

April 25, 1961

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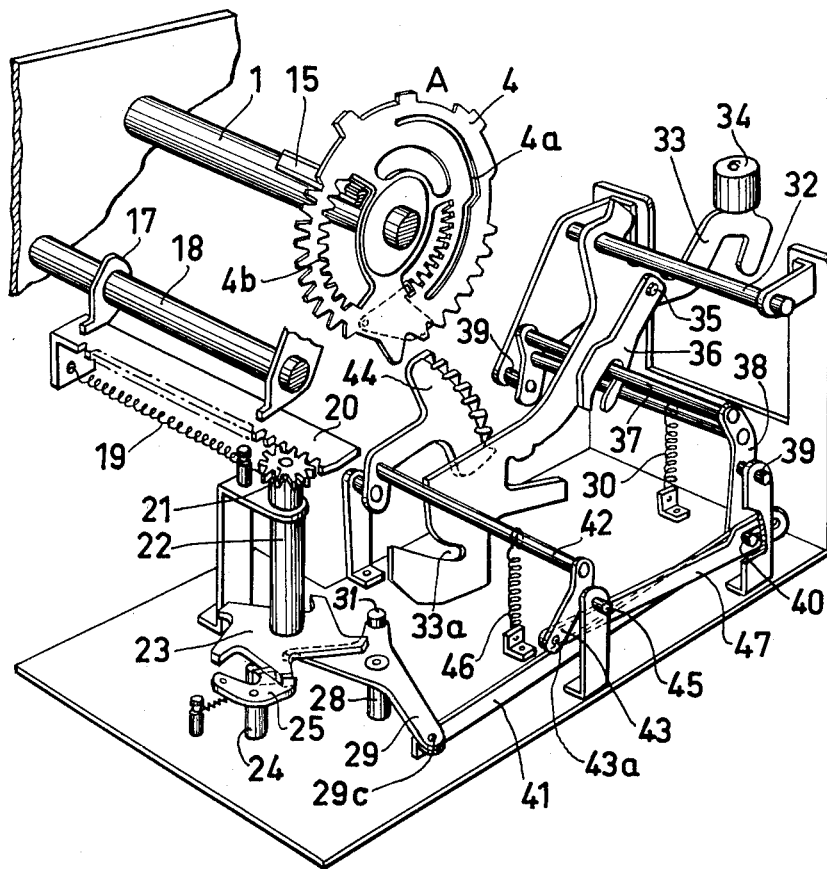
2,981,468

CALCULATING MACHINES OF THE TEN-KEY TYPE

Filed April 2, 1958

6 Sheets-Sheet 1

FIG. 1



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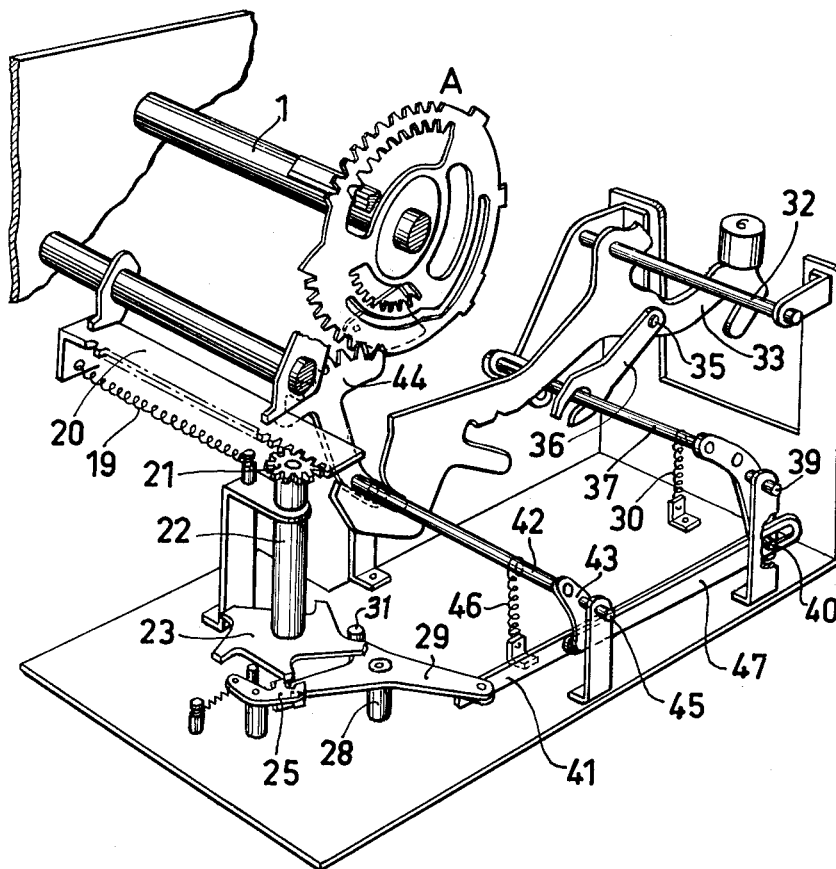
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6 Sheets-Sheet 2

FIG. 2



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2,981,468

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Filed April 2, 1958

6 Sheets-Sheet 3

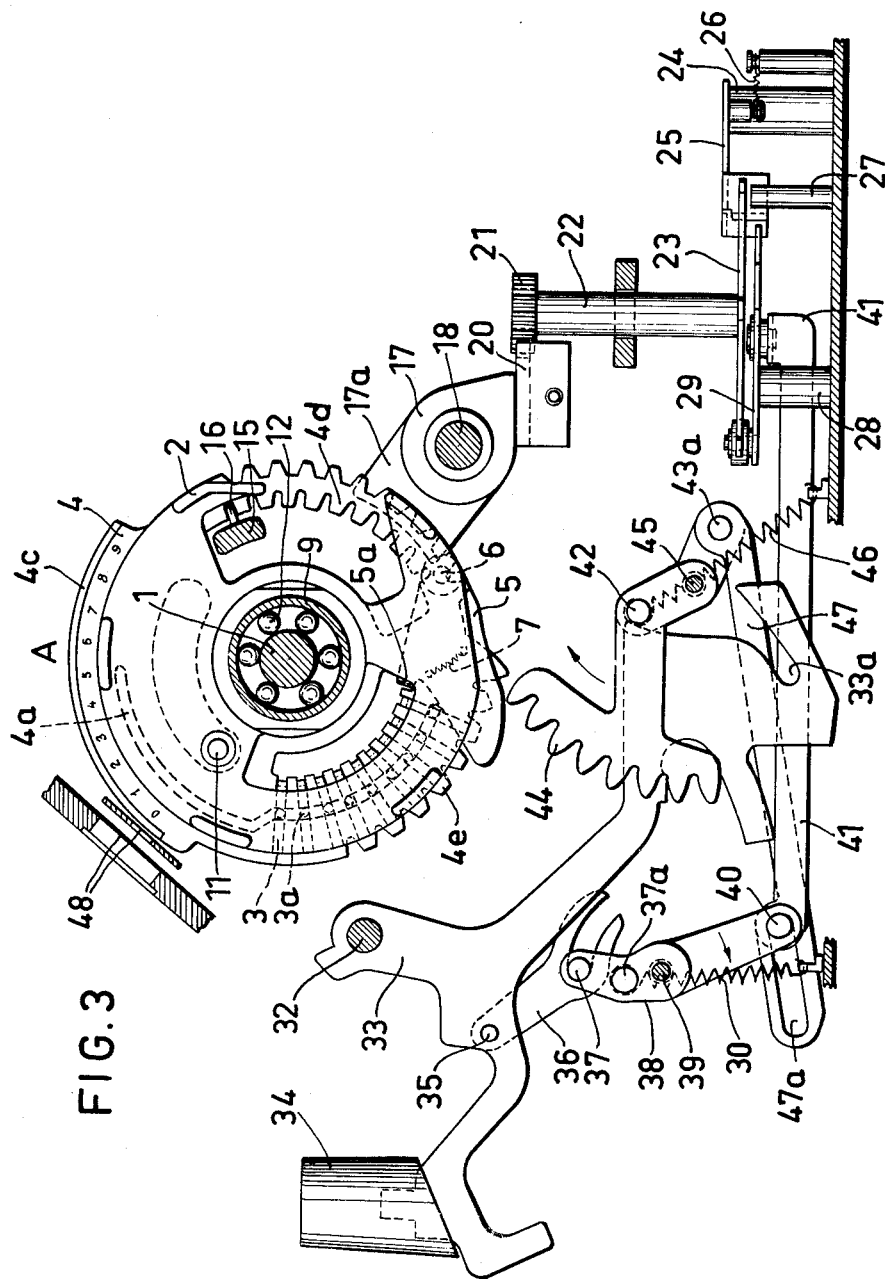


FIG. 3

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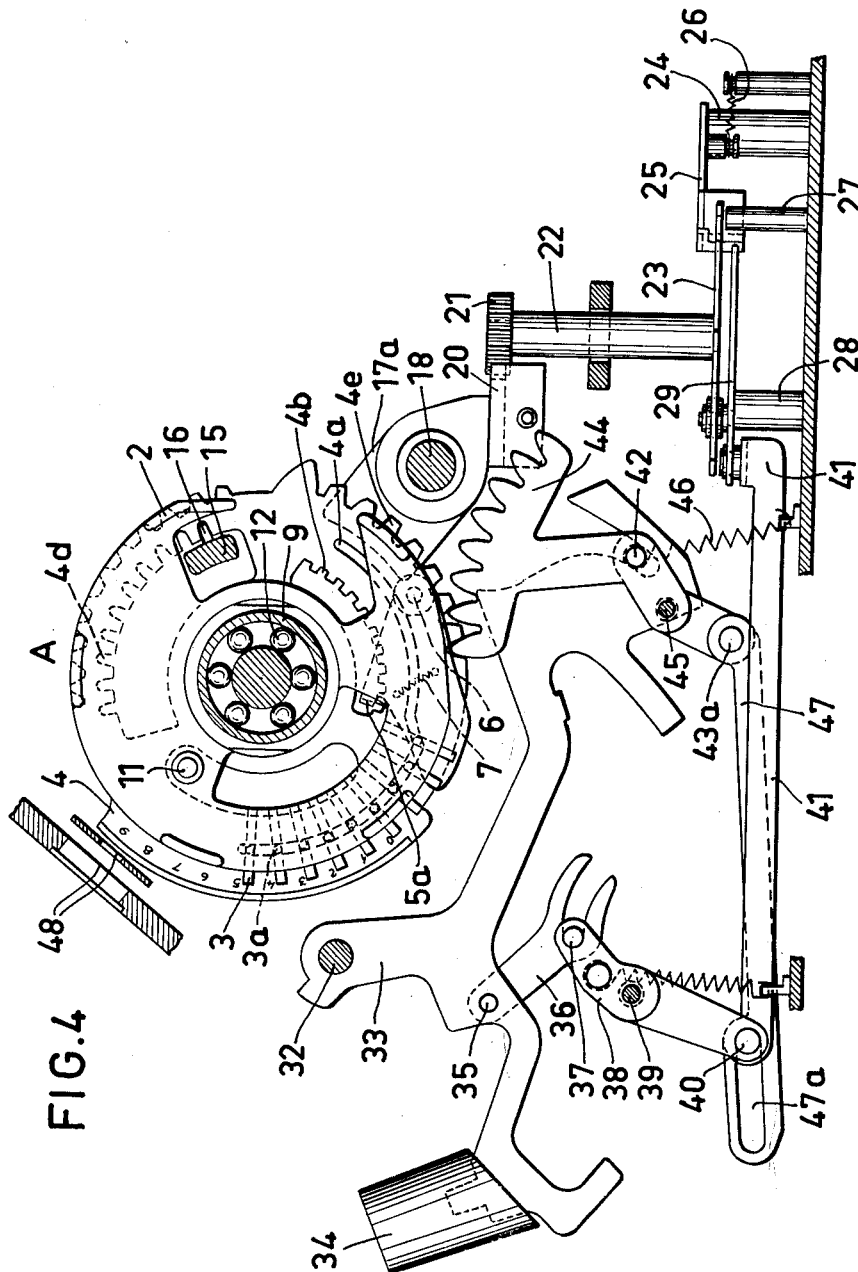
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CALCULATING MACHINES OF THE TEN-KEY TYPE

Filed April 2, 1958

6 Sheets-Sheet 4



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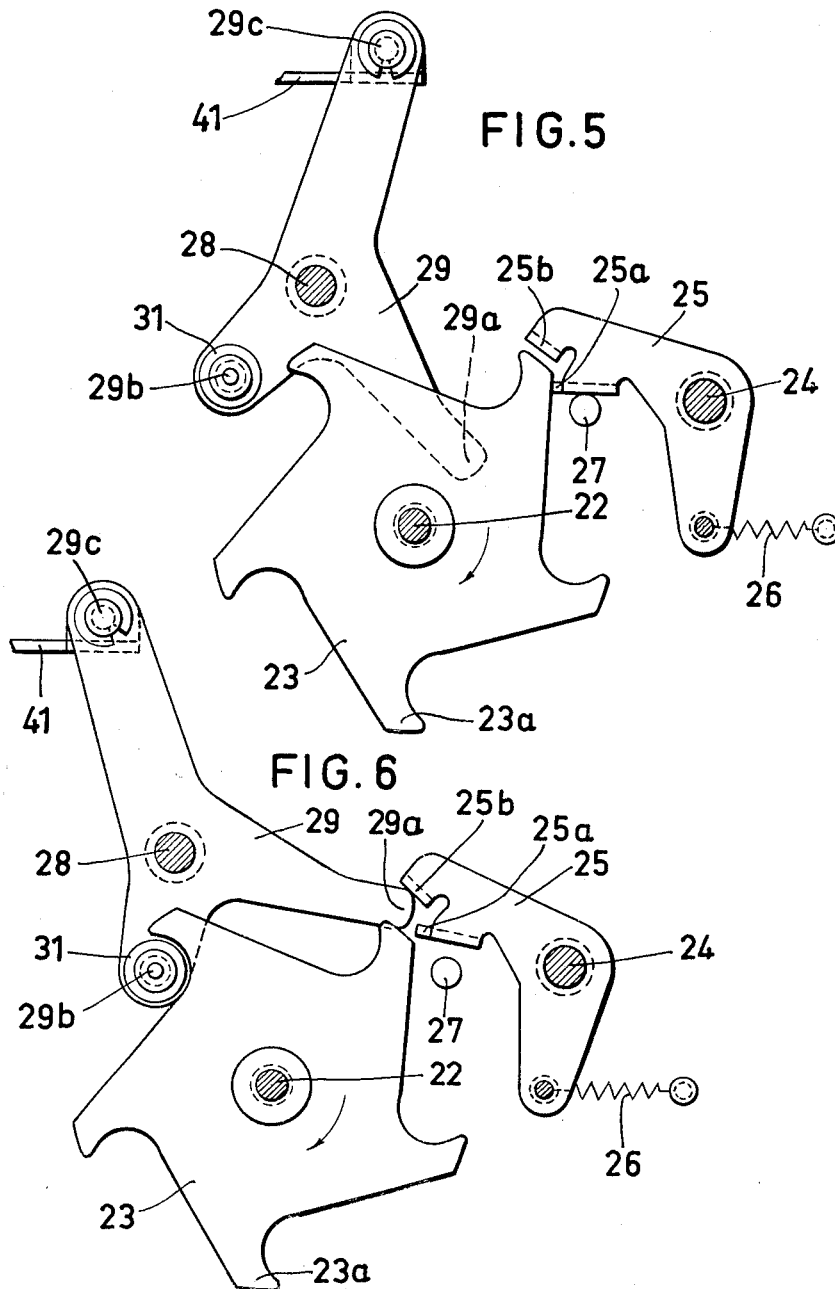
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CALCULATING MACHINES OF THE TEN-KEY TYPE

Filed April 2, 1958

6 Sheets-Sheet 5



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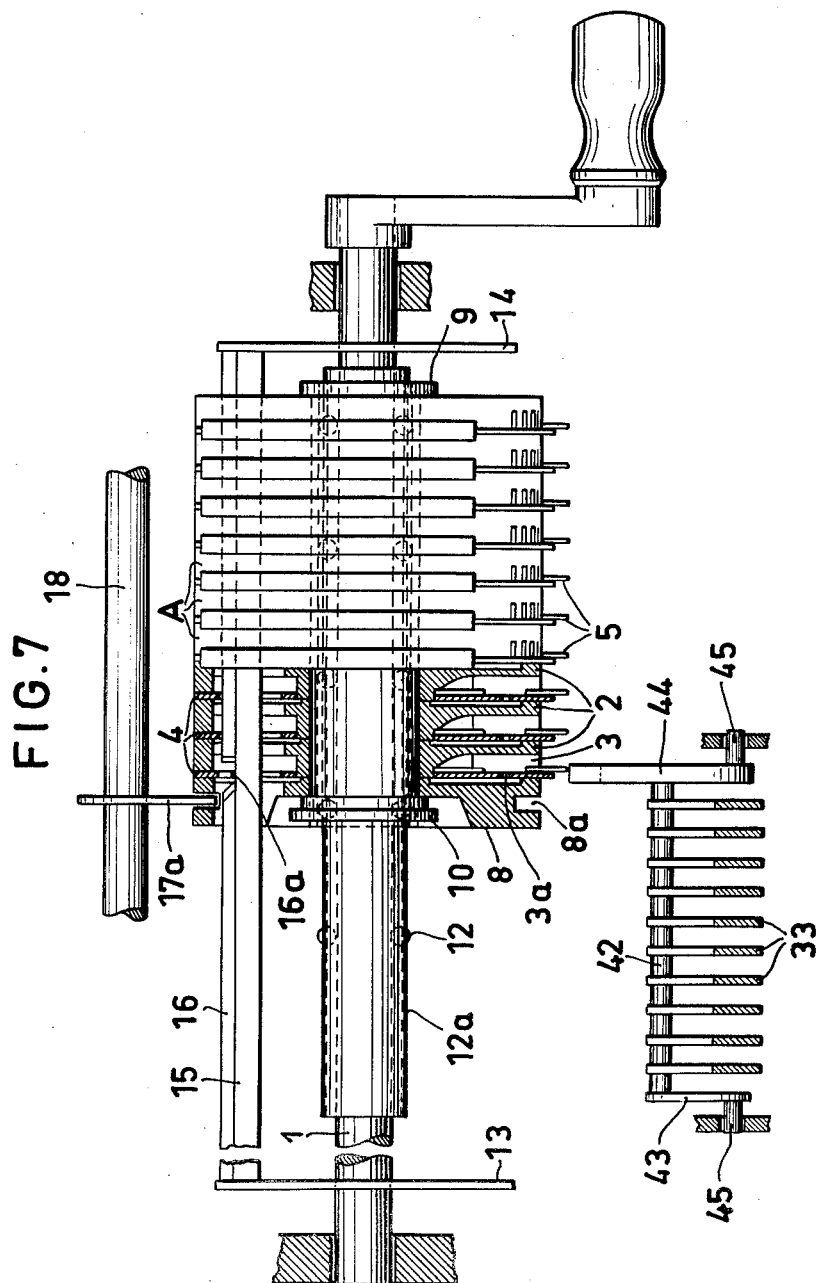
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2,981,468

CALCULATING MACHINES OF THE TEN-KEY TYPE

6 Sheets-Sheet 6



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1

2,981,468

CALCULATING MACHINES OF THE TEN-KEY TYPE

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Filed Apr. 2, 1958, Ser. No. 725,825

Claims priority, application Sweden Apr. 6, 1957

4 Claims. (Cl. 235—63)

This invention relates to calculating machines of the ten-key type.

Current calculating machines with ten digit keys suffer from the disadvantage that the keys require rather great pressures in operation and must perform rather protracted setting-up motions. Extended calculations will, therefore, prove rather tiring for the operator's fingers.

In adding machines, for example, this problem has been long ago solved through the provision of a special setting-up pin carriage enabling the key-motions to be quite short and easily actuated.

This problem is, however, more difficult to solve in calculating machines with ten keys, especially those provided with a pin wheel rotor, due to the fact that upon depression the key must both move aside a number of latch members and rotate a setting-up disc through an angle which, as a rule, is proportional to the number set-up. Consequently, the setting-up disc for the digit nine must perform a motion nine times as great as the motion of the digit one. In many machine-types the nine-key therefore offers a much greater resistance against depression than e.g. the zero or one-key. This is disadvantageous, as such a key-board with keys requiring different actuating pressures will prove rather tiring for the operator's fingers when making extended calculations.

This disadvantage may be alleviated to some extent by choosing the non-actuated position of the setting-up discs between the digits four and five, the disc thus being rotated in the one or the other direction during setting-up. Alternatively, the zero may be provided at a middle position with the other digits being grouped at both sides to equalize the setting-up motions somewhat.

If the zero is thus provided at a middle position to afford an easier operation of the key-board, the design of the pin-wheel rotor will, on the other hand, suffer great complication, this being true particularly if the machine is to perform repeated multiplications (the results of which are added, for example), and, further, manufacturing difficulties will be encountered.

The provision of the initial position of the cipher discs between digits four and five will also give rise to certain disadvantages, mainly manufacturing difficulties, which make this arrangement expensive for simple machines, although well suited for larger and more complicated machines which are provided with a storing register since in such case it may be combined with very simple returning mechanism.

The chief object of the present invention is the provision of a key-board for calculating machines, preferably pin-wheel rotor machines, in which each key requires a very small actuating pressure and wherein the key motion will be rather short without the pin-wheel rotor being unduly complicated.

According to the invention this object is gained by the provision of means for enabling the step motion mechanism to tension one or more tension springs, said spring or springs acting upon crank-shaped means, the latter

2

being moved through a top dead center position upon shallow initial depression of a key, the action of the spring or springs upon the said crank-shaped means assisting the finger actuating the key in depressing the latter so deep that the setting-up in the rotor is effected.

A very simple embodiment of the invention applied on a common type of pin-wheel machine will now be described, reference being had to the appended drawings, in which

Fig. 1 is a perspective view of a setting-up mechanism in non-actuated (zero) position,

Fig. 2 is a similar view after the actuation of a digit key,

Fig. 3 is a sectional elevation of the mechanism in Fig. 1,

Fig. 4 is a sectional elevation of the same mechanism with the parts taking up the same positions as in Fig. 2,

Figs. 5 and 6 are bottom plan views of certain elements during two stages of the setting-up operation, respectively, and

Fig. 7 is a top plan view of a pin-wheel rotor being designed for cooperation with mechanism according to the invention.

In the illustrated embodiment a spring device which assists in depressing each digit key comprises two springs 30 and 46 which both act upon crank-shaped members which, on shallow initial depression of a key, are moved by the latter through a top dead centre, the springs thereafter assisting, through their action against the crank-shaped members, the operator's finger to depress the key far enough so that the required setting-up operation of the rotor will be effected. Upon the stepwise displacement of the setting-up mechanism to the next denominational order the springs are tensioned afresh by a very powerful spring, which displaces the rotor axially (such as that shown in U.S. Patent No. 1,540,247). That spring returns the crank-shaped members to their non-actuated position.

The machine illustrated is provided in known manner with a setting-up rotor A displaceable axially along a shaft fixed in the machine frame. The rotor A is assembled in the usual way with a number of calculating discs 2 (Fig. 7) as clearly shown in U.S. Patent No. 2,744,686. As seen from Fig. 3 there are nine radial slots in each calculating disc 2, and calculating pins 3 are longitudinally displaceable in the slots. Each pin 3 has a lateral projection 3a which engages a cam slot 4a in a setting-up disc 4, belonging to each disc 2 and rotatively disposed on a hub formed on the latter. The shape of the setting-up discs 4 can best be seen in Figs. 1 and 2.

Each setting-up disc 4 at its periphery supports a strip 4c provided with numerals, Figs. 3 and 4, which are shown through a window 48 in the machine casing (not shown), and indicate the number set-up in the rotor. Each calculating disc 2 is provided with a latch hook 5 pivoted on a stud 6 secured to the disc 2, and a tension spring 7 is continuously operative to urge a laterally bent portion 5a of the hook member 5 into engagement with gaps 4b between teeth provided on the disc 4, as seen in Fig. 4.

The calculating discs with their respective setting-up discs are assembled on a central tube 9 and are held together as a unit by an end plate 8 formed with a circumferential groove 8a. The end plate 8 is secured by a nut 10 threaded onto the tube 9. The calculating discs 2 are prevented from rotation relative to the end plate 8 and to each other by a shaft 11 which passes through an aperture in all discs 2. The setting-up discs 4 are formed with a corresponding aperture having such dimensions that their rotation is not prevented by the shaft 11.

3

The rotor assembly A is journaled on ball bearings 12 and 12a on the shaft 1, and may be rotated as well as displaced axially relative to the latter, Figs. 3, 4, and 7.

Near each extremity of the shaft 1 an end plate 13, 14, respectively, is secured to the shaft. A guide rod 15 is supported between these end plates 13 and 14, and passes through apertures in the discs 2 and 4. The rod 15 is formed with a longitudinally extending rib 16 which determines the position of all setting-up discs 4 by engaging interior recesses 4d in the latter, as seen from Fig. 4. The rib 16 is recessed at one point, 16a (Fig. 7) the position of said recess being directly opposite each disc 4 when the latter has been brought to its setting-up position, in which it is secured circumferentially only by the latch hook 5.

The rod 15 also passes through an aperture in the end plate 8 which permits axial displacement of the rotor A. Upon rotation of shaft 1 the rotor is, however, entrained.

The shaft 1 which is journaled in the machine frame may be rotated by means of a crank or an electric motor in either direction for calculation in the additive or subtractive sense.

When a number is set up in the rotor the latter is displaced in known manner one step at the time, to the left in Fig. 7, and this stepwise displacement is brought about by a rotor bail member 17 which is axially displaceable and non-rotatively disposed on a shaft 18 secured to the machine frame. The bail member 17 is provided with an arm 17a which engages the circumferential groove 8a in the end plate 8. The rotor A and the bail member 17 in this manner are fixed axially relative to each other.

The assembly made up by the rotor A and the bail member 17 is urged towards the left in Fig. 7 by a powerful spring 19 (Fig. 1). The bail member 17 is further rigidly connected to a rack member 21 continuously engaged by a gear 21 secured to a shaft 22. As seen from Figs. 1 to 6 the shaft 22 is journaled in the machine frame and is provided at its lower end with a ratchet wheel 23 with five projecting arms 23a.

It will be seen from Figs. 1 and 2 that the ratchet wheel 23, the shaft 22 and the gear 21 will be rotated by the rack member 20 as soon as the rotor A and the bail member 17 are displaced axially, and the transmission ratio is chosen in such a manner that upon a displacement of the rotor corresponding to one denominational order (one step) the ratchet wheel 23 will rotate by one fifth of a revolution. When the rotor is displaced to the left in Fig. 7 the ratchet wheel 23 is rotated clockwise in Fig. 5 as indicated by the arrow. (As formerly stated, Figs. 5 and 6 are bottom views of certain parts.)

The ratchet wheel 23 cooperates with a latch mechanism which comprises a stud 24 fast in the machine frame and pivotally supporting a hook member 25 which is urged by a spring 26 towards a stationary stud 27 (Figs. 5 and 6). The hook member 25 which affords a two-armed lever, is provided with two abutment projections 25a and 25b. In the position illustrated in Fig. 5 the rotor is prevented from moving to the left since the projection 25a abuts an arm 23a of the ratchet wheel 23. Only after the hook member 25 has been rocked on its pivot 24 to the position depicted in Fig. 6, the ratchet wheel 23 may be rotated in the sense of the arrow, and the rotor then moves to the left.

On another stud 28 fast in the machine frame, an arm 29 is pivoted. If the arm 29 is rocked about its pivot 28 to the position illustrated in Fig. 6, the extreme end 29a of the arm 29 will abut the projection 25b of the hook member 25, and the latter will be rocked so that the engagement between the projection 25a and one arm of the ratchet wheel 23 will cease. The rotor A and the bail member 17 are now free to move to the left, urged by the spring 19. A protracted movement in that direc-

4

tion is, however, prevented in the following manner: The arm 29 by its rocking movement urges a roll 31 rotatively supported on a stud 29b thereon into the path of one of the arms of the ratchet wheel 23. When the rotor moves further to the left the roll 31 by its engagement with the oblique flank of the ratchet wheel arm is constrained to move to the left, and the arm 29 will resume its initial position, simultaneously releasing the hook member 25 which will stop the ratchet wheel 23 when the latter engages by its next arm the projection 25a. The rotor assembly has thus moved one step to the left in Fig. 7, and further motion has been prevented by the mechanism just described.

The key-board of the machine and the parts cooperating therewith are arranged in a manner to be described below. It should be noted that for an easier understanding of the arrangement and function only one key is shown in the drawings, but that the embodiment shown is, of course, provided with the full complement of keys belonging to a normal ten-key machine. Each key 33 (in the embodiment illustrated the one corresponding to the digit nine) is pivotally supported by a shaft 32 fixed to the machine frame. The key is provided with a knob 34 with an appropriate marking, and a fork member 36 is pivoted on a stud 35 on the key lever. The shanks of the fork member 36 straddle a shaft 37 forming part of a crank device 38 comprising two arms which are pivotally supported from the machine frame by studs 39. One arm of the crank device 38 is formed with a depending portion provided with a pin 40 which engages a hole near one end of a link member 41, the opposite end of which latter is pivoted on a stud 29c provided on the arm 29. As seen from Figs. 1 and 2 a depression of the key 33 will cause a rocking movement of the crank device 37, 38, also indicated by an arrow in Fig. 3. The link member 41 will thereby be pulled to the left in Fig. 5, and the resulting movement of the arm 29 will permit a one step movement of the rotor A.

The crank device 37, 38 is connected to a tension spring 30 disposed between the shaft 37 and a bracket secured to the machine frame. From Figs. 3 and 4 it is seen that the line of action of spring 30 upon movement of the crank device will pass through and beyond the center line of studs 39, and that the spring will assist in depressing the key as soon as the crank device has passed its top dead center.

If the key is kept depressed the rotor A is prevented from axial movement since the spring 19 acting upon the ratchet wheel 23 is not able to raise the key by means of the motion connection 29—41 against the pressure of the finger. The step motion thus will not be effected until the key has been released.

The key 33 further in a known manner is provided with a heel portion having a cam slot 33a formed therein which engages a shaft 42 upon depression of the key. The shaft 42 at one end is rigidly connected to an arm 43 and at its other end to a tooth segment 44, the three parts forming a second crank-shaped assembly being pivotally supported on studs 45 by the machine frame. A tension spring 46 acts upon the shaft 42, and its line of action upon movement of the shaft passes through and beyond the center line of the pivots 45, whereby after the crank-shaped assembly has passed its top dead center, the spring assists in urging the shaft 42 downwards and thus aids the key to rotate the toothed segment 44 (Fig. 4).

When the key 33 is pressed downwards the edge of the slot 33a will engage the shaft 42 and move the latter upwards, so that the segment 44 is swung clockwise as shown by the arrow in Fig. 3, until at the bottom position of the key the segment has assumed the position illustrated in Fig. 4.

The arm 43 rigidly connected to the shaft 42 is provided with a stud 43a forming a pivot for a link member 47 having an elongated slot 47a formed therein at its

opposite end which is engaged by the pin 40 at the crank device 37, 38.

As is seen from Figs. 1 and 3 the crank device 37, 38 in its inactive position holds the segment 44 in non-actuated position. When the crank device 37, 38 is rocked upon depression of a key, the segment 44 is activated, and as seen from the said figures the crank device 37, 38 when urged back by the spring 19 through the motion connections 29—41 in the manner formerly described will restore the link member 47 by the pin 40 to the initial position shown in Figs. 1 and 3. The segment 44 is entrained in this movement, and the spring 46 becomes re-tensioned. From the same figures it will be appreciated that the spring 30 acting on the crank device 37, 38 has its line of action passing beyond the pivot center line so that the spring facilitates the depression of the key after initial actuation of the latter.

The force needed to restore the springs 30 and 46 back to their tensioned state is delivered by the spring 19 which therefore has to be suitably balanced with regard to the existing mechanical advantage and the forces exerted by the two other springs 30 and 46.

When a key is depressed and the segment 44 is caused to swing about its pivots 45 the first tooth thereon will lift aside the latch hook 5 so that the disc 4 is released in a manner known per se at the same time as the teeth 44 engage teeth 4e at the circumference of disc 4. When the segment continues to rotate the disc 4 is entrained, and for the example illustrated with the key corresponding to the digit nine the disc is rotated by nine steps. Of course the spacing of the pins 3, the recesses 4b and 4d and the teeth 4e must agree with the spacing of the numbers at the number strip 4c.

In a general way the different keys 0 to 9 differ only by the shape of the slot 33a. For example, the key for the digit one, has a slot which is only of such length that the disc 4 will be rotated through an angle corresponding to a single unit.

The relative positions of the tooth segment 44, the rotor A and the rod 15, 16 are seen from Fig. 7, and it is also seen that the disc 4 when in its setting-up position stands directly opposite the recess 16a in the rib 16.

The setting-up of a digit in the rotor A will now be reviewed.

When the key 33 is depressed the toothed segment 44 will be turned during the initial movement of the key, and thereafter the springs 30 and 46 assist in pivoting the crank device 37, 38 and the segment 44 as far as permitted by the cam slot 33a of the key. As a result the setting-up disc 4 is rotated in a manner known per se, a number of units corresponding to the denomination of the key, after the segment 44 has released the hook member 5.

The number set up can be read in the window 48 where-through the markings on the strip 4c are shown.

At the same time as the segment 44 is rotated the fork member 36 causes a pivotal movement of the crank device 37, 38. The motion of the latter is transmitted by the link member 41 to the arm 29 which is moved to the position illustrated in Fig. 6. The ratchet wheel 23 is released by the hook member 25, and the rotor is rendered free to perform an axial motion imparted thereto by the spring 19. If the key is now released the ratchet wheel 23 by means of the roll 31 returns the crank device 37, 38, the toothed segment 44 and the key 33 to their initial positions at the same time as the rotor is moved by one step.

When the rotor is displaced one step laterally, it will first move the distance required for the recess 4d (see Fig. 3) corresponding to the set-up digit to enter upon the rod portion 16, as during that portion of the step motion the segment 44 and the disc 4 must be prevented from rotation (Fig. 4). Otherwise it might happen that the disc 4 might move and indicate another digit than the one set up.

During that portion of the rotor displacement the ratchet wheel 23 is turned through an angle, but the arms 23a (Fig. 6) engaging the roll 31 are shaped in such a way that the segment 44 will have ceased to engage the disc 4 before the ratchet wheel 23 will begin to move the roll 31 radially outwards. The segment 44 thus has moved out of the path of the next setting-up disc 4 when it slides along to its setting-up position. The next setting-up disc now is ready to be set up.

By suitably balancing the characteristics of the springs 30, 46, and 19 relative to each other a very agreeable manipulation of the keys is attained without the need for complicating the machine design.

What I claim is:

1. In a calculating machine of the ten-key pin-wheel type, in combination, a calculating rotor comprising a plurality of setting discs and a corresponding plurality of pin-wheels, means mounting said rotor for axial movement, means operated by the keys to rotate said setting discs in accordance with the value of the operated key, resilient means released by key actuation for causing a single step of axial movement of said rotor after setting of a digit in one of said setting discs, said key-operated means for said setting discs comprising crank means, said crank means being held in initial position by a toggle spring, said toggle spring acting after initial rotation of said crank means under drive of a selected one of said keys beyond dead center position to drive said crank means to a final position and means actuated by said stepping means for causing axial step movement of said actuator to restore said crank means to initial position.
2. A device according to claim 1 wherein said means actuated by said stepping means comprises a ratchet wheel and a follower driven by said wheel, said follower being connected to said crank means to effect restoration thereof to initial position.
3. A device according to claim 2 wherein the digit keys drive segments for setting up the setting discs of the rotor, said segments being driven initially by the digit keys only and wherein a second crank having a toggle spring is provided, said second toggle spring assisting the digit keys to move associated segments to final position after said crank passes a dead center position.
4. A device according to claim 3 characterized in that said first and second crank means are interconnected by a link having a lost motion connection to cause said cranks to operate independently during forward movement thereof and to be restored to initial position simultaneously when said stepping means actuates said ratchet wheel and its follower.

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