Fig. 1), rocking the bail 30 clockwise and through the hooked arm 20 connecting it with the bail 30 rocking the associated pin setup or raising arm 23 counterclockwise against the action of spring 24 to set up, in a manner to be described, a pin in a pin setup carriage representing the digit value of the key depressed. This operation takes place without effecting any further movement of the key since, at this time, the finger extension 19 will merely ride down against the stud 18 without effecting any movement of the rocked arm 14 or the interconnected key stem 11.

Near the end of the solenoid plunger power stroke a stud 55 on an arm of the bail 30 operates against the upper edge of the contact closing member 43, rocking the latter slightly counterclockwise and disengaging shoulder 47 from the left-hand contact blade of contacts 46 so that by their inherent resiliency said contacts 46 again open and deenergize the solenoid 35. The depressed key must be returned to nearly its normal position before spring 44 will rock member 43 so as to re-engage the contacts 46 for another closure thereof. Also the hooked arm 20 is not disengaged from the bail 30 until near the end of the return stroke of the solenoid core 34. Therefore, the depressed key must be returned nearly home before another key can be depressed, or a redepression of the same key can be effected. At this point the rocked arm 14 is released from the single key interlocking mechanism to be

presently described so that another key can be depressed.

This single key interlocking mechanism is of a well known construction and comprises a series of disks 56 (see Fig. 4) which have a normal separation which allows the entrance of only one arm 14 between associated disks 56, thus crowding the remaining disks 56 so that no other key stem 14 can be interposed between and thus no other key can be depressed. When a key is returned home the arm 14 moves away from adjacent disks 56, allowing this normal separation to enable the depression of another key and associated arm 14 between them. Because such form of interlocking mechanism is well known it is only briefly described herein.

In the differential mechanism the setup pins or stops 60 are arranged in a transverse series as shown in Fig. 1 in which all pins in each transverse series represent the same digit and in which the pins or stops are also arranged in longitudinal series (Fig. 3) in numerical order 0–8 and all the pins are capable of being selectively set to limit the movements of actuating devices.

The pin setup carriage which is designated generally by the reference character 61 (Fig. 3) includes a U-shaped plate 62 carrying rollers 63 which are slidably mounted in track 64 (Fig. 1) each formed by a shoulder in castings 65 (Fig. 3) and a cap plate 66 secured thereto. By this means the pin setup carriage is moved step by step as the longitudinal series of stop pins 60 are successively set up to represent the digits of the keys depressed. The carriage is urged to the left as shown in Fig. 1 by means of a spring 67 connected to the carriage, the step-by-step movement being under control of an escapement mechanism to be subsequently described. The several series of longitudinal stop pins 60, of which there are nine longitudinal series for setting up a number having nine denominational orders, are slidably mounted in a bottom guide plate 70 (Fig. 3) and upper guide plates 71, both of said guide plates 70 and 71 being carried by and mounted within the U-shaped plate 62. As best shown in Figs. 3 and 7, there are nine pin raising levers 23 for keys 0–8 having nine fingers or extensions 68 which project through said pin setup carriage as shown in Fig. 1 so as to raise an associated stop pin 60 corresponding to the digit keys 0–8 depressed of the effective longitudinal series. For each longitudinal series of pins 60 there is a spring-urged detent plate 72 carrying pins 73 which engage one or the other of a pair of notches in each stop pin 60 to hold the pins 60 down in normal position, or one in elevated position, as is well known in such detent mechanism.

Secured to the U-shaped frame plate 62 and carried thereby in any suitable manner are two upstanding side plates 75 and 76 (Figs. 1 and 2). To side plates 75 and 76 are attached the guide plates 70 and 71, as seen in Fig. 1. Thus, an extension of the pin carriage is provided and the upper portion of said carriage has cross connecting members, such as guide bars 77 and 78 (Fig. 3) on which certain members are slidably mounted, as well as supporting shafts 79 and 80 and cross bars 81 and 82. These cross members provide a rigid frame which is an extension and part of the movable pin carriage.

Pivotally mounted on a rod 85 also carried by side frame members 75, 76 is a series of spring-urged latch members 86 (see Fig. 3), each having a hook normally engaging a shoulder 87 of a series

of setup slides 88 slidably mounted in the pin setup carriage by the guide rods 77 and 78. A spring 89 attached to each rack 88 urges the latter to the right to cause the hook of the latch member 86 to normally engage the shoulder 87 of the associated slide 88. Each latch member 86 has an extension 90 adapted as the step of movement of the pin carriage moves the effective longitudinal series of stop pins out of engagement with the extensions 68 after a stop pin in said series has been set up, to engage the cam edge 91 of a stationary cam plate 92 (see also Fig. 2).

As is viewed in Fig. 2, if the first or left-hand longitudinal series of pins 60 has been set up to represent the digit of the depressed key, a step of movement of the pin carriage will cause the extension 90 of the latch 86 of the associated series to engage the cam edge 91, which cam edge will cause the rocking of the latch member 86 counterclockwise (Fig. 3) to disengage it from the setup slide 88. The spring 89 attached to said slide 88 will now move it to the right until a depending extension 93 thereof strikes the elevated pin stop 60, as is shown in Fig. 3 for the pin 60 elevated by the 3-digit key. It is, of course, understood that the release of the slide 88 occurs after the pin 60 has been raised and held elevated by the detent plate 72. Each slide 88 has rack teeth which mesh with a gear 94 having on the periphery numeral indicia which are visible through a slot in the cabinet so that the numerical value of the previously depressed key is exhibited. As the carriage moves step by step the indicia are brought into view, to represent a number which has been set up.

The escapement mechanism is provided for obtaining the step-by-step movement of the pin carriage to the left, as viewed in Figs. 1 and 2, as the several longitudinal series of pins 60 are set up by the successive depression of the keys. Underlying the ten pin raising arms 23 for keys 0–9 is a bail 100 secured to the rock shaft 28, said bail 100 having, as shown in Figs. 2 and 6, depending arms 101 and 102, said arm 102 having connected thereto a spring 103 which is adapted to return the bail to normal position after having been rocked by the arms 23. Arm 102 moves back and forth between a pair of adjustable stops 104 (Fig. 6) which limit the extent of rocking of the shaft 28 to which said bail 100 is secured and also an escapement operating arm 105 secured to the shaft 28. Mounted on a fixed bracket 106 by a stud 107 on said bracket is an escapement dog 108 which is urged by its spring 109 so that a stud 110 carried thereby normally abuts a finger 111 of the escapement operating arm 105. The locking dog 112 is also pivoted on the stud 107 and is rocked by a spring similar to spring 109 so that its tail 113 overlies a lug 114 offset from the escapement operating arm 105. An escapement rack 115 is carried by the side plates 75 and 76, said rack having escapement teeth 116 and the escapement rack 115 is of sufficient width so that the teeth 116 cooperate with both the locking dog 112 and the escapement dog 108.

When the pin setup carriage is at its normal position having previously been returned to such position, the locking dog 112 engages the extreme left-hand tooth of the escapement rack 115, as shown in Fig. 6, to hold the pin carriage at normal. When bail 100 is rocked downwardly through the power operation of the selected pin raising arm 23 shaft 28 will be rocked counterclockwise and rock the escapement operating arm 105 in the same direction and by the offset lug 114 in cooperation with the tail extension 113 of the locking dog 112 the latter will be rocked clockwise against the action of its spring. In the meantime, however, spring 109 causes the stud 110 to follow the finger 111, allowing escapement dog 108 to be rocked upwardly as the locking dog 112 moves out of engagement with said first tooth, the pin carriage is now moved by its spring 67 (Fig. 1) a slight amount but not a full step of movement. When bail 100 is returned by its spring 103 escapement operating arm 105 will now be rocked clockwise and finger 111 acting on pin 110 will rock escapement dog 108 out of engagement with said first tooth. In the meantime locking dog 112 is rocked upwardly to cause an ultimate engagement with the second tooth. When the escapement dog 108 fully clears said first tooth the spring 67 which moves the pin setup carriage will move it the remainder of the distance determined by engagement of locking dog 112 with the second tooth to thereby complete the step of movement of the pin carriage. This form of an escapement mechanism is well known and its operation is only described herein, it being noted, however, that the escapement operation is not performed here by the power applied to the keys but is operated by power derived from the solenoid 35 which, it will be recalled, is the instrumentality for rocking the selected pin raising arms 23 and bail 100. Hence, the customary power required by the keys in the previous pin setup mechanisms for operating the escapement is avoided and by causing the power operation of the escapement mechanism the load upon the fingers of the operator is further lessened which aids in a lightened key load and faster key operations.

It is also explained that the 9 key does not cause the setting up of any of the stop pins 60 because there is no pin raising extension 68 for the 9 key and no "9" stop pin 60. Only the digit keys 0–8 inclusive raise stop pins 60. The arm 23 related to the 9 key, however, does operate the bail 100 to operate the escapement mechanism, allowing as will be presently described, for a 9 digit setup a step of movement of the pin setup carriage. Referring to Fig. 3 it will be recalled that upon setting up any of the stop pins 60 for the digits 0–8, setup slides 88 take a commensurate movement so as to cause square studs 120 carried at their rearward extremities to be displaced a differential extent rearwardly from hook portions 121 of now stationary actuating control slides 122. As the carriage moves step by step the setup slides 88 are also moved step by step so as to move one or more slides 88 to cause their studs 120 to move in the plane of the hook portions 121 of the control slides 122, said control slides 122 being, in the meantime during the keyboard operation, elevated as shown in Fig. 3 so as to allow this operative relationship to take place without interference.

It will be observed that whenever a 9 key is operated, although no stop pin 60 is set up, the latch member 86 associated with the longitudinal series of pins 60 now effective is nevertheless rocked to unlatch the associated setup slide 88 which will be moved by its spring 89 until its extension 93 strikes a rod 125. This rod is stationary during the operation of the keys and will allow the positioning of the stop stud 120 rearwardly so that a certain number of steps of movement may be given to the control slide 122 during the subsequent cycle of operation of the machine to enter the digit 9 and print the digit 9.

After the setup slides **88** have controlled the differential movement of control slides **122** during the cyclic operation of the machine in a manner fully described in the patent to H. H. Woodruff, No. 2,307,177, issued January 5, 1943 the latched pins **60** which have functioned as stops for setup slides **88** are depressed to normal position by the aforementioned rod **125**, the pin carriage is returned to normal position and the setup slides **88** are also restored by the rod **125**.

The rod **125** passes through side frames **75** and **76** (see Fig. 1) and carries rollers at its extremities which roll in guide slots formed in castings **126**. The rod **125** is connected by a pair of links **127** (Figs. 1, 3 and 7) to respective rock arms **130** pivoted on a rod **131**. One of the arms **130** has connected thereto a plate **132** (Fig 7) having a bayonet slot **133**, the vertical slot of which in the normal position of plate **132** engages a roller **134** of a follower arm **135** cooperating with a profile cam **136** connected to the main drive shaft **150**. When said shaft is turned one revolution in a counterclockwise direction during the cyclic operation of the machine the cam **136** will cause through the linkage just described rod **125** to be moved to the left at the end of the cycle to engage the upper bevel portions of the raised pins **60**, thus depressing them to normal position and also thereafter engaging the shoulders **93** (Fig. 3) of each of the unlatched setup slides **88**. The latter are moved back by the rod **125** to normal position where they are relatched by the latch members **86**.

For returning the pin setup carriage to home position where it is held in such position by the escapement mechanism one of the arms **130** (Fig. 7) carries a stud **140** which engages an upward extension **141** of a bell crank **142** pivoted on a stud **143**. One arm (Figs. 3 and 7) of said bell crank **142** engages a roller **145** carried by the U-shaped plate **62** and as the bell crank is rocked the pin carriage will be returned to normal at the end of the cycle and held at such normal position as shown in Fig. 2 by the locking dog **112**, it being noted that during such return locking dog **112** merely ratchets over the teeth of the escapement rack **115**. During the return of the pin carriage the carriage return spring **67** (Fig. 1) will also be retensioned as is evident.

While there have been shown and described and pointed out the fundamental novel features of the invention, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a ten-key keyboard mechanism, the combination of a plurality of digit keys, a step-by-step movable pin carriage carrying several longitudinal series of digit stop pins, a series of pivoted pin raising levers, each having a free end which is rocked for elevating the associated digit stop pin of the effective longitudinal series, and an opposite end which is actuated, a first bail for actuating said opposite end of a selected pin raising lever, a series of connecting members each pivoted on the opposite end of a related pin raising lever and adapted to engage said bail, a series of pivoted arms each pivotally connected to the related digit key to be rocked thereby and having a part engaging the related connecting member for rocking the latter into engagement with said first bail, a light spring connected between each connecting member and the related pin raising lever in such manner that it causes each connecting member to be normally adjacent said part of a related arm so that when an arm is rocked by the depression of a digit key its associated part engaging the related connecting member rocks the latter against the action of said light spring to cause the connecting member to engage the first bail, a solenoid for rocking said first bail, a separate second bail actuated by the keys, contact closing means actuated by said second bail for energizing said solenoid to rock said first bail after the engagement of a connecting member with said first bail and through the connecting member actuate the opposite end of the associated pin raising lever to cause its free end to elevate a digit stop pin of the effective longitudinal series having a digital value corresponding to the depressed key, and means operated by said first bail to disable said contact closing means to effect the deenergization of said solenoid after the elevation of a selected digit stop pin.

2. The combination of elements in a ten-key keyboard mechanism specified in the preceding claim and which further comprises an escapement mechanism for said movable pin carriage, a third bail rocked by one of the ends of any of said pin raising levers after the related connecting member has been connected to the first bail, and when said first bail has rocked a pin raising lever, and means operated by said third bail to actuate said escapement mechanism to thereby space the stop pin carriage to position the next longitudinal series of digit pins in operative association with the free ends of the series of pin raising levers.

FRANK J. FURMAN.
HAROLD L. READ.
HAROLD J. KISTNER.

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