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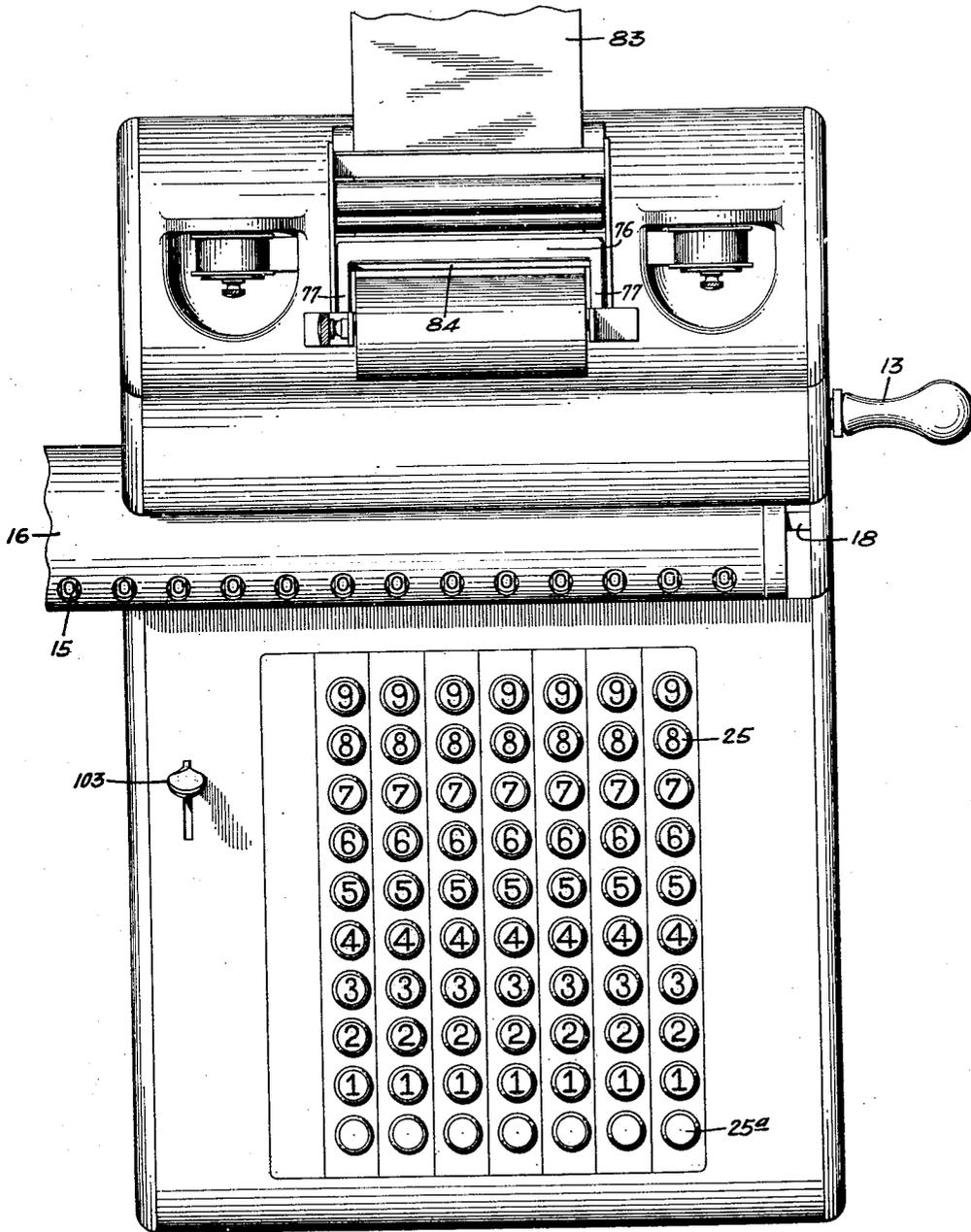
C. M. F. FRIDEN
CALCULATING MACHINE

1,936,903

Filed July 23, 1927

4 Sheets-Sheet 1

FIG. 1.



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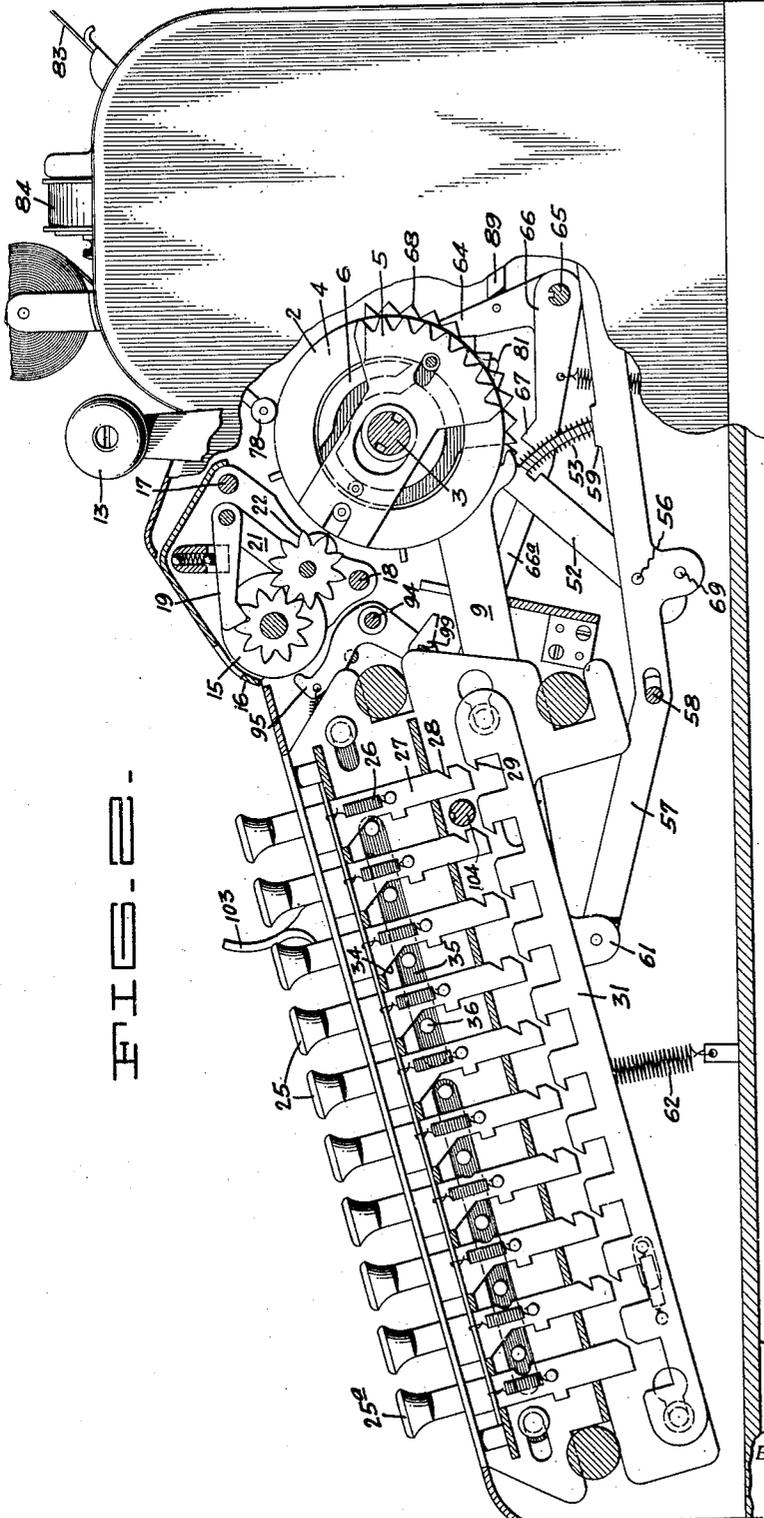
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CALCULATING MACHINE

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4 Sheets-Sheet 2



F I D E N

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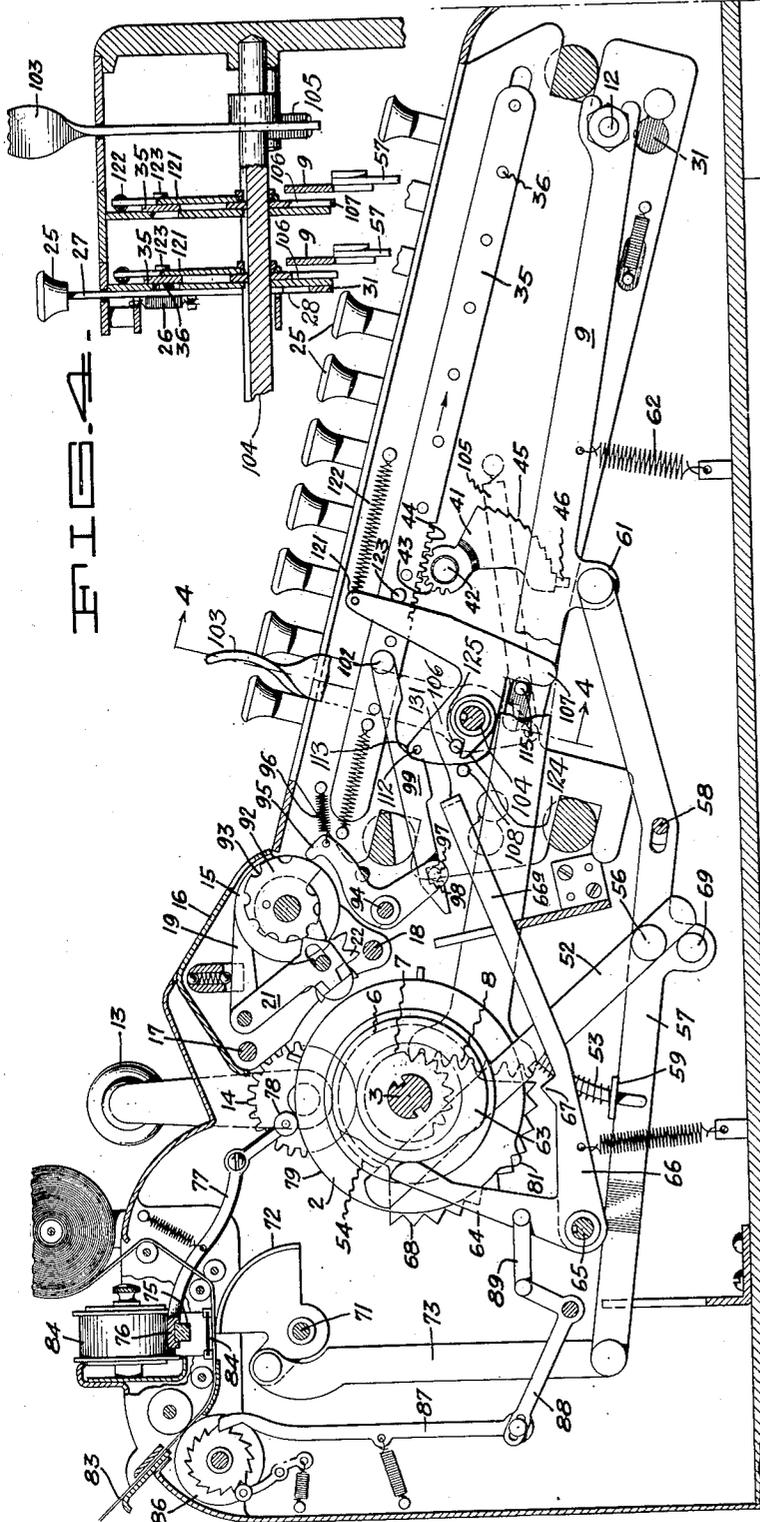
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CALCULATING MACHINE

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4 Sheets-Sheet 3



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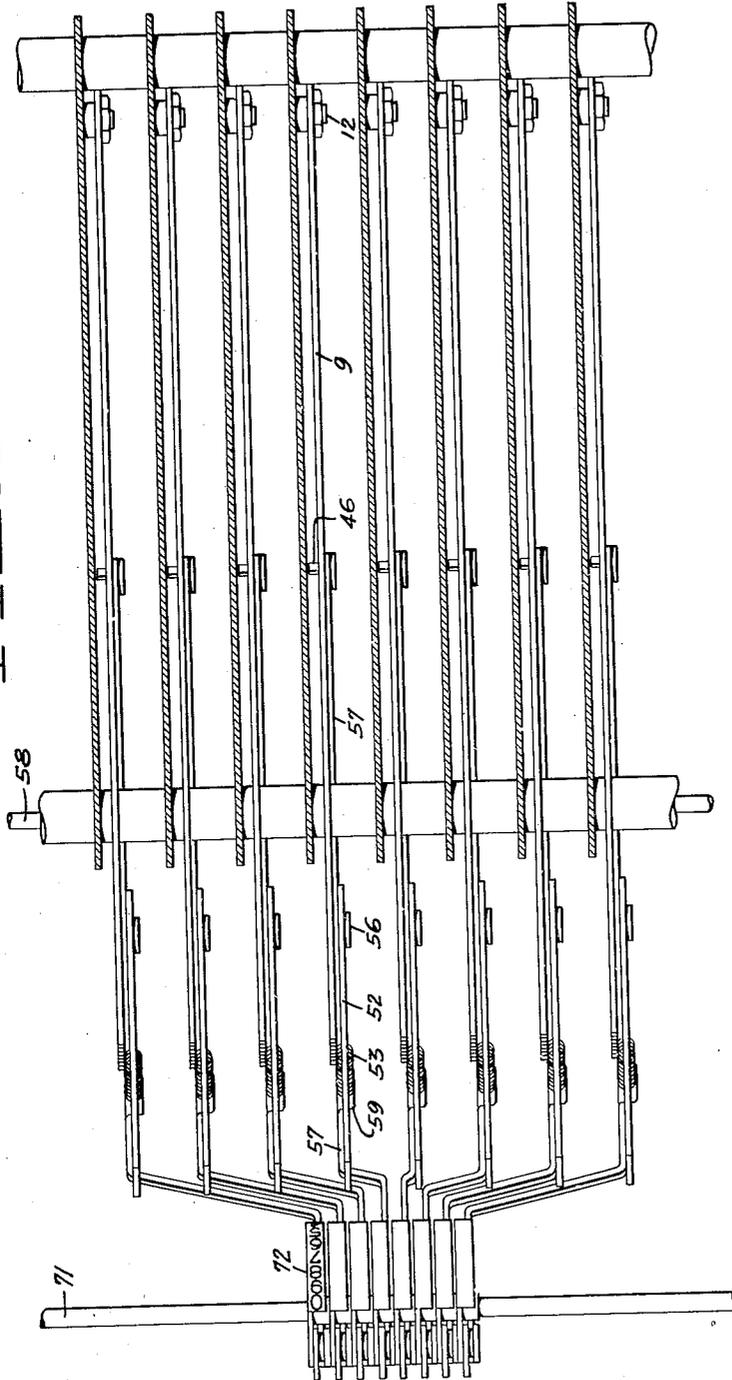
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CALCULATING MACHINE

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4 Sheets-Sheet 4

FIG. 5.



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UNITED STATES PATENT OFFICE

1,936,903

CALCULATING MACHINE

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Application July 23, 1927. Serial No. 207,958

26 Claims. (Cl. 235—58)

The invention relates to calculating machines constructed and adapted to perform the four rules calculations.

An object of the invention is to provide a calculating machine having means for recording or printing the items and the total or result of the calculation.

Another object of the invention is to provide a calculating machine for performing the four rules calculations, which may also be efficiently employed as a printing adding machine.

Another object of the invention is to provide in one machine all of the essential characteristics of a printing adding machine and a calculating machine.

Another object of the invention is to provide a calculating machine including an actuator and a total register and a printing mechanism, with means for transferring values from the actuator to the printing mechanism and from the total register to the printing mechanism.

Another object of the invention is to provide a calculating machine having a rotary actuator, into which the values are introduced by rotation of the actuator.

Another object of the invention is to provide a keyboard calculating machine, depression of the keys serving to introduce values into the machine and rotation of the actuator serving to transmit the introduced values to the actuator.

A further object of the invention is to provide a keyboard calculating machine, in which the depression resistance of all of the keys is substantially equal.

The invention possesses other advantageous features, some of which with the foregoing will be set forth at length in the following description, where I shall outline in full that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown one form of calculating machine embodying my invention, but it is to be understood that I do not limit myself to such form, since the invention as set forth in the claims, may be embodied in a plurality of forms.

Referring to said drawings, Figure 1 is a plan or top view of a calculating machine embodying my invention.

Figure 2 is a longitudinal, vertical section through a portion of the machine, showing the means for introducing values into the machine.

Figure 3 is a vertical, longitudinal section through a calculating machine embodying my invention, showing the means employed for trans-

mitting the introduced values to the actuator and to the printing mechanism and also showing the means for transmitting the values from the total register to the printing mechanism.

Figure 4 is a section taken on the line 4—4 of Figure 3.

Figure 5 is a plan view of the levers by which the values are transmitted to the actuator and to the printing mechanism.

The calculating machine shown in the drawings comprises a rotary actuator and a plurality of keys for introducing values into the machine. The depression of a key introduces a value corresponding to the numeral on the key, into the machine and rotation of the actuator serves first to transfer these values into the actuator and then to transfer them into the numeral wheels or register, to effect the calculating operation. The values introduced into the actuator are transmitted on rotation of the actuator in either direction to the numeral wheels of the counting mechanism, which, for the purpose of making direct action of the selected values on the numeral wheels of highest value possible, is disposed in parallel displaceable relation to the axis of the actuator. The invention is shown embodied in a hand operated keyboard machine but it is to be understood that the invention is also applicable with equal efficiency to a motor driven machine. The machine generally comprises means for introducing values into the machine, means for transmitting the introduced values to the actuator and then to the numeral wheels of the counting mechanism and also means for transferring the values from the actuator and from the counting mechanism to the printing mechanism.

The machine comprises a suitable frame in which the various instrumentalities cooperating to complete the machine, are suitably arranged and mounted. The machine is provided with a reversible rotary actuator 2, such as is disclosed in my United States Patent No. 1,476,197 issued December 4, 1923. This actuator comprises a shaft 3 to which is secured a plurality of wheels 4 carrying slidable toothed actuating members 5. Associated with each wheel 4 and usually rotatably mounted on the hub thereof is a differential selecting element 6 which serves, upon rotation of the wheels 4, to move and time the movement of the toothed actuating element 5. Means are provided for positioning the differential selecting members 6 in differential position, this means in the present instance, comprising a gear or arcuate rack 7 secured to each differential selecting

element 6. Engaging each gear 7 is an arcuate rack 8 which is formed on the rear end of the lever 9 which lever is suitably pivoted to the frame adjacent the front of the machine, on the bolt 12.

5 The actuator, in the present construction, is rotated by the hand crank 13 which is arranged on the outside of the casing. Secured to the shaft of the hand crank is a gear 14 which meshes with a gear of the same size, secured to the shaft 3 of the actuator so that the actuator makes one complete revolution for each rotation of the crank 13. Upon rotation of the actuator, the values introduced therein are transmitted to the numeral wheels 15 of the total register, which is mounted in a transversely displaceable carriage 16, so that the numeral wheels may be brought into cooperative relation with different units of the actuator whereby the actuator may register in different numerical orders. Suitable means are provided for moving the carriage transversely from one numerical order to the other, and any suitable or well known means may be used for this purpose, such as the carriage shifting means shown in my co-pending United States application, Serial Number 539,422, filed in the Patent Office February 27, 1922. The carriage 16 is slidably mounted on the rods 17 and 18 and contains the numeral wheels 15 and their associated elements such as the detents 19, the transfer levers 21 and the intermediate gears 22.

20 The machine is provided with a plurality of rows of numeral keys 25 by which values are introduced into the machine. The keys are normally held in elevated position by the springs 26 secured at one end to the frame of the machine and at the other end to the key stems 27. Each key, with the exception of the first key 25a in each row, which is the clearance key is provided on its lower end with a notch 28, which, when the key is depressed, is engaged by a tooth 29 on the spring pressed retaining slide 31, whereby the depressed key is held in depressed position. Depression of the clearance key 25a moves the slide 31 to release the restrained key. Each key stem is provided with an inclined face 34 and cooperating with all of the key stems in one row of keys is a slide 35 provided with a plurality of pins 36 which cooperate with the inclined faces 34 and which are normally differentially positioned with respect thereto. The normal distance between the pin 36 and the inclined face 34 of its associated key decreases from the number 1 key to the number 9 key so that, upon depression of any key, the slide 35 is moved a distance corresponding to the value of the depressed key. The slide 35 is slidably mounted in the key assembly and is differentially positioned by the depression of a key. By virtue of the fact that depression of a key serves only to move the slide 35 to differential position the depression resistance of all of the keys is substantially equal.

Means are provided for transferring the value introduced by the depression of a key from the slide 35 to the differential selecting element of the actuator, and this means is preferably operated by the hand crank 13, so that the effort required to introduce values into the machine is reduced. Associated with each slide 35 is a contact member having a graded face, in the present instance, this contact member comprises a sector 41 pivoted on the stud 42 and provided with a curved rack 43 which is in mesh with a rack 44 formed in the lower edge of the slide 35. The lower surface of the sector 41 is graded or is provided with a series of steps 45 which form contact sur-

faces to limit the movement of an associated operating member. This member consists of the lever 9 which is provided with a contact projection 46, which, when the lever 9 is moved upward from its normal or zero position, contacts with one of the steps 45 and thus determines the limit of upward movement of the lever 9. Since the lever 9 is connected with the differential selecting elements 6 of the actuator, the value introduced into the machine by the depression of a key is thus transferred to the actuator.

In the present machine, upward movement of the lever 9 from zero position, is caused by the initial rotation of the actuator in either direction from full cycle position. The actuator is normally held in full cycle position by the centralizing lever 52 which is pressed by the spring 53 into engagement with the flat surface of the cam discs 54 which is secured to the actuator shaft 3. Rotation of the actuator in either direction from full cycle position, causes counterclockwise movement of the centralizing lever 52. The lever 52 is fulcrumed on the pin 56 which is secured to the lever 57 which is in turn slidably pivoted on the fixed rod 58. The spring 53 also bears against an ear 59 which is secured to the lever 57 to the rear of the pin 56 and the rod 58. At its forward end, the lever 57 is pivoted to the lever 9, which is provided with an ear 61 for that purpose. The lever 9 is normally held in zero position by the spring 62. Upon rotation of the actuator and consequent movement of the centralizing lever 52 in a counterclockwise direction, the downward pressure of the spring 53 on the lever 57 being greater than the downward pull of the spring 62 on the lever 9, the lever 9 is pushed upward until it is stopped by contact of the projection 46 with the stepped face 45. Thus, the initial rotation of the actuator from full cycle position, introduces the values into the actuator. Means are provided for locking the differential selecting elements 6 in differential position after they have been positioned by the lever 9. Secured to the shaft 3 of the actuator is a cam 63 which is engaged by a lever 64 which is secured to the shaft 65 which is journaled in the frame of the machine. Secured to the shaft 65 are a plurality of fingers 66, there being one finger for each unit of the actuator, which fingers are provided with teeth 67 which are adapted to engage the toothed periphery 68 of the differential selecting element. The actuating surfaces of the cam 63 are spaced so that the lever 64 is not rocked upon rotation of the actuator in either direction until the differential selecting elements have been moved to selected positions by the levers 9 and then, the cam operates to move the lever 64, to lock the differential selecting elements in adjusted position. The centralizing lever 52 extends downward below the pin 56 and normally, lies in contact with the stud 69 secured to the lever 57. On the return of the centralizing lever to normal position, the lower end of this lever contacts with the stud 69 and returns the lever 57 to normal position. It is understood that a lever 9, a lever 57, a centralizing lever 52 and a finger 66 is associated with each differential selecting element of the actuator.

Means are provided for recording the items introduced into the actuator, at each revolution of the actuator so that the machine may be used as a printing adding machine or to print the items entering into any calculation. Mounted in the rear of the machine is a suitable printing mechanism to which the values introduced into the actuator are transmitted, and which operates, upon

rotation of the actuator, to print the values on a record sheet. Any suitable or well-known form of printing mechanism may be employed for this purpose, and in the drawings, I have shown one suitable form. Mounted on the shaft 71, extending across the back of the machine, are a plurality of arcuate type carriers 72 which normally lie in zero position. These respective type carriers are connected by the links 73 with the rear ends of the levers 77, so that as the levers 77 are rocked, to transmit the introduced values to the actuator, the type carriers are also rocked to position the proper type directly below the impression hammer 75. The hammer 75 is preferably formed of rubber or other conformable material and is held in a crossbar 76 to the opposite ends of which are secured the levers 77 which are provided on their opposite ends with rollers 78 which engage cams 79 secured to the actuator shaft 3. Each cam 79 is provided with an abruptly raised portion 81 which, as it passes under the roller 78, during the rotation of the actuator, operates the impression hammer to print the values introduced into the type carriers onto the sheet or strip 83 which is provided for that purpose. An inked ribbon 84 interposed between the script 83 and the hammer 75, causes the value to be imprinted on the script. The inked ribbon is moved, as in a typewriting machine and any suitable means are provided for advancing the sheet 83 after the printing impression. In the present instance, this means comprises a feed roller 86 which is advanced by the pawl 87 which is operatively connected by the lever 88 and the link 89 with the lever 64. I have not attempted to show the details of the printing mechanism or the paper feed or ribbon feed, because these features are well known in adding machines. The machine also embodies means for transferring the values accumulated in the total register to the printing mechanism so that the total or the result of the calculation may be recorded. When this operation is to be performed, the carriage is shifted to its right hand extremity to bring the numeral wheel at the right hand end of the carriage into cooperative relation with the type carrier at the right hand end of the type carrier series. In order to permit the total to contain more numerical places than there are rows of keys on the keyboard the machine is provided to the left of the left-most row of keys, with one or more slides 35 which are not associated with keys. In the present instance, I have shown eight slides and seven rows of keys so that the machine is capable of printing a number containing eight figures. Since the printing mechanism will be used principally in recording items and totals in addition, one or two additional slides 35 will be sufficient to permit the machine to function properly.

Secured to each numeral wheel 15, which is associated with a slide 35, when the carriage is in its right hand position, is a differential cam 92 having a series of depressions 93 related to the successive numbers on the numeral wheels. The distance of these depressions from the axis of the wheel is the differential element which determines the numerical value of the depression. Pivoted on the transverse shaft 94 and associated with the cams 92 are a plurality of fingers 95 which are normally held out of the path of the cams and out of the path of the numeral wheels 15 by the springs 96. Each finger is provided on its lower end with a pin 97 which is normally disposed in a notch 98 formed in the

under side of the lever 99 which is pivoted to the slide 35 at 102. Forward movement of the slide 35 in the direction indicated by the arrow in Figure 3 will rock the fingers 95 about their pivots to an extent depending upon the position of the cams 92. Forward movement of the slides 35, to transfer the total from the register 15 to the type carriers is effected by forward movement of the totalizing lever 103. This lever is secured to the transverse shaft 104 and is normally held in its rearward position by the spring 105. Secured to the shaft 104 are a plurality of bell-crank levers 106, one arm of which extends backward into cooperative relation with the lever 99 and the other arm 107 of which extends downward in cooperative relation with the releasing slide 31. The bell-crank lever 106 is normally held in normal position by contact with the fixed stud 108, thereby normally holding the shaft 104 in normal position. Projecting laterally from the rearward end of the lever 106 is a pin 112 which is in contact with an inclined portion 113 of the under surface of the lever 99. When the slide 35 is moved backward by the depression of a key 25, the lever 99, which is connected to the slide rides up over the pin 112, lifting the notch in the rear end of the lever 99 from engagement with the pin 97, so that when the slide 35 is moved by the depression of a key, the slide is disengaged from the finger 95. The downward projection 107 of the lever 106, lies directly in front of a pin 115 secured to the releasing slide 31 so that, when the totalizing lever 103 is pulled forward, the depressed keys in the keyboard are released.

Mounted on the shaft 104 are a plurality of levers 121, there being one of these levers associated with each slide 35. These levers are normally held in restrained position by the spring 122, and each lever is in contact with a stud 123 projecting laterally from the slide 35. Each lever 121 is provided with a tooth or projection 124 which underlies a stud projecting laterally from the associated lever 106. The stud 125 operates to hold the lever 121 in its normal or backward position as shown in Figure 3. When the totalizing lever 103 is pulled forward, the lever 106 is rocked, moving the pin 125 upward, and permitting the springs 122 to move the levers 121 and consequently the slides 35 forward. The slides 35 are connected through the lever 99 with the fingers 95, which are moved into their respective depressions thereby causing the slides 35 to be differentially positioned in accordance with the differential positions of the cams 92. Thus, when the totalizing lever is pulled backward, the slides 35 are differentially positioned in accordance with the values in the total register and since these slides are connected with the type carriers rotation of the actuator will serve to transmit the values represented by the differential position of the slides to the type carriers and print the total or result accumulated in the total register 15, on the strip 83. Since the keyboard is cleared on the initial forward movement of the totalizing lever, the slides 35 are free to be positioned in accordance with the values accumulated in the total register. Means are also provided for releasing the slides 35 after the values have been introduced into the printing mechanism. The printing mechanism is directly connected with the actuator so that when the values have been introduced into the actuator, they are also introduced into the printing mechanism. The values are locked in the actuator by the fingers 66 and the type carriers are

- locked in similarly adjusted position. The fingers 66 are provided with extensions 66a having laterally bent lips or projections 131 on their forward ends which underlie the levers 99 and when the fingers 66 are moved upward into engagement with the racks 68, the lips 131 strike the levers 99 and raise them from contact with the levers 95, permitting these levers to spring back to neutral or zero position, so that no restraint is opposed to the movement of the numeral wheels 15, on rotation of the actuator. Since values are contained in the actuator, the numeral wheels are moved on rotation thereof. The values contained in the actuator are equal to those contained in the total register, so that in printing the total, reverse rotation of the actuator will serve to reset the total register to zero.
- I claim:
1. In a calculating machine, a product register, an actuator therefor, centralizing means for the actuator, a printing mechanism, and means operated by said centralizing means for transferring values from the product register to the printing mechanism.
 2. In a calculating machine, numeral wheels, an actuator therefor, centralizing means for said actuator, a printing mechanism, and means operated by said centralizing means for introducing values into the actuator and into the printing mechanism.
 3. In a calculating machine, an accumulator, a rotary actuator therefor, a member displaceable thereby, recording means and means operated by said member for introducing values into the actuator and into the recording means.
 4. In a calculating machine, numeral wheels, an actuator therefor, centralizing means for said actuator, a differential selecting element secured to each numeral wheel, a plurality of type carriers, and means operated by said centralizing means for transferring values from the selecting elements to the type carriers.
 5. In a calculating machine, numeral wheels, a rotary actuator therefor normally at rest in full cycle position, means for introducing values into the machine and oscillable means operated by the actuator on movement thereof from full cycle position for transferring said values to the actuator.
 6. In a calculating machine, numeral wheels, a rotary actuator therefor, normally at rest in full cycle position, a plurality of type carriers, means for introducing values into the machine and oscillable means operated by the actuator on movement thereof from full cycle position for transferring said values to the actuator and to the type carriers.
 7. In a calculating machine, a rotary actuator including a plurality of differential selecting elements, a type carrier associated with each selecting element, means for introducing values into the machine and means comprising a linkage operated by the actuator on rotation thereof for differentially positioning said selecting elements and type carriers in accordance with the values introduced.
 8. In a calculating machine, a rotary actuator, a plurality of differential selecting elements, arranged to be differentially positioned by rotation thereof, a plurality of type carriers, means for positioning the type carriers in selected position in accordance with the positions of the selecting elements, means operated by the rotation of the actuator for first locking the type carriers in selected position and means operated by movement of the locking means for disengaging the type carriers from the selecting elements.
 9. In a calculating machine, a total register, a reversible rotary actuator therefor, a plurality of type carriers, means for introducing the values accumulated in the total register into the actuator and the type carriers, means for locking the type carriers and actuator elements in adjusted position and for disconnecting the value introducing means.
 10. In a calculating machine, a total register, a reversible rotary actuator therefor including a plurality of differential selecting elements and means operated by the actuator for introducing the values accumulated in the total register into the actuator whereby reverse rotation of the actuator resets the total register to zero.
 11. In a calculating machine, numeral wheels, a rotary actuator therefor, means for introducing values into the machine and means operated by said actuator on rotation thereof for transferring the values to the actuator said last named means including a yieldable connection.
 12. In a calculating machine, a rotary actuator, a row of keys of different numerical value, a differential element associated with the row of keys and adapted to be differentially positioned by the depression of a key, and means associated with the differential element and operated by the actuator on rotation thereof for transferring the value to the actuator.
 13. In a calculating machine, an actuator, a row of keys of different numerical value, a slide arranged to be differentially positioned by depression of a key, a member having a graded face associated with said slide, means for entering values into the actuator associated with said member and means operated by said actuator for operating said value entering means.
 14. In a calculating machine, a rotary actuator including differential selecting elements, a row of numeral keys associated with each selecting element, a contact member adapted to be differentially positioned by the depression of a key, a lever engaging each selecting element and associated with the respective contact member and means operated by rotation of the actuator for moving said lever into contact with said contact member whereby the selecting element is positioned in accordance with the value of the depressed key.
 15. In a calculating machine, a rotary actuator, a member oscillable thereby, keys for introducing values into the machine and means operated by said member for transferring the introduced values to the actuator.
 16. In a calculating machine, a rotary actuator including differential selecting elements, a member oscillable by the actuator, keys for introducing values into the machine, means operated by said member for differentially positioning the selecting elements in accordance with the introduced values and means operated by said actuator in a timed relation with the operation of said member for locking the selecting elements in differential position.
 17. In a calculating machine, a reversible rotary actuator including differential selecting elements, a row of numeral keys associated with each selecting element, a slide associated with each row of keys and adapted to be differentially positioned by the depression of a selected key, a differential contact member associated with each slide, a lever connected to each differential selecting element and associated with the associated

contact member and means operated by rotation of the actuator to move said levers into contact with said contact members to differentially position said selecting elements.

sociated with each registering element, sensing means therefor, differential mechanism setttable thereby, controlling means for setting said mechanism, and means operable on operation of said controlling means for disabling said sensing means. 80

5 18. In a calculating machine, numeral wheels, an actuator therefor, a member oscillable by the actuator upon rotation thereof, controlling means including a selecting element associated with each numeral wheel, a plurality of type carriers, a second controlling means for introducing values into the machine, means operated by movement of said member for transferring the values on one of said controlling means to the actuator and to the type carriers, and means for selecting the effective controlling means.

24. In a calculating machine, numeral wheels, a reversible rotary actuator therefor, a printing mechanism, means for introducing values into the actuator and into the printing mechanism, means actuated in time with the rotation of the actuator in either direction to operate the printing mechanism, and line spacing mechanism controlled by said actuator and operable in an invariable sequence with relation to said printing mechanism in either direction of rotation of said actuator. 85

15 19. In a calculating machine, actuating means, a plurality of differentially setttable elements, controlling means therefor, means controlled by said actuating means for locking said elements in set position, and means operable as an incident to the operation of said locking means for disconnecting the setttable elements from said controlling means.

25. In a calculating machine having registering elements, rotary actuating mechanism therefor and driving means for said mechanism; the combination of movable selecting members for controlling differential operation of said registering elements by said actuating mechanism, a series of setttable keys, and means driven by said driving means and controlled by said keys for positioning said selecting members prior to operation of said registering elements by said actuating mechanism. 90

20 20. In a calculating machine, actuating means, a plurality of differentially setttable elements, controlling means therefor, and means controlled by said actuating means for locking said elements in set position and disconnecting said controlling means therefrom.

26. In a calculating machine having registering elements, rotary actuating mechanism therefor and driving means for said mechanism; the combination of movable selecting members for controlling differential operation of said registering elements by said actuating mechanism, a series of setttable keys, means driven by said driving means and controlled by said keys for positioning said selecting members prior to operation of said registering elements by said actuating mechanism, and a lock, operated by said driving means in timed relation with the operation of said positioning means, to prevent movement of said selecting members during operation of said registering elements by said actuating mechanism. 95

25 21. In a calculating machine having an actuator, registering elements including a selecting member associated with each registering element, means for sensing the values on said selecting members, means for enabling said sensing means, and means controlled by said actuator for superseding the control of said enabling means and rendering said sensing means ineffective.

30 22. In a calculating machine having an actuator, registering elements including a selecting member associated with each registering element, means for sensing the values on said selecting members, means for enabling said sensing means, and means controlled by said actuator for rendering said enabling means ineffective.

35 23. In a calculating machine having registering elements including a selecting member as-

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