Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 1

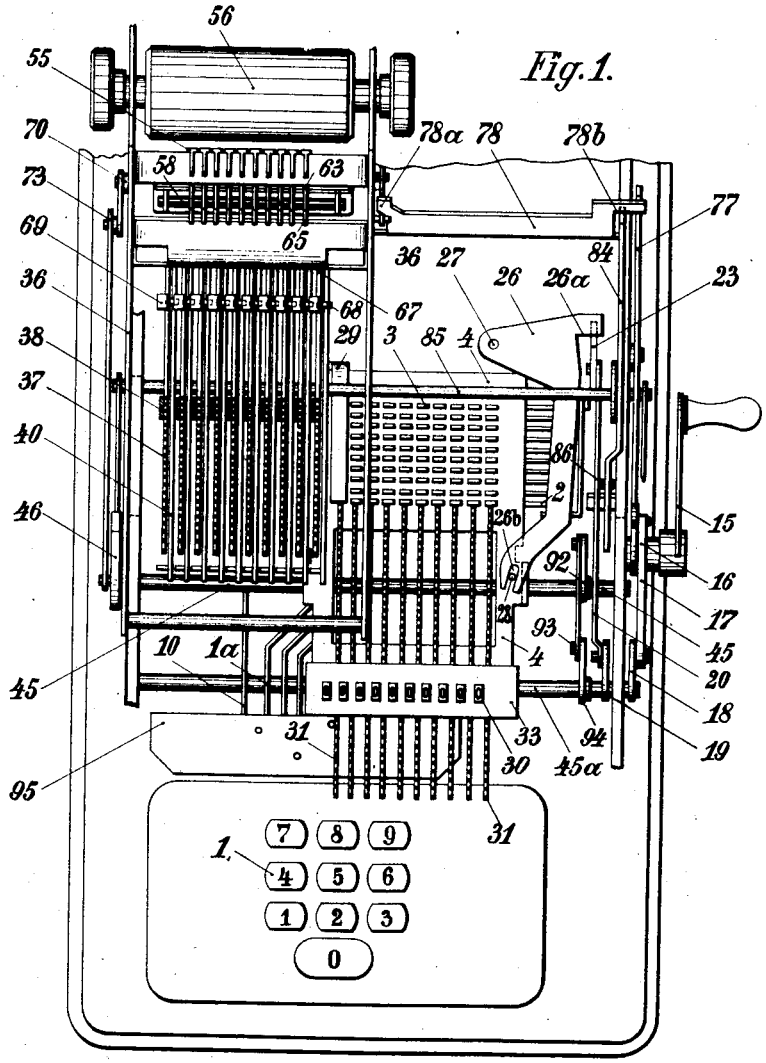

Fig. 1.

Inventor:
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Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 2

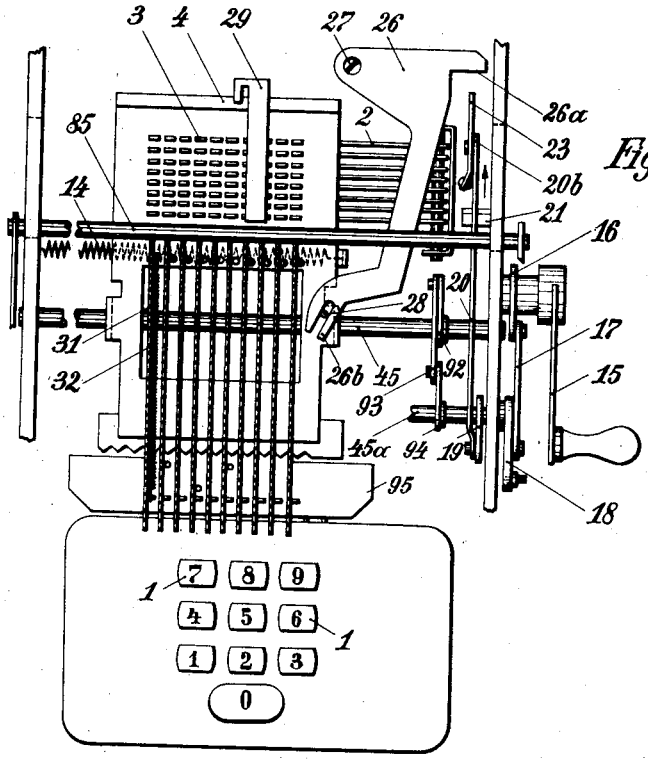

Fig.2.

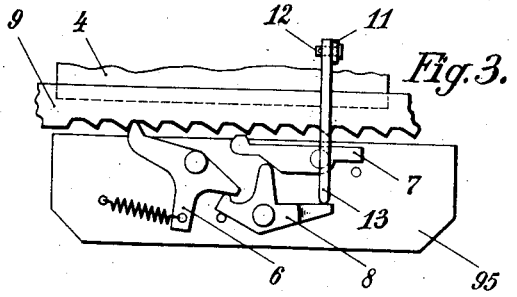

Fig.3.

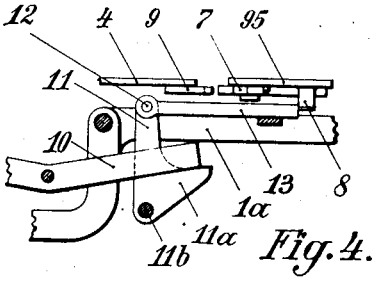

Fig.4.

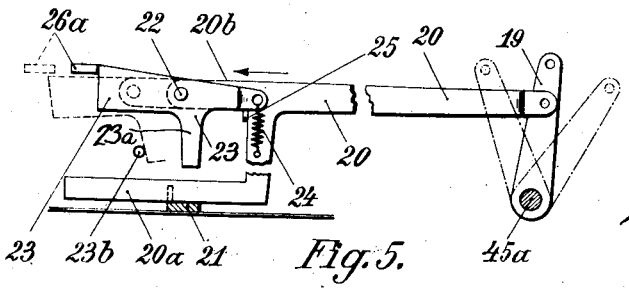

Fig.5.

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Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 3

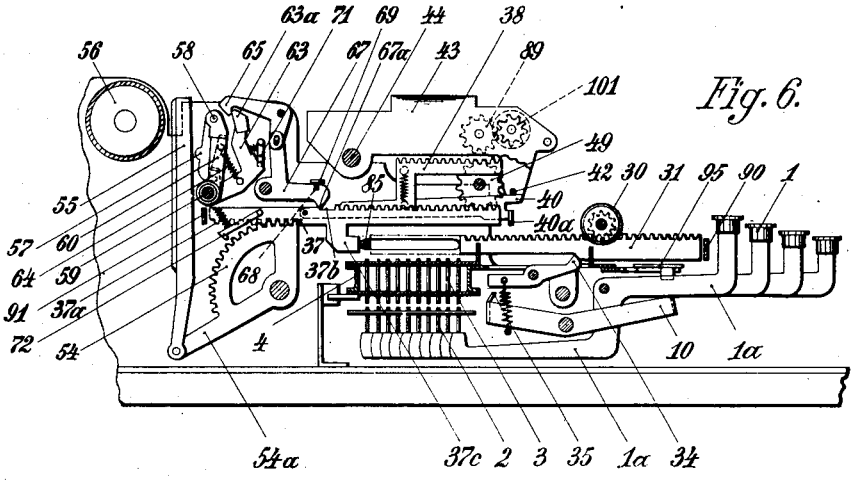

Fig. 6.

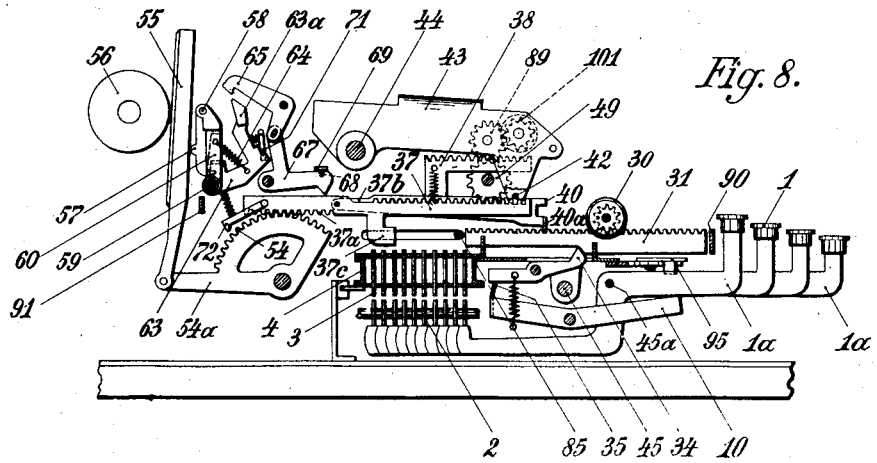

Fig. 8.

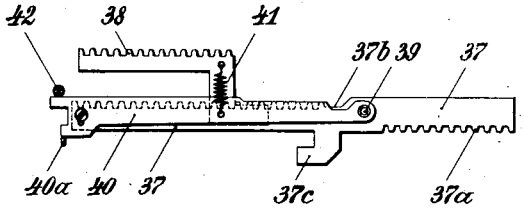

Fig. 7.

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Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 4

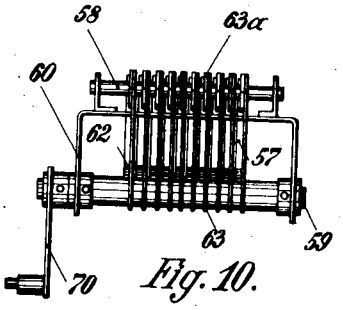

Fig. 10.

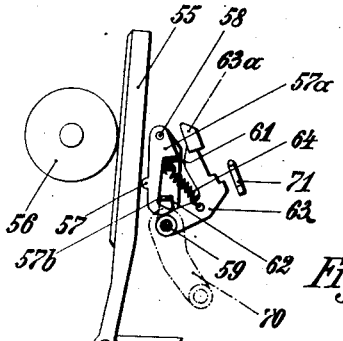

Fig. 9.

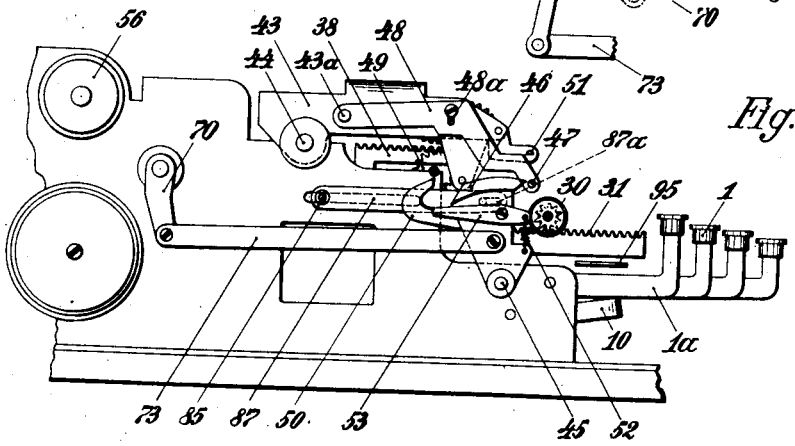

Fig. 11.

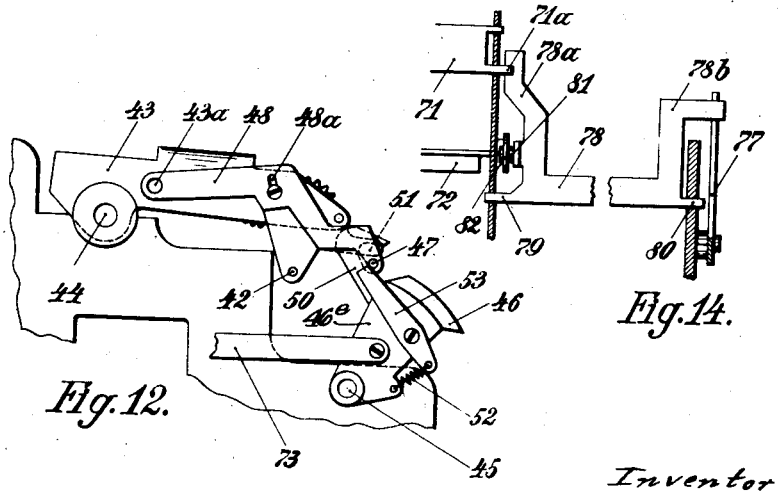

Fig. 12.

Fig. 14.

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Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 5

Fig. 13.

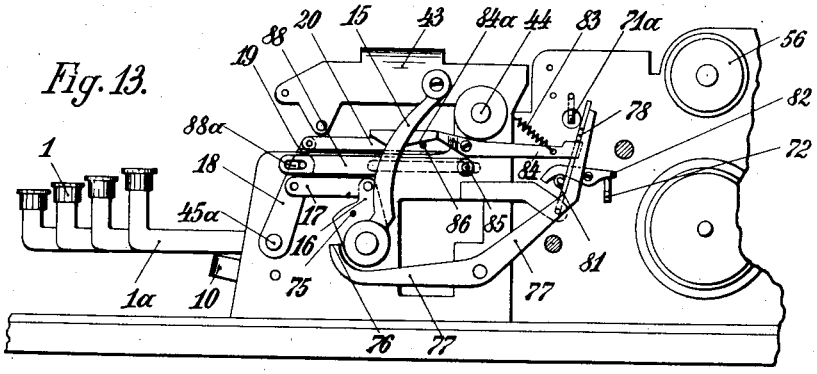
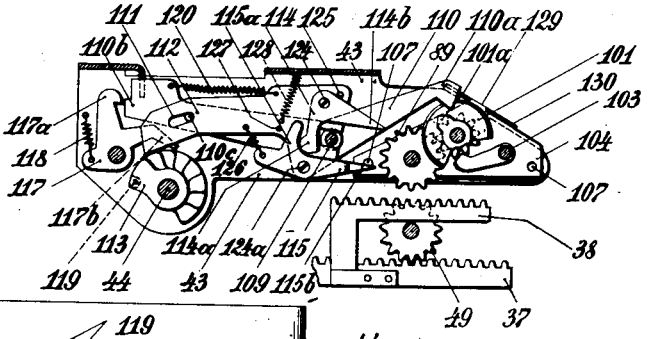


Fig. 15.



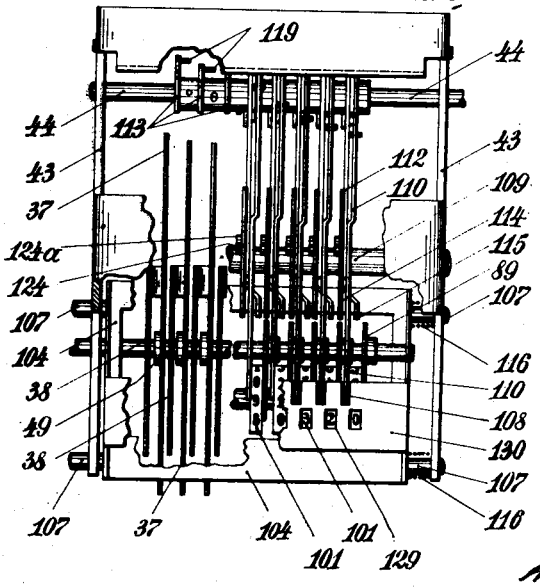


Fig. 16.

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By [illegible] Attorney

Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 6

Fig. 18

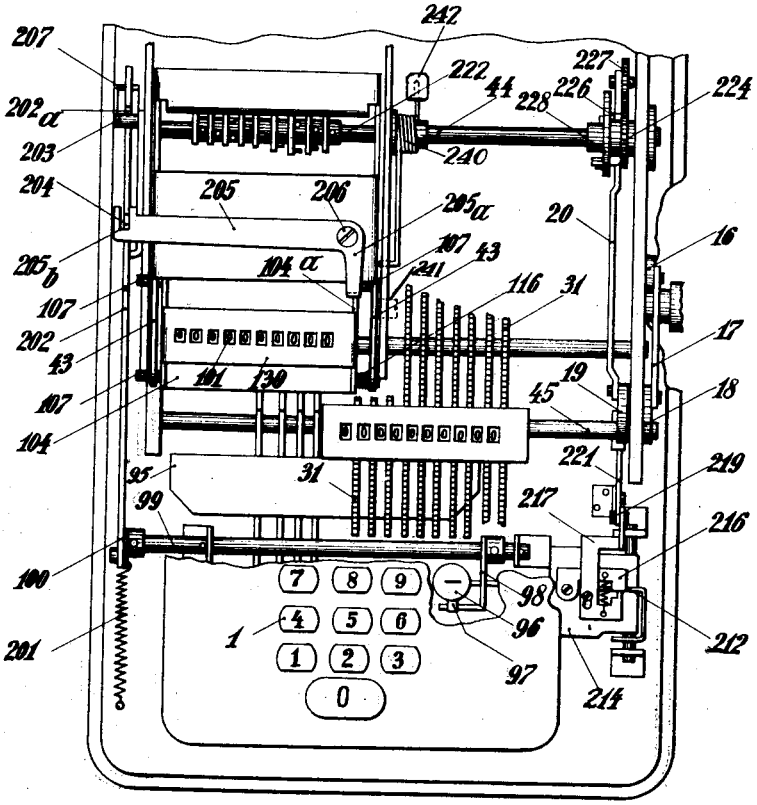


Fig. 17

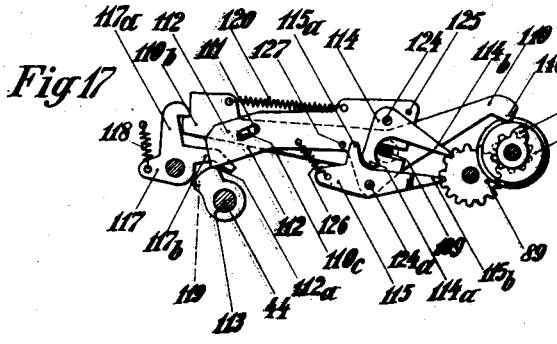
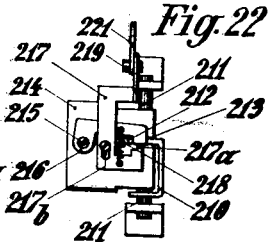


Fig. 22



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Sept. 20, 1938. A. KOTTMANN 2,130,723

CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 7

Fig. 18a.

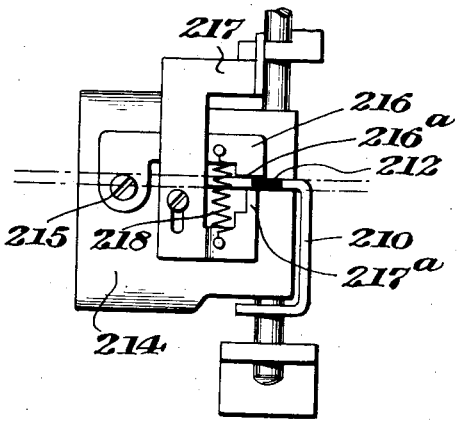


Fig. 18b.

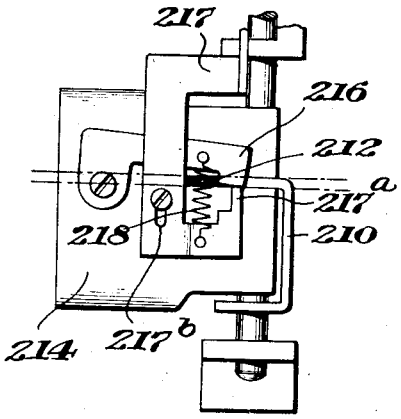


Fig. 18c.

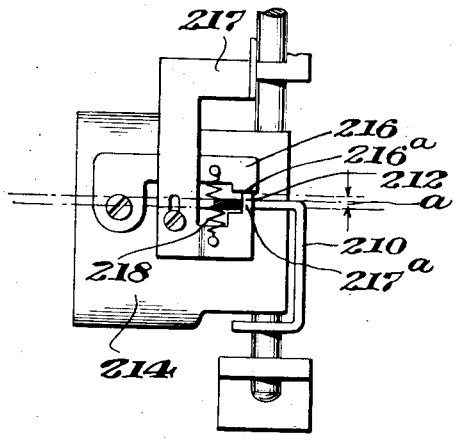
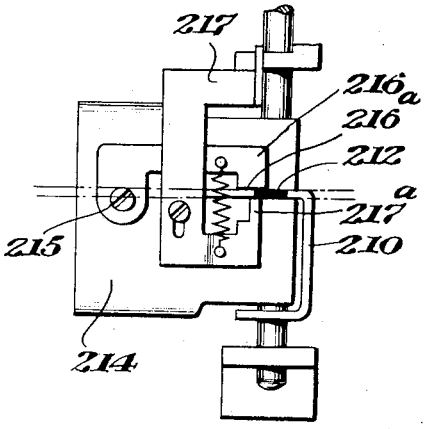


Fig. 18a1



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By
Bonnelycke, Young, Culey & Thompson
attys.

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CALCULATING MACHINE

Filed March 5, 1935 8 Sheets-Sheet 8

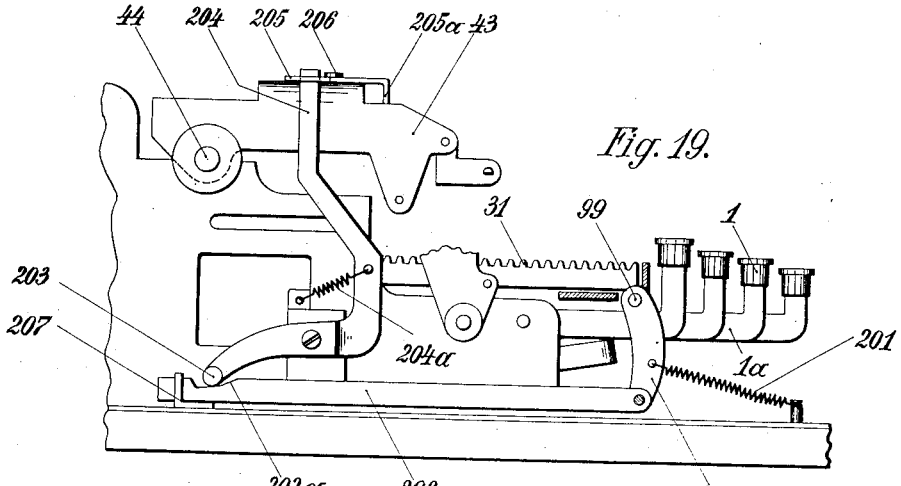

Fig. 19.

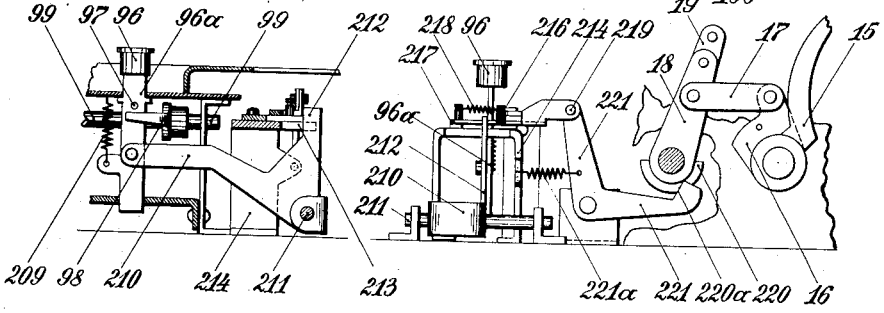

Fig. 20.

Fig. 21.

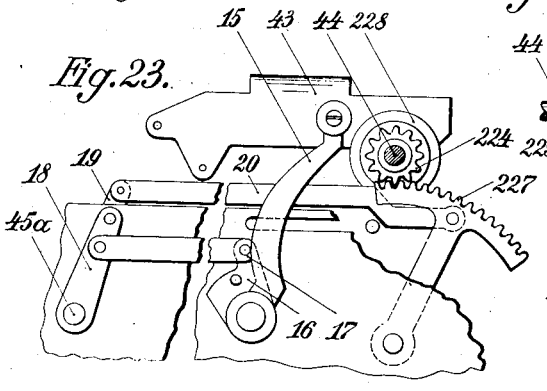

Fig. 23.

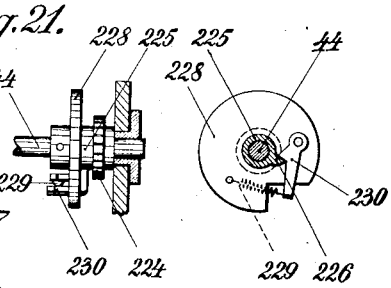

Fig. 24. Fig. 25.

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Patented Sept. 20, 1938 2,130,723

UNITED STATES PATENT OFFICE

2,130,723

CALCULATING MACHINE

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Application March 5, 1935, Serial No. 9,509
In Germany June 6, 1933

8 Claims. (Cl. 235—137)

This invention relates to calculating machines and particularly to machines of the kind capable of both additive and subtractive operations, the present application being a continuation-in-part of applicant's co-pending application Serial No. 728,603, filed June 1, 1934. In machines of this kind, it is necessary to provide tens-carrying mechanism that will function correctly in both kinds of calculation.

An object of the present invention is to provide a tens-carrying mechanism capable of functioning in both additive and subtractive calculations and which will be simple in construction and reliable in operation.

A further object of the present invention is to provide a tens-carrying mechanism which will be positive in operation and free from over-running without the inclusion of special over-running prevention means.

The invention will be described with reference to the accompanying drawings.

Figure 1 shows the calculating machine according to the invention, the cover plates and accumulator being removed,

Fig. 2 is a plan of the setting gear, with the setting members,

Fig. 3 is a view, from below, showing the ratchet gear for the setting member carriage,

Fig. 4 is a side elevation of the members for actuating the ratchet gear,

Fig. 5 shows the actuating device for the return stroke of the carriage,

Fig. 6 is a longitudinal section through the entire machine, with the parts in the initial position,

Fig. 7 shows the arrangement of an actuating rack,

Fig. 8 is a view corresponding to Fig. 6 and shows the position of the parts when the operating handle is drawn forward, shortly before the printing of a calculated value,

Fig. 9 shows the change in position of the parts of the printing mechanism after the impression,

Fig. 10 represents details of the printing mechanism,

Fig. 11 is a side elevation of the drive for the control of the accumulator,

Fig. 12 shows the accumulator, with its control members in position after being coupled, to the actuating members,

Fig. 13 is a side elevation showing the parts in their positions for addition,

Fig. 14 is the front elevation of a detail of a control member,

Fig. 15 is a side elevation of the accumulator with the tens-carrying means in their initial or neutral position, in conjunction with the main parts of an accumulator drive designed as a rack drive,

Fig. 16 is a plan of the arrangements according to Fig. 15, the accumulator being shown on the right half of the figure, and the racks of the accumulator drive on the left, certain plates, which would otherwise conceal the interior of the machine, being cut away,

Fig. 17 shows the tens-carrying mechanism as operating during subtraction,

Fig. 18 shows the plan of the parts required for carrying over the tens, and for the minus setting of the accumulator,

Figs. 18*a*, 18*b*, 18*c* and 18*a'* are plan views of the locking members on an enlarged scale and in different positions of operation,

Fig. 19 is a side elevation of a part of the machine showing the position of certain parts required in subtraction,

Figs. 20 and 21 are two views of the minus key with certain parts co-operating therewith,

Fig. 22 shows the locking members allocated to the minus key, in the locking position,

Fig. 23 is an elevation of the drive for the tens feed shaft, and

Figs. 24 and 25 are two views, partly cut away, of the actuating members seated on the tens-carrying shaft.

The numerical values to be introduced into the machine are introduced in known manner, by means of the keys 1 (Figs. 1 and 6), key levers 1*a* and intermediate levers 2, into the setting pins 3 of the carriage 4. The setting pins thus raised serve as stops for racks forming the setting members 31, which are mounted in guide notches of the carriage 4, and, in being set, actuate at the same time indicating wheels 30 which are also mounted on said carriage. The number of setting members 31 is the same as that of the rows of setting pins 3. When any of the keys is struck, the corresponding key lever 1*a* depresses a lever 10 (Figs. 6 and 8) which by means of a lug 35 releases a pawl 34 engaging the corresponding setting member 31. Said member 31, which was previously retained in the neutral position by the pawl 34, is then free to be actuated by a spring 32 (Fig. 2) and moves towards the left (Figs. 6 and 8) until its end bears against a simultaneously raised setting pin 3, thus setting the member 31.

By means of a ratchet mechanism 6, 7, 8 (Fig. 3) which acts on a rack 9 on the carriage 4 and is mounted on a plate 95 of the machine frame,

the carriage 4 is moved to the left (Figs. 1, 2) to an extent corresponding to the spacing of two adjacent rows of setting pins by the action of a spring 14 (Fig. 2) each time a key is struck, so that the rows of setting pins pass in succession over the ends of the intermediate levers 2 and the pawls 34 pass in succession over the lug 35 on the lever 10.

The ratchet mechanism is actuated by the lever 10 (Fig. 6) arranged below the key levers 1a (Fig. 6). When any of the keys 1 is struck, the corresponding key lever 1a depresses the lever 10, which in turn depresses the arm 11a of a lever 11 (Fig. 4) and thus turns the lever 11 about the pivot 11b. A presser bar 13 which in turn rocks a pawl 8 is articulated at 12 to the lever 11. The pawl 8 actuates the two ratchet pawls 6, 7 in the desired manner.

The carriage 4 is returned to its original position when, to effect an addition or a subtraction, the handle 15 is rocked forwardly and backwardly. The movement of the handle 15 is transmitted, by intermediate members 16, 17, 18 (Figs. 1 and 13), a shaft 45a, a one-armed lever 19 (Figs. 1 and 5), and a thrust bar 20, to a thrust pawl 23. The bar 20 has an arm 20a (Fig. 5) by which it is guided in a member 21 mounted in the base of the machine. The thrust pawl 23 is pivoted on a pin 22 and bears, under the action of a spring 24, against a stop 25 on the thrust bar. As long as the handle 15 is in normal position, the thrust pawl 23 is held in the position shown in dotted lines in Fig. 5 because the arm 23a of the pawl 23 bears against a pin 23b on the machine frame. When the handle is moved forwardly the bar 20 is moved to the right (Fig. 5) whereby the arm 23a is moved away from the pin 23b, and the pawl 23 passes into the position shown in full lines in Fig. 5. When the handle 15 is returned to normal position and the bar 20 with pawl 23 moves to the left in Fig. 5, the pawl encounters an arm 26a on a driver lever 26 (Figs. 1, 2, 5) pivoting on a pin 27 and having an arm with a forked end 26b engaging a pin 28 on the carriage 4. The rocking movement of the lever 26 forces the carriage 4 back into the original position (Fig. 1), while, at the same time, the pins 3, set at the beginning of the operation, are forced back into their original position, sliding under a member 29 provided with a bevel. Shortly before the handle 15 returns to its initial position the arm 23a of the pawl 23 again encounters the pin 23b on the machine frame whereby the pawl is restored to the position shown in dotted lines in Fig. 5. If a new number is now set up in the carriage 4 and the latter moves from its normal position, the arm 26a of the lever 26 can move freely over the pawl 23. The return of the setting members 31 will be described later.

Driving or transmission racks 37 (Figs. 1, 6, 7, 8 and 15) on which are riveted secondary racks 38, are provided in the same number and displaceable in the same direction and to the same extent as the setting members 31 in a frame 36 (Fig. 1) mounted in the frame of the machine. Secured on the transmission racks 37 are coupling members 40 (Figs. 1, 6, 7, 8) which are adapted to turn on pivot pins 39, and are swung by springs 41 (Fig. 7) in the direction of a member 42 (Figs. 6 and 8) on a frame 43 carrying an accumulator 101, said frame being disposed above the racks 37 and pivotally mounted on a shaft 44. The accumulator 101 can be raised and lowered by turning the accumulator frame about the shaft 44. The intermediate pinions 89 are thus brought into or out of engagement with the racks 38 whereby the drive connection between the racks 38 and the numeral wheels of the accumulator 101 can be established or interrupted. The accumulator 101 is raised and lowered by means of a curved member 46 (Figs. 11 and 12) mounted on a shaft 45 which is actuated through intermediate members 92, 93, 94 (Fig. 1) by a shaft 45a, which also effects the return movement of the carriage 4 and is actuated in turn by the handle 15. When the forward movement of the handle 15 and of the curved member 46 begins, the latter engages a guide roller 47 (Fig. 11) of a lever 48, pivotable for a distance determined by a pin and slot guide 48a about a pin 43a on the accumulator frame 43, and causes the accumulator 101 to descend as the movement of the curved member continues, and to engage, through the intermediate pinions 89, with the rack 38. The member 42 mounted on the accumulator frame and descending with the accumulator simultaneously brings angular projections 40a of the coupling members 40 into engagement with the teeth of the setting members or control racks 31 (Fig. 8).

Together with the curved member 46 a positive movement is imparted to a hook 50 riveted on said member (Figs. 11, 12) which hook engages behind a half round pin 51 (Fig. 11) provided on the accumulator frame and thus retains the accumulator in the coupled position (Fig. 12). The hook 50 is rigidly connected with segment 46e mounted on shaft 45 and having the curved member 46 thereon. The segment 46e, the curved member 46 and the hook 50 therefore move together in the same manner as if they were integral or in one piece.

At the same moment that the locking hook 50 engages behind the pin 51, the under side of the curved member 46 has passed out of contact with the guide roller 47 of the lever 48. The roller 47 and lever 48 are forced up (Fig. 12) at the same moment by a lever 53 attached to the curved member 46 and under the tension of a spring 52, so that during the return of the handle into its original position, the guide roller 47 runs back over the upper surface of the curved member and is able to swing the accumulator back into neutral position by a spring 240, (Fig. 18) one end of which engages below the accumulator and presses it upwardly against a stop 241, while the other end engages under a lug 242 on the frame.

Consequently, during the forward movement of the handle 15, the accumulator is brought into engagement with the racks 38, and is disengaged during the return movement. Similarly during the forward movement of the handle, the transmission racks 37, 38 are coupled with the setting member 31 by the coupling members 40 actuated by the accumulator frame 43 through the member 42, the coupling being disengaged in the return movement.

When the handle 15 is moved forward, a driver bar 85 (Figs. 1, 2, 6, 8, 11) is advanced the distance corresponding to the numerical value "9" by connecting rods 87, 88 (Figs. 11, 13). By this means all the setting members 31 previously set in accordance with the items to be added, are returned to the zero position. Thereby the transmission racks 37 coupled to the setting members 31 by the coupling members 40 are moved through a distance corresponding to the amount set. Excessive movement is prevented by a limiting bar 98 (Figs. 6 and 8), which is mounted in

the carriage 4 transversely in front of the ends of the setting members 31 and stops the latter from being moved beyond the zero position.

As soon as the handle 15 has reached the end of its forward stroke the accumulator 101 comes out of engagement with the transmission racks 37, 38 as already described and the setting members 31 are uncoupled from the transmission racks, said members and the numerical control rollers 30 being thus again set to zero.

In the return stroke of the handle 15 and driver bar 85 into the original position, the latter encounters hooked projections 37c (Figs. 6, 7, 8) of the racks 37 and pushes the latter back into the original position (Fig. 6). Excessive movement is prevented by a limiting bar 91 (Figs. 6, 7, 8) mounted in the frame 36 transversely across the ends of the racks 37 which prevents them from being moved beyond the original position. Consequently, the movement of the transmission racks 37, 38 is wholly positive no springs being employed therefor.

When the setting members are in the position corresponding to the numerical value "9" the driver 85 is closely engaged between the opposing surfaces of the hooks 37c and setting members 31. When said members are set for the value "0" the driver can reciprocate between the two surfaces to an extent corresponding to the value "9" without displacing the racks 37 or the members 31. When the member 31 is set in accordance with the value "3" the driver 85 describes at first, at the beginning of both the forward and return strokes, an idle movement corresponding to the value "6" and then pushes the setting member 31, or the driving rack 37 back into the original position. The driver 85 therefore actuates each of the driving racks 37 by the aid of two stops (hook 37c setting member 31) that are provided thereon and project within the sphere of movement of the driver, the one stop (hook 37c) being fixed on the driving rack 37 and the other (setting member 31) being engaged with the driving rack after being key-set.

The drawbars 87 and 88 moving with the driver 85 are connected by means of longitudinal slots 87a, 88a (Figs. 11 and 13) with the arm 18 and the curved member 46 of the shafts 45a and 45. Consequently, at the beginning of the forward and return strokes, the handle 15 describes a certain movement during which the driver 85 is not moved. During this movement, the accumulator 101 is brought respectively into and out of engagement and the setting member coupled with or uncoupled from, the driving racks. These operations therefore proceed with the driver 85 at rest.

Intermediate pinions 49 (Figs. 6, 8, 15, 16) are in engagement with the transmission racks 37. The upper portions of the toothed rims of these intermediate pinions 49 are on a level with the gear teeth of the racks 38 riveted on the transmission racks 37. The accumulator 101 is laterally displaceable to a slight extent. When it is pushed towards the left (Figs. 16, 18), the intermediate pinions 89 of the accumulator engage with the racks 38 and when the accumulator is pushed towards the right, they engage with the intermediate pinions 49 of the gear driving the accumulator. In the former case, the action is one of addition, and in the latter case one of subtraction.

To provide the lateral displacement of the accumulator 101, the numeral wheels thereof (Figs. 15, 16, 17) are disposed, with the corresponding intermediate pinions 89 and locking pawls 103, in a frame 104, which, in turn, is slidably mounted in the frame 43 adapted to swing on a cross shaft 44. The frame 104 has lateral pins 107 sliding in gaps in the cheeks of the frame 43. At the same time, the numeral wheels of the accumulator 101 are guided into window openings 129 in the cover plate 130.

It should be noted that in Fig. 16 there is shown at the left only the driving members, viz. 37, 38 and the intermediate wheels 49, the overlying parts of the accumulator being omitted. At the right of the figure, on the contrary, there are shown only the parts of the accumulator overlying the racks 37, 38, and of the tens carrying mechanism, and the underlying drive racks are omitted for clearness. Nevertheless the machine is provided with a rack 37, rack 38 and intermediate wheel 39 for each decimal place including the units. The pinion 39 of each decimal place of the accumulator lies during addition in the plane of the rack 38, and during subtraction in the plane of the wheel 49.

In changing over to subtraction, the lateral displacement of the frame 104 is effected by depressing a minus key 96 (Figs. 18, 20, 21) provided on the keyboard, said key rocking a lever 98, shaft 99 and lever 100 (Fig. 19) by means of the pin 97 disposed on its stem 96a. The lever 100 produces a lateral displacement of a connecting bar 202, guided in a bracket 201, against the pull of the spring 201. The bar 202 has a bevel 202a which, on the minus key 96 being struck, is pushed under a roller 203 on a lever 204. The displacement of the bar 202 lifts the roller 203 and turns the lever 204 against the action of a spring 204a.

The lever 204 engages in a fork 205b (Fig. 18) of a lever 205, which is pivotally mounted on pin 206 on the frame 43 of the accumulator and engages with its other arm 205a, on the one cheek 104a of the frame 104 that is to be displaced laterally. Consequently, depressing the minus key 96 moves the frame 104 to the right against the spring 116, the machine being thereby changed over to effect subtraction.

The minus key 96, which is constrained by the spring 209 (Fig. 20) to rise again directly after being depressed is locked in the bottom position, by a locking device, until the subtraction is at an end. With this object, a lever 210 (Figs. 18, 20, 21, 22) is articulated to the stem of the minus key, so as to pivot on an axis 211, which lever has an arm 212 engaging in a slot 213 of a U-shaped holder 214.

The holder 214 carries a pawl 216, adapted to turn on a pin 215, and a locking slide 217 guided by a slot 217b. Both are drawn together by a spring 218. When the minus key is not operated, and the handle is in neutral position, the spring 218 draws the pawl 216 and the projection 217a of the slide 217 towards the lateral faces of the arm 212 of the lever 210 (Fig. 18). When the minus key 96 is depressed, the arm 212 in Figs. 18 and 22 is moved slightly towards the left, whereupon, as shown in Fig. 22, the pawl 216 engages behind the arm 212 and locks the key 96 in bottom position.

Articulated to the slide 217 at 219 is a lever 221 (Fig. 21) which is influenced by a curved cam 220 moved by the handle 15 through the rods 16, 17, 18, 19.

On the handle 15 being operated in performing subtraction, and the curved surface 220 moved with it, the control lever 221, lying in a

notch 220a in said cam is forced out of the notch against the action of the spring 221a and now slides over the periphery of the cam. By these means the slide 217 and the pawl 216 (Fig. 22) are raised, so that the ascending pawl 216 releases the arm 212 of the lever 210. Said arm 212 (Fig. 22) can therefore spring a little towards the right, but in so doing it bears against a projection 217a on the slide 217 and is retained thereby until the return of the handle 15 into the original position causes the end of the control lever 221 to re-engage in the notch 220a, under the influence of the spring 221a. By this means the slide 217 (Fig. 22) is again slightly depressed into its original position represented in Fig. 18, so that the arm 212 of the lever 210 is released.

The operation of the locking member is clearly shown in Figs. 18a, 18b, 18c and 18a', in which the projection 217a of the slide 217 and the end 216a of the pawl 216 are arranged in the same plane. In the normal position the arm 212 of the lever 210 lies between the ends 217a and 216a as shown in Fig. 18a. If the subtraction key 96 (Fig. 20) is pressed, then the arm 212 of the lever 210 will assume the position shown in Fig. 18b. The end 216a of the pawl 216 will hold the arm 212 in this position as shown in Fig. 18b whereby the subtraction key 96 will be held in the depressed position. If the handle 15 (Fig. 21) is moved toward the front in order to carry out a subtraction, then, as explained in the foregoing the slide 217 will be moved up the distance a as shown in Fig. 18c. The end 217a of the slide 217 also moves up the end 216a of the pawl 216 so that this will free the arm 212 of the lever 210. The arm 212 is now under the influence of the spring 209 (Fig. 20) against the end 217a of the slide 217. The minus key 96 will move somewhat upwards from its lowest position, but if the machine is maintained in this position of the key 96 it will be still connected for subtraction. If the handle 15 is now moved back then the slide 217 is again moved downwardly the distance a. The end 217a will now move out of the path of movement of the arm 212 but the pawl 216 cannot follow the slide 217 since its end 216a is against the side surface of the arm 212. Therefore, the arm 212 will move into the position shown in Fig. 18a', and this latter position corresponds with the position of the parts shown in Fig. 18a. The minus key 96 will then return to its original position.

The lever 210, the minus key 96, and all the parts displaced by the latter, then return to their original position. In particular, the frame 104 is also returned to its left-hand end position by the springs 116, thus re-setting the machine for addition.

The upper edge of the cover plate 130 containing the window openings 129 (Fig. 16) is provided with guide slots 108, in which levers 110 for preparing tens-carry—rotatably mounted about an axis 109 (Figs. 15, 16, 17) and laterally displaceable within certain limits—are guided in such a manner that, during the change over from addition to subtraction, they share the lateral shifting of the frame 104 and their ends 110a are always within the sphere of movement of tens-carry preparing lugs 101a on the numeral wheels 101.

If, during addition or subtraction, one of the numeral wheels 101 of the accumulator passes from "9" to "0", or from "0" to "9", the cam 101a on the numeral wheel will turn its allotted preparatory lever 110 causing its rear extremity 110b to press on an arm 117b of a pawl 117 and, aided by the spring 118, brings said pawl into a position in which it locks the lever 110 in the preparatory position.

Pins 110c on the levers 110 engage longitudinal slots 111 in slides 112 which are guided by transverse notches on the shaft 109. The corners 112a (Fig. 17) of the slides of those levers 110 that are locked in the preparatory position lie within the sphere of movement of cams 113, which are offset on the shaft 44 round which the frame 43 of the accumulator 101 swings, and therefore the shaft 44 is also the driving shaft of the tens-carrying mechanism. It is actuated after the values have been transferred into the accumulator and the latter is again brought out of engagement with its actuating mechanism, the shaft 44 making one clockwise revolution for each operation of the machine. The cams 113 then displace, to the right, the slide 112 of any lever 110 (Figs. 15 and 17) that is locked in the preparatory position.

The drive of the tens-carrying shaft 44 is shown in Figs. 23, 24 and 25. By means of rods 16, 17, 18, 19, 20 the handle 15 actuates a toothed sector 227, which gears with a pinion 224 on the shaft 44, and is provided with such a number of teeth that it imparts one revolution to the pinion, in one or the other direction, both during the forward and return movement of the handle. The hub 225 (Fig. 25) of the pinion 224 carries a driver tooth 226 which lies close in front of a disc 228, keyed on the tens-carrying shaft 44 and provided with a driver pawl 230 which is under the tension of a spring 229. When the machine is in neutral position, said pawl lies in the position, in relation to the driver tooth, shown in Fig. 25. During the forward movement of the handle 15, the pinion 224 and the driver 226 (Fig. 25) describe one clockwise revolution. The pawl 230, disc 228 and shaft 44 do not share this movement, but the driver tooth 226 describes an independent clockwise revolution at the end of which it slides under the pawl 230, so that the relative position of driver 226 and pawl 230 is again the same as shown in Fig. 25.

During the return stroke of the handle 15, the pinion 224 and driver tooth 226 are turned in the opposite direction and carry along the pawl 230, disc 228 and shaft 44, which latter describes the revolution necessary for actuating the tens-carrying slide 112.

Pivotally mounted on pins 124 and 124a on the slides 112, are two tens-carrying pawls 114, 115 (Figs. 15, 17), which coact by means of lever arms 114a and 115a and, when the tens-carrying device is out of action, are held by the spring 126 in the position shown in Fig. 15, in which the pawl 114 bears against the pin 125. The tip 115b of the lower pawl 115 is bent sideways to the same extent as the frame 104 is displaced laterally during the change over from addition to subtraction. The two pawls 114 and 115 are so arranged that, when the frame 104 is in the left position (referred to Fig. 16), that is to say, set for addition, the intermediate pinions 89 lie in the same vertical plane as the tips 114b of the pawl 114, and when the frame 104 is in the right-hand position, that is, set for subtraction, said pinions 89 are in the same plane as the tips 115b of the pawl 115, and—reckoning from the accumulator order wherein the preparatory cam 101a has become operative—the pawls 114 and 115 engage in the intermediate pinion 89 of the next higher order of the accumulator.

If, in an order, a carry has been made ready and the slide 112 is pushed towards the right by a cam 113 (Figs. 15 and 17), the pawls 114 and 115 are at first pushed only in a straight line towards the right until the pawl which is operative for the time being has engaged in a tooth gap of the corresponding intermediate pinion 89. After the slide 112 has been moved a certain distance towards the right, the arm 114a of the pawl 114 strikes against the shaft 109 whereby the arms 114a and 115a of the pawls 114 and 115 are prevented from moving farther to the right. During the further movement of the slide 112 towards the right the pawls 114 and 115 are consequently swung round the pins 124 and 124a in such a manner that the ends 114b and 115b move like the jaws of closing tongs, that is to say, the tip 114b of the pawl 114 descends, and the tip 115b of the pawl 115 ascends.

When the frame 104 is in the left-hand position, and the machine is therefore set for addition, the pawl 114 engages in the pinion 89, so that the numeral wheel is turned in the additive direction a distance corresponding to one unit. With the frame 104 in the right-hand position, and the machine therefore set for subtraction, the pawl 115 engages in the intermediate pinion 89 and turns the numeral wheel in the subtracting direction.

Towards the end of the operative movement of the pawls 114 and 115, the arm 115a of the pawl 115 strikes against a pin 127, whereby any overrunning movement of the pawls 114 and 115, and the numeral wheels they actuate, is reliably prevented.

At the same moment that the arm 115a of the pawl 115 bears against the stop pin 127, the cam 113 of the shaft 44 slides off the edge 112a of the slide 112. During the further rotation of the shaft 44, a pin 119 on the cam 113 strikes against the downwardly bent end of an arm 117b of the locking pawl 117, thus forcing the latter out of the locking position. The preparatory lever 110 then returns to its original position, under the pull of the spring 128, and the slide 112 returns to neutral position under the pull of the spring 120.

The rear ends of the lower edges of the transmission racks 37 are provided with gear teeth 37a (Figs. 6, 7, 8) which are engaged by the toothed quadrants 54, these latter, in turn, carrying on arms 54a type carriers 55 of the printing mechanism. In proportion as the racks 37 are moved by the setting members 31 with which they are coupled the type carriers are also raised, in a positive manner, so that, in accordance with the setting of the racks and type carriers, the values transferred into the counting mechanism can be printed on a strip of paper clipped on to a platen 56 (Fig. 8).

The impression mechanism of the printing device (Figs. 1, 6, 8, 9, 10) consists of a number of press pawls 57, corresponding to the number of orders in the accumulator, said pawls being adjacently disposed on a shaft 58 fixed in a frame 60 (Figs. 6, 8, 10) adapted to swing on a shaft 59, parallel with the axis of the platen. The movement of these pawls about the shaft 58 in the direction of the platen is restricted by a bar 61 (Fig. 9), against which the projections 57a of the pawls 57 bear. Pressure levers 63 carrying weights 63a are allotted to the pawls 57, and are controlled by springs 64, but are normally held in a neutral position by locking pawls 65 (Figs. 6 and 8). In addition a locking bar common to all the pressure levers is mounted in the frame of the machine and engages in notches in the levers 63, being released just before the printing operation by devices which will be described later.

The locking pawls 65 form part of the zero-printing device and coact with releasing pawls 67, the number of which is the same as that of the transmission racks 37. When the corresponding transmission racks are in neutral position, the tip 67a of each releasing pawl 67 engages in a recess 37b of the transmission rack (Fig. 6). As soon as the transmission rack leaves its original position, its unrecessed portion passes under the tip of the pawl, thereby turning the pawls 67 and 65 and effecting the release of the pressure lever 63 (Fig. 8). On their right side, the pawls 67 are provided with pins 68, while the left sides are provided with lugs 69 of such dimensions that, in each case, the pin 68 of each pawl lies under the lug of the next lower, adjacent pawl, so that if any pawl be raised by its allotted transmission rack all the pawls lying to the right of it in Fig. 1 will also be raised whereas the pawls on the left will remain in the locked position. In printing a value containing a smaller number of figures than there are orders in the printing mechanism, the pawls 65, 67 prevent the impression of "0's" in front of the first numeral of the multi-numeral value to be printed, whereas zeros inside the row of numerals are printed.

During the forward movement of the handle 15, the frame 60, with the press pawls 57, is swung, by means of the shaft 45a, shaft 45, curved member 46, drawbar 73 (Figs. 1 and 11) and the arm 70, towards the platen 56, in such a manner that the press pawls 57 bear against the back of the type carriers 55 and bring the latter so close to the platen 56 that the type characters almost touch the paper, whereas the pressure levers 63 are held at first in their original position in relation to the frame of the machine by the bar 71. During the swinging of the frame 60, tension is applied to the springs 64 of the pressure levers 63, which springs are attached at one end to the cross bar 61 of the frame 60. Shortly before the handle 15 reaches the end of its forward stroke, a striker pin 75 (Fig. 13), which is arranged on the lever arm 16, connected to the handle, comes into contact with a surface 76 on a two-armed lever 77 and deflects the latter in such a manner that its second arm moves a pivotal release member 78 (Figs. 13, 14). The arm 78a of the member 78, which turns on two pivots 79 and 80, moves a pin 71a on the bar 71 when said member is deflected and swings the bar 71 out of the locking position. A roller 81, arranged on an angular bend of the same arm 78a influences a rocking member 82 (Fig. 13) so that the latter forces a straight-edge 72 (Figs. 13, 6, 8) into the toothed sector 54 (Fig. 8). These last described members are relatively arranged so that, in the first place, the straight-edge 72 engages in the tooth gaps of the sector 54, after which the arm 78a comes in contact with the pin 71a and effects the release of the spring-controlled pressure lever 63. The forward movement of the release member 78 brings a locking pawl 84 (Fig. 13), controlled by a spring 83, into position behind the arm 78b, and locks the release member until the handle is moved back again.

At the moment the locking bar 71 is being released, the springs 64 swing the pressure levers 63 on the shaft 59 and impart a high velocity to the weights 63a (Fig. 9). The bent surfaces 62 of the levers 63 then slide downwards on the rear surfaces 57b of the press pawls 57 and,

transforming the kinetic energy of the weights 63a and levers 63 into pressure, press the pawls 57 and type carriers 55, slowly but forcibly, against the surface of the paper so that the impression on the paper is produced less by impact than by uniform pressure.

The thrust bar 20, moved by the handle 15 and actuating the return mechanism of the carriage of the setting members, carries a pin 86 (Fig. 13) which, at the beginning of the return stroke of the handle 15, lifts the curved arm 84a of the locking pawl 84 and thus frees the locking of the release member 78, by which means the straight-edge 72, obeying the pull of a spring 72a (Fig. 8) detaches itself from the teeth of the sector 54, and the locking bar 71 is released again. During the further return movement of the handle 15, the driver 85 actuated thereby pushes the transmission racks 37 back into the original position, as already described thus returning the type carriers into their original position.

The frame 60 carrying the printing mechanism is also swung back during the return of the handle 15 into its original position by means of the shaft 45a, shaft 45, curved plate 46 and drawbar 73, the pressure levers 63 being again locked by the descent of the locking pawls 65, while, at the same time, the locking bar 71 is enabled by spring tension to engage in the notches in the pressure levers.

The return of the pawls 65 into locking position is rendered possible through the return of the allotted driving racks into neutral position so that the release or control pawls 67 are able to drop into the recesses 37b provided in the same, thereby enabling the pawls 65 to move into the locking position.

The invention has been described herein as applied to a ten key calculating machine, but it is to be understood that the invention is not limited to application to this particular machine nor to those of similar type, and may be employed generally in calculating machines.

I claim as my invention:

1. In a calculating machine, a tens-carrying device between a lower order and a higher order wheel and operable in the accumulator when its gears are out of mesh with the actuators, comprising a slide, a cam operated during tens-carrying to move the slide, an additive tens-carrying pawl and a subtractive tens-carrying pawl mounted on the slide and so arranged that one or the other of said pawls is brought into co-operation with a gear in the accumulator when the cam is operated, and a stop on the slide for arresting the pawls at the ends of their tens-carrying movement and while the effective pawl is in over-running preventing engagement with the accumulator gear.

2. In a calculating machine, a tens-carrying device between a lower order and a higher order wheel and operable in the accumulator when its gears are out of mesh with the actuators, comprising a slide, a cam operated during tens-carrying to move the slide, an additive tens-carrying pawl and a subtractive tens-carrying pawl mounted on the slide and so arranged that one or the other of said pawls is brought into co-operation with a gear in the accumulator when the cam is operated, a stop for arresting the pawls at the ends of their tens-carrying movement and while the effective pawl is in over-running preventing engagement with the accumulator gear, and a carry preparing lever actuated by the numeral wheel of the next lower order passing through zero and on which lever the slide is movably mounted, the arrangement being such that actuation of the preparing lever brings the slide into the path of the cam.

3. A tens-carrying mechanism according to claim 2, in which a cross shaft is provided and the tens-carry preparing lever is transversely slidably arranged on the cross shaft.

4. In a calculating machine, a tens-carrying device between a lower order and a higher order wheel and operable in the accumulator when its gears are out of mesh with the actuators, comprising a slide, a cam operated during tens-carrying to move the slide, an additive tens-carrying pawl and a subtractive tens-carrying pawl mounted on the slide and so arranged that one or the other of said pawls is brought into co-operation with a gear in the accumulator when the cam is operated, a stop for arresting the pawls at the ends of their tens-carrying movement and while the effective pawl is in over-running preventing engagement with the accumulator gear, a carry preparing lever actuated by the numeral wheel of the next lower order when passing through zero to bring the slide into the path of the cam and on which lever the slide is movably mounted, and means for positively locking the tens-carry preparing lever in a position holding the slide in the path of the cam when the corresponding numeral wheel in the accumulator passes through zero.

5. In a calculating machine, a tens-carrying device between a lower order and a higher order wheel and operable in the accumulator when its gears are out of mesh with the actuators, comprising a slide, a cam operated during tens-carrying to move the slide, an additive tens-carrying pawl and a subtractive tens-carrying pawl mounted on the slide and so arranged that one or the other of said pawls is brought into co-operation with a gear in the accumulator when the cam is operated, a stop for arresting the pawls at the ends of their tens-carrying movement and while the effective pawl is in over-running preventing engagement with the accumulator gear, a carry preparing lever actuated by the numeral wheel of the next lower order when passing through zero to bring the slide into the path of the cam and on which lever the slide is movably mounted, means for positively locking the tens-carrying preparing lever in a position holding the slide in the path of the cam when the corresponding numeral wheel in the accumulator passes through zero, and means on the cam for subsequently moving the locking means into position releasing the tens-carry preparing lever.

6. A tens-carrying mechanism according to claim 1, in which the additive and subtractive tens-carrying pawls have coacting extensions which co-operate with a stop in the latter part of the tens-carrying movement of the slide to cause said pawls to effect a tongs-like movement while one of said pawls is in engagement with the corresponding numeral wheel.

7. In a calculating machine, a tens-carrying device between a lower order and a higher order wheel and operable in the accumulator when its gears are out of mesh with the actuators, comprising a slide, a cam operated during tens-carrying to move the slide, an additive tens carrying pawl and a subtractive tens-carrying pawl mounted on the slide and so arranged that one or the other of said pawls is brought into co-operation with a gear in the accumulator when the cam is operated, a stop for arresting the

pawls at the ends of their tens-carrying movement and while the effective pawl is in over-running preventing engagement with the accumulator gear, and a tens-carrying preparing lever arranged substantially parallel to the actuators, said lever being actuated by the numeral wheel of the next lower order passing through zero and on which lever the slide is movably mounted.

8. A tens-carrying mechanism according to claim 2, in which means is provided so that the accumulator has a limited transverse shift between additive and subtractive positions, said tens-carrying preparing lever participating in this shift and means being provided to retain said lever in the path of carrying lugs on the numeral wheels of the accumulator in both positions of the accumulator.

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