Jan. 12, 1954

K. WESTINGER ET AL

2,665,844

CALCULATING BUSINESS MACHINE

Filed Dec. 4, 1950

3 Sheets-Sheet 1

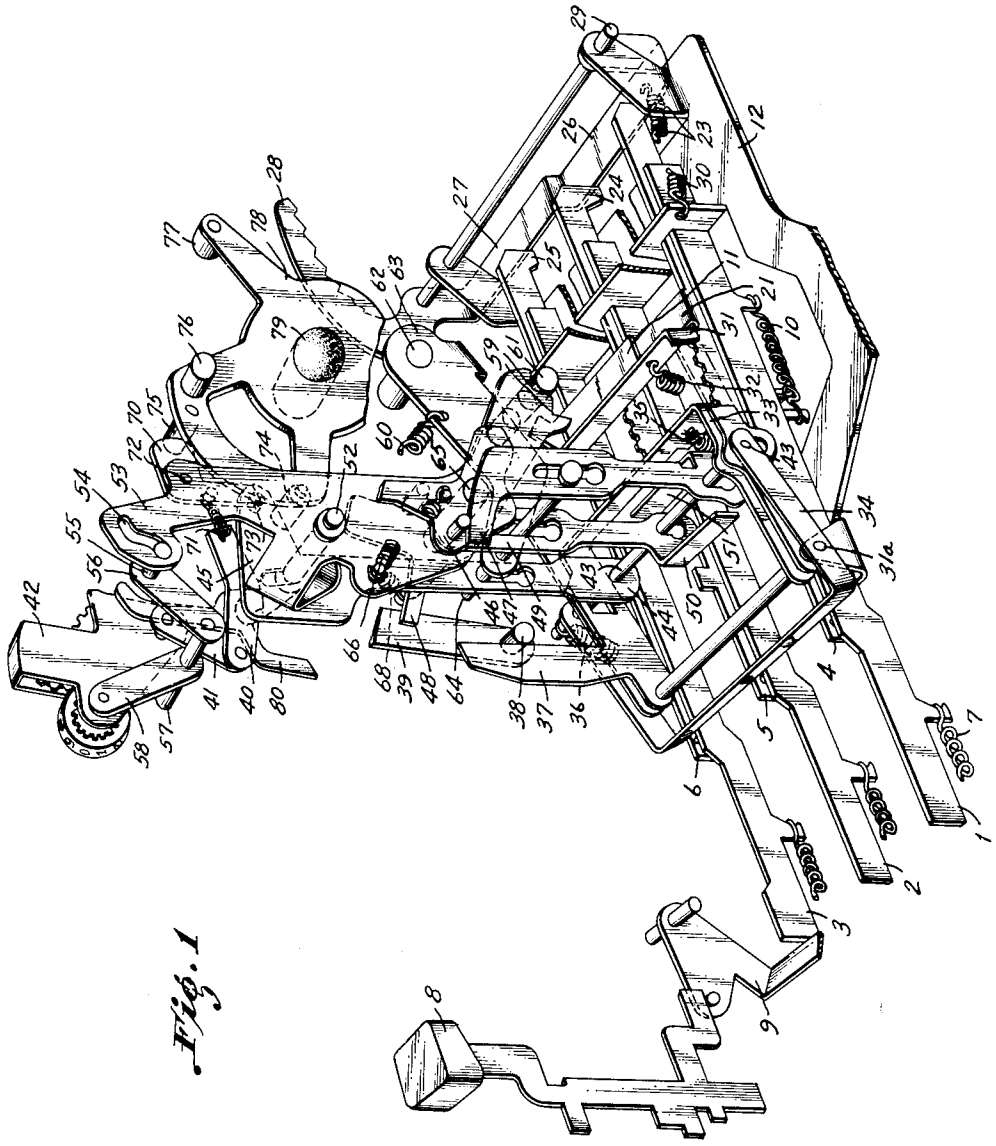


Fig. 1

Inventors
KARL WESTINGER,
ERNST ALTENBURGER
& OTTO HIRT

By Karl Michaelis
Attorney

Jan. 12, 1954 K. WESTINGER ET AL 2,665,844

CALCULATING BUSINESS MACHINE

Filed Dec. 4, 1950

3 Sheets-Sheet 2

FIG. 7

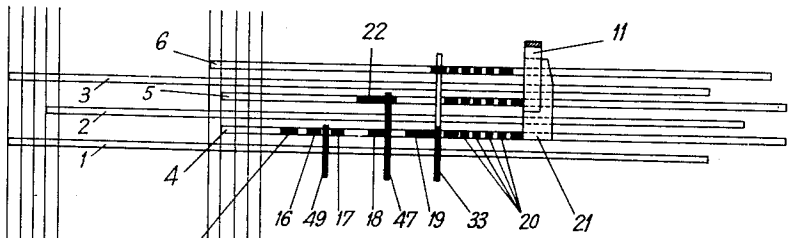


FIG. 8

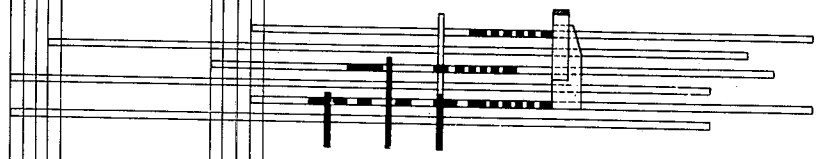


FIG. 9

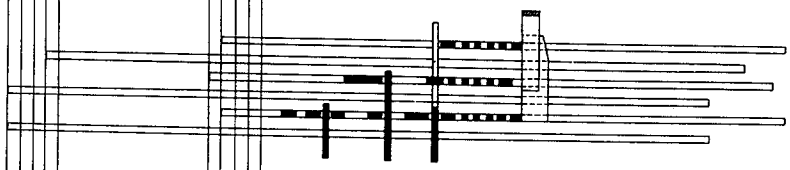
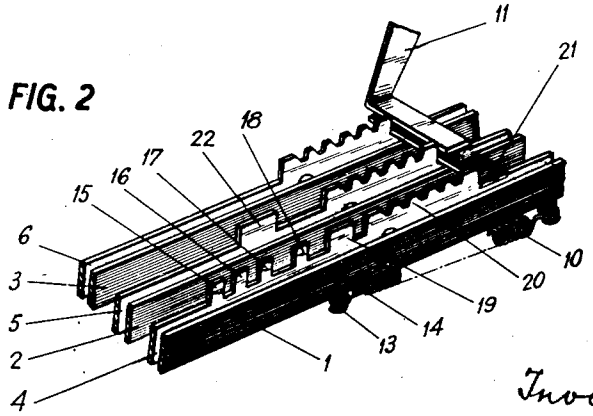


FIG. 2



Inventors
Karl Westinger,
Ernst Altenburger and
Otto Hirt
by Karl Michaelis, atty.

Jan. 12, 1954

K. WESTINGER ET AL

2,665,844

CALCULATING BUSINESS MACHINE

Filed Dec. 4, 1950

3 Sheets-Sheet 3

FIG. 3

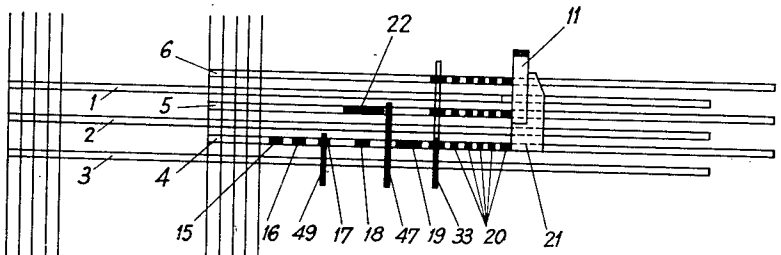


FIG. 4

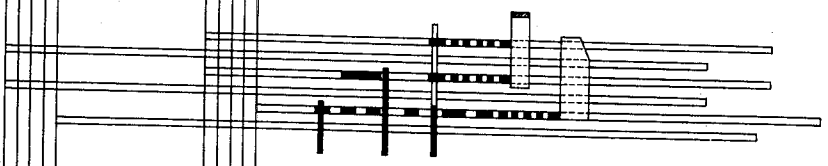


FIG. 5

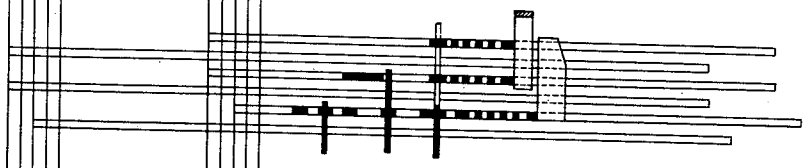
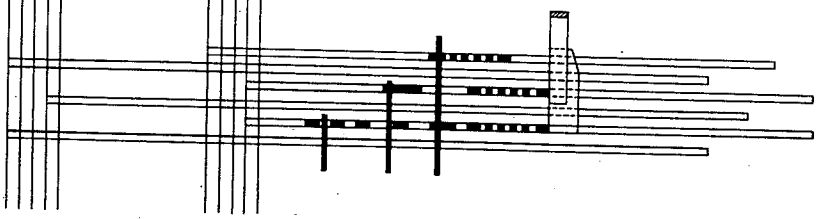


FIG. 6



Inventors
Karl Westinger,
Ernst Altenburger and
Otto Hirt
by Karl Michaelis, Atty.

Patented Jan. 12, 1954

2,665,844

UNITED STATES PATENT OFFICE

2,665,844

CALCULATING BUSINESS MACHINE

Karl Westinger, Ernst Altenburger, and Otto Hirt, Oberndorf (Neckar), Wurttemberg, Germany, assignors to Olympia Werke West G. m. b. H., Wilhelmshaven, Germany, a company of Germany

Application December 4, 1950, Serial No. 198,955

Claims priority, application Germany December 7, 1949

13 Claims. (Cl. 235—60.2)

1

This invention relates to calculators broadly and to business machines comprising calculating mechanism in particular.

It is one object of the invention to improve the calculating mechanism of this type of machines to the extent of speeding up the calculating operations, more especially in the sense that the calculating operations can follow each other without any material interruption up to the full extent of the working capacities of the mechanisms involved and of the skill of the person operating them.

Other objects of the invention will appear from the description below of the general and specific features of the invention.

Obviously, in order to fully utilize the working capacity of a business machine, it is imperative that different operations should follow one another as quickly as possible and without any material interval. For instance, if numeral values are introduced, as by depressing keys into a calculator and mechanism set for certain functions such as addition, subtraction, non-adding, totalling or sub-totalling, the calculating operation already under way must have come to a finish before new items or functions can be introduced. In other words, no preparatory action can be taken, as far as the calculating mechanism is concerned, while the calculator is still busy on a previously introduced operation.

In order to enable the period of such operation to be utilized for the preparation of another operation to follow, means have already been suggested, for instance in connection with ten-key adding machines, for introducing new items while there is an operation in progress in the machine. This so-called pre-selecting of numeral values led to a considerable increase of the capacity of the calculating machine.

According to the present invention, a further speeding up of operations is obtained by providing the calculating machine with a storer or accumulator which becomes ready for the reception of new numeral values while a calculating operation is proceeding and which allows the pre-selection of new functions.

In a preferred form of mechanism according to this invention, the elements serving for transmitting the functions from the function keys into the machine are subdivided into pre-selecting elements controlled by the function keys and selecting elements actually carrying out these functions. The pre-selecting elements and the actual selecting elements are connected with each other by an elastic member, such as a spring

2

in such a manner that the actual selecting elements which during a current operation remain locked in their position, on being released at the end of this operation, are pulled by the pre-selected elements into the position where they become effective.

Preferably the pre-selecting elements and the actual selecting elements have the form of juxtaposed sliding bars movable longitudinally and pairwise connected by springs which pull them towards suitable checks.

These pairs of elements, which form the storer or accumulator according to this invention, render it possible to utilize for the carrying through of different functions the same selecting and pre-selecting slides by rendering them fit to be set for different travelling distances and thereby for different functions. The sub-dividing of the members transmitting the functions into the machine into elastically coupled selecting and pre-selecting slides involves a great simplification and a reduction of the number of transmitting elements. Not being positively connected, but relatively movable to a certain extent, the pre-selecting slides and the actual selecting slides can be fitted with drivers and checks which enable them to carry along different selecting slides for certain functions and to be blocked in their travel independently of the pre-selecting elements by other members of the calculating mechanism.

We prefer to provide in a machine according to this invention three sets of pairs of pre-selecting and actual selecting slides, one set, which forms the index slide, being arranged for three working positions corresponding to addition, non-addition and subtraction, while the two other sets, constituting the totalling and the sub-totalling, slides both of which on being displaced carry along the index slide, can move each into two operating positions, one of which, corresponding to the position of its pre-selecting slide, corresponds to positive total or sub-total, while the other, differing from the position of its pre-selecting slide, which is brought about by a blocking member directed in dependency from the sign of the value of register, corresponds to the negative total or sub-total. The selecting slides are formed with notches for arresting them by means of a locking bail or hook and with teeth on or between which, according to the kind of selection, sensing members may come to rest which start the functions selected by the depression of corresponding keys.

The new elements forming part of a machine

according to this invention, being of simple design and leading to a reduction of the number of controlling members, enable the business machines of which they form part, to allow of introducing, during a calculating operation, a new function which then becomes effective directly after that operation has come to an end. In consequence of this possibility all operations in a machine of this kind can now succeed each other practically without any interval and the working speed of the machine now depends merely upon the pace set by the operator.

In the drawings affixed to this specification and forming part thereof an embodiment of the invention is illustrated diagrammatically by way of example.

In the drawings:

Fig. 1 is a perspective side view of the entire mechanism, while

Fig. 2 is a similar view of the selecting slides and the pre-selecting slides.

Figs. 3–9 are diagrams indicating the positions taken by the pre-selecting slides, the actual selecting slides and the sensing elements during the different possible combinations.

Referring to the drawings, the ten-key adding machine here illustrated is provided with three pre-selecting slides 1, 2 and 3 and with three actual selecting slides 4, 5 and 6, respectively, each actual selecting slide being coordinated with a pre-selecting slide of its own. The pre-selecting slides 1, 2 and 3 which are pulled towards the left by recoil springs 7 can be moved towards the right by means of function keys 8 through the medium of angular levers 9 in the longitudinal direction through different distances. They are connected by means of coil springs 10 with their selecting slides 4, 5 and 6, each of them extending alongside of and movable in the same direction as its pre-selecting slide. The pre-selecting slide 1 is displaced together with its actual selecting slide 4, the so-called index slide, through two travel units, while remaining in its position during addition. The pre-selecting slide 2 together with its actual selecting slide 5, the so-called totalling slide, and the pre-selecting slide 3 with its actual selecting slide 6, the so-called sub-totalling slide, are displaced through three travel units during a totalling and a sub-totalling operation, respectively. The two selecting slides 5 and 6 can however be blocked in a manner described farther below after displacement through one travel unit by means of a blocking lever 11, which becomes active in the case of a negative value of the total or sub-total, although their pre-selecting slides 2 and 3, respectively, are being displaced through three travel units. All the slides 1–6 are slidably mounted in a frame 12. The coil springs 10 pull the slides of each pair towards each other in such manner that the lips 13 of the selecting slides, which also serve for attaching the springs, tend to rest on checks 14 of their pre-selecting slides.

The selecting slides 4, 5 and 6 are formed with teeth and projections by means of which they can act on certain controlling members for the throwing in and out of a "plus" or "minus" setting of the calculators. These teeth and projections are arranged, as shown in Fig. 2, in the following manner: the index slide 4 is formed, starting from the left, with three rectangular teeth 15, 16 and 17, the width and distance of which correspond to one travel unit. From these teeth is spaced by two travel units a 4th tooth 18 of the same width and a 5th tooth 19 of double the width. Then follows after another travel unit a notched member 20 formed with five notches, spaced in accordance with so many travel units. Following the notched member 20 the index slide 4 carries a check arm 21 extending horizontally across the totalling slide 5 and the sub-totalling slide 6. The totalling slide 5 is formed only with a single tooth 22 of treble width which, in the basic position of all the slides, is arranged symmetrically to the 4th tooth 18 of the index slide 4, while the sub-totalling slide 6 has no tooth. The two selecting slides 5 and 6 are however formed with notched members 20 in the same position as the slide 4. The index slide 4 and the totalling slide 5 are formed at their right hand ends with downwardly directed lips 23 and 24 respectively, equal in length, while the sub-totalling slide 6 has a shorter lip 25. These lips act on the bottom step 26 and on the top step 27, respectively, of a check bar in the form of a sickle-shaped member 28 serving for setting a printing mechanism (not shown) for the signs of the functions selected at that time. The selecting element 28 can turn about the stationary axle 29 and is forced by a spring 30 against the lips or catches of the selecting slides. The blocking lever 11 mentioned above only extends across the notched sections 20 of the totalling slide 5 and the sub-totalling slide 6. It is moved by means of a device (not shown) influenced by the positive or negative position of the calculator through a sensing lever 80 in such manner that, if the value of the register is positive, it is carried along by the notched sections 20 of the totalling and sub-totalling slides 5 and 6, while they are being displaced. In contrast thereto, if the value of the register is negative, the sensing lever 80 blocks the slides 5 and 6 when they have moved through one travel unit. The notched sections 20 of the selecting slides 4, 5 and 6 are arranged for coaction with a blocking bar 31 which blocks them throughout one operation after a function has been set for. This bar 31 can turn about a stationary axle 31*a* mounted on the frame 12 and is pulled clockwise by a spring 32 towards the notches. On the same axle are mounted a setting bar 33 and a swing loop 34, both of which are pulled by springs 35 and 36 in the same direction as the blocking bar 31. The bar 33 which is so formed as to be able to contact only the index slide 4, has an upwardly directed arm 37 resting against the stud 38 of a switch member 39 which, according to the position it assumes, sets the counter 42 by means of a lever 40 and a link 41 for "plus" or "minus." The swing loop 34 carries an axle 43 to which is linked a lifting bar 44, the top end of which is formed with a lateral catch 45 (shown in dotted lines). The axle 43 carries, apart the blocking bar 31 and the setting bar 33, an adjusting bar 47 (index bar) actuating the index pawl 46 and an adjusting bar 49 (totalling bar) which actuates the totalling pawl 48. The index bar 47 is formed at its bottom end with a cross arm 51 which extends across the index slide 4 and the totalling slide 5, while the totalling bar 49 carries a cross arm 50 extending only across the index slide 4. The blocking bar 31, the setting bar 33 and the two adjusting bars 47 and 49 are formed with slots embracing the axle 43 on which they come to rest when the lifting bar 44 is lifted, and on being lowered, can rest with their cross arms on the teeth or projections of the selecting slides 4, 5 and 6 when

these slides are in corresponding positions. Between the adjusting bars 47 and 49 is mounted an operating member 53 arranged to turn about the stationary axle 52 and being formed with a cam slot 54 acting on the pin 55 of a lever 56. Since this latter is fixed to the axle 57 which by way of a lever 58 is operatively connected with the counter 42, this counter, when the operating member 53 is rotated, will be oscillated about the axle 57 so as to be thrown in or out. The stationary axle 52 of the operating member 53 extends across, and guides, the lifting bar 44 in a slot (indicated in dotted lines). The operating member 53 is formed at the bottom with an M-shaped notch 59 into which is pulled by a spring 60 the stud 61 of a lever 63 mounted for turning movement about a stationary axle 62. The lever 63 carries on its left hand end a rod 64 which extends through slots in the two adjusting bars 47 and 49 and is guided therein. It can serve also as a check for the left hand flank of the operating member 53 is this member is formed accordingly. The member further carries a pin 65 which forms an axle for the index pawl 46 arranged in the front and for the totalling pawl 48 arranged to the rear. The index pawl 46, being pulled anti-clockwise by a spring 66 rests with its stud 67 on the top check, pointing left, of the index bar 47, while the totalling pawl 48 is turned by the spring 68 towards the right until its stud 69 meets the top check, directed towards the right, of the totalling bar 49. From the top end of the operating member 53 there projects towards the right an uncontrolled resetting latch 70 which is pulled by a spring 71 clockwise around an axle 72 and comes to rest against a stud 73 mounted on the operating member 53. The latches 46 and 48, which when the adjusting bars 47 and 49 descend, are pulled towards the right by their springs 66 and 68, project in the operating position (left hand movement) of the operating member 53 into the path of studs 74, 75, 76 and 77 of studded disc 78. This disc is fixed to the machine shaft 79 and is pulled, together with this shaft, through a predetermined angle anti-clockwise when advancing, and clockwise when receding. The studs 74, 75 and 77 extend backwards, the stud 76 forwards. The stud 74 in the starting position holds the lifting bar 44 up by its lip 45 together with the members coupled with it through the axle 43 of the swing loop 43, i. e. the blocking bar 31, the setting bar 33 and the adjusting bars 47 and 49, while releasing them at the beginning of the advance so that they can move downwards, while lifting them again at the end of the backward movement. The stud 74 also serves for operating the totalling pawl 48, while the stud 76 operates the index pawl 46. The stud 75 acts at the beginning of the forward movement on the resetting latch 70, while near the end of this movement the stud 77 acts on this latch.

The mechanism hereabove described operates as follows: in their position of rest all the parts are arranged as shown in Figs. 1, 2 and 3. If the function key 8 is then lowered, it shifts by means of the angular lever 9 one of the pre-selecting slides 1, 2 or 3 through the distance towards the right corresponding to the particular operation. Since the lock bar 31 is raised, the pull of spring 10 causes the selecting slide 4, 5 or 6 corresponding to the pre-selecting slide which has been moved to follow this slide through the same distance. In this movement the totalling slide 5 and the sub-totalling slide 6 carry along the index slide 4 by means of their notched sections 20 which meet its check member 21. Normally they are shifted through three travel units. There extends however in the path of their notched sections 20 the blocking lever 11 and this latter, whenever a negative total or sub-total value is selected, will limit the travel of the totalling or sub-totalling slide 5 and 6, respectively, to a single travel unit.

During or after actuation of the function key 8 the machine is started working either manually or by a motor. The machine shaft 79 is rotated in the direction towards the left and the stud 74 of the studded disc 78 fixed on this shaft releases the catch 45 of the lifting bar 44, causing this latter to descend together with the axle 43 linked to it. In consequence of this movement the blocking bar 31 which up until now had been held by it in raised position, is turned in the direction towards the right by its spring 32 and enters the notches of the notched sections of the slides 4, 5 and 6, thereby locking these slides in their actual positions. The setting bar 33 is also pulled towards the right by its spring 35 and according to the position occupied by the selecting slide 4 comes to rest on or between the teeth 18—19, and the notched sections 20. If the bar remains in the upper position, it sets by means of its upper left hand arm 37 the counter 42 on "plus" by means of the stud 38 of a member 39, the lever 40 and the link 41. However, if the bar 33 drops into a gap between the teeth, it sets the counter 42 for "minus." At the same time the adjusting bars 47 and 49 which hitherto were held in the upper position by the axle 43, will descend. If in doing so they meet one of the teeth or projections 15—18 or 22, they do not change the position of the pawls 46 or 48 controlled by them. If however they enter a gap between the teeth, the corresponding pawl 46 or 48 is swung by its spring 66 and 68, respectively, towards the right. Since the stud 75, when the machine shaft 79 starts turning around, meets the resetting latch 70 of the switch member 53 which, being held in its position by the stud 73, cannot give way, this member is turned anti-clockwise around its axle and will throw out the counter 42. During this movement of the switch member 53 the pawls 46 and 48, insofar as they have been turned towards the right by the adjusting bars 47 and 49, have crossed the path of the studs 74 and 76. In this movement the stud 76 can act only on the index pawl 46. During the advance however this pawl gives way in downward direction without starting any action. Only when being pulled back, the stud 76 will force this pawl which is now hindered from turning to the left by the upper lip of the index bar 47, away together with the entire switch member 53, and this member will now be moved clockwise and will throw in the counter 42. On the other hand the stud 74 will act on the totalling pawl 48 only during its advance, because this pawl is then hindered by the upper lip of the totalling bar 49 from turning to the right and consequently, on moving the stud 74, is forced to give way towards the left together with the switch member 53 and will then turn this latter clockwise for the throwing in of the counter. During its return, however, the pawl 48 can give way towards the left and thus, when moving the studs 74 and 75, does not produce any action.

While these movements occur, which will be described in greater detail here below, another function may be selected by means of a key after

the machine has passed through about one half of its operation. To this end one of the function keys 8 is again depressed and will shift the pre-selecting slide 1, 2 or 3 corresponding to the new function towards the right. At the same time the pre-selecting slide previously shifted into an effective position, being acted upon by its recoil spring 7 returns into its initial position, since on another function key being depressed, the key previously depressed is returned into its position of rest in a well known manner. The selecting slide 4, 5 or 6 which is coordinated with the pre-selecting slide now adjusted, is hindered from following it since all selecting slides are locked in their actual positions by the lock bar 31 as long as a calculating operation is being carried out. The new pre-selecting slide adjusted by the depression of another key is retained in its new position by its function key and therefore at first places its coordinated selecting slide under the action of its spring 10. As soon, however, as the calculating operation under way has come to an end, the stud 74 on the studded disc 78, when this disc returns into its initial position, lifts the catch 45 of the lifting bar 44 and by means of the axle 43 also lifts the adjusting bars 47 and 49, the setting bar 33 and the blocking bar 31. This movement causes the selecting slide which had previously become effective, to be released and pulled by its pre-selecting slide into its initial position by way of the spring 10. On the other hand the spring 10 of the pre-selecting slide now actuated pulls its coordinated selecting slide into effective position and a new operation can start.

When the selecting slides 4, 5 or 6 are shifted in lateral direction, they displace by means of their lips 23, 24 and 25 respectively and the steps 26 and 27 of the check bar the member which acts on the printing mechanism, into the position where it prints the symbols corresponding to the calculating operation for which the machine has been adjusted.

In the following the coaction of the different parts will be described in greater detail for every calculating operation.

1. Addition

When effecting an addition or subtraction, the racks of the counter must be free of the counters during the advance in order that the sensing levers coupled with them are free to adjust themselves relative to the studs of a stem carriage set by the keys. Only on collecting the sensing levers during the return movement of the counter racks must be moved into mesh with the counters. This is being done in the following manner: in the case of an addition, either when operating manually or when operating the machine by a motor, only the motor key is depressed. This key does not act on the pre-selecting slides 1, 2, 3 and these slides therefore remain in the position shown in Figs. 1–3. Thus, when being advanced, the totalling adjusting bar 49 comes to rest on the 3rd tooth 17 of the index slide 4, leaving the totalling pawl 48 controlled by it in its position of rest. On the other hand the index bar 47 will enter the gap between the teeth 18 and 19 of the index slide 4 and now turns the index pawl 46 towards the right. The adjusting bar 33 rests on the left hand part, free from teeth, of the notched section 20 of the index slide 4 and sets the counter 42 for "plus." After the stud 74 or the studded disc 78 has turned right at the beginning of the advance the switch member 53 by way of the pawl 70 towards the left, thereby throwing out the counter 42, the stud 76 after having moved through a predetermined angular path, passes the index pawl 46 which gives way resiliently. In contrast thereto, when returning, the stud 76 turns by means of the index pawl 46, whose stud 67 comes to rest on the left hand lip of the index bar 47, will turn the switch member 53 in clockwise direction and this member then will carry the positive counter gear of the counter 42 into mesh with the racks of the counter. Near the end of its return movement the stud 74 by means of the lip 45 lifts the lifting bar 44 and with it the adjusting bars 47 and 49, the blocking bar 31 and the setting bar 33.

2. Subtraction

For subtraction the corresponding function key 8 shifts the pre-selecting slide 1 and at the same time or after the current operation has come to an end, the selecting slide 4 towards the right through four travel units. The index bar 49 now rests on the first tooth 15 of the index slide 4 and the index bar 47 enters the gap between the teeth 17 and 18 of this slide. Thus the position of the adjusting bars 47 and 49 is the same as during addition, in contrast thereto the setting bar 33 now enters the gap between the teeth 18 and 19 of the index slide 4 thereby setting the counter 42 to "minus." Apart from this difference, the adjustments of the parts are the same as during addition.

3. Non-adding

During this operation only some numerals shall be introduced without being set in the counter. Therefore the counter must not be thrown in during this entire operation. As shown in Fig. 5, the index slide 4 is now shifted through two travel units towards the right, whereby the index bar 47 and the index bar 49 are brought to rest on the teeth 16 and 18, respectively, of the index slide, while the setting bar 33 comes to rest on the tooth 19. Consequently, since neither pawl 46 nor pawl 48 is moved, once the counter has been thrown out during the advance by means of the stud 75 of the disc 78 and the resetting latch 70 of the switch member 53, no further actions occur.

4. Total operation

During total operation it becomes necessary to couple the counter when the advance begins, with its racks in order that in descending the racks the counters be set for zero and transmit their values to the printing mechanism. During collection of the sensing levers coupled with the counter racks the counters must however be thrown out in order not to return into them the values transmitted to the printing mechanism. As shown in Fig. 6, during the total operation the pre-selecting slide 2 is shifted towards the right through three travel units. If the value of the total is positive, the selecting slide 5 will follow its pre-selecting slide 2 through the same distance and in doing so will carry along the index slide 4 by means of the driver 21. In this position the totalling bar 49 can enter the gap between the teeth 15 and 16 on the index slide 4, while the index bar 47 comes to rest on the left hand end of the tooth 22 of the totalling slide 5. The setting bar 33 of the counter meets the tooth 19 of the index slide 4 and therefore sets the counter for "plus." At the beginning of the advance, similarly as in the other calculating operations, the counter 42.

provided it does not occupy the idle position, is thrown out by the stud 75 and pawl 70. Shortly thereafter the stud 74 meets the totalling pawl 48 and thereby turns the switch member 53 in clockwise direction so that the counter 42 is thrown in, until the stud 77 at the end of its advance meets the resetting latch 70 and thereby turns again the switch member 53 in anti-clockwise direction, whereby the counter 42 is thrown out. When the machine shaft 79 returns, the studs 74 and 75 pass the totalling pawl 48, which gives way yieldingly, without provoking any action. At the end of the movement the blocking bar 31, the setting bar 33 and the adjusting bars 47 and 49 are lifted again by means of the stud 74, the lifting bar 44 and its axle 43.

If however a negative (below zero) value is contained in the counter, then the blocking lever 11 will limit the travel of the totalling slide 5 to one unit, which results in a position of the selecting slides such as shown in Fig. 7. The totalling bar 49 enters the gap between the teeth 16 and 17 of the index slide 4, the index bar 47 rests on the right hand end of the tooth 22 of the totalling slide 5, while the setting bar 33 enters the gap between the tooth 19 and the notched section 20 of the totalling slide 4, whereby the counter 42 is set for "minus." Apart from this circumstance, since the position of the index bar and the totalling bar is the same as when totalling a positive total, the movements of the parts are the same as in that case.

5. *Sub-total operation*

As is well known, it is necessary, in a sub-total operation to couple the counter with its racks during advance as well as during the return movement in order to sense the numeral value contained in the counter and to return it into the counter for a further calculating operation after it has been printed. Hitherto the counter was thrown in during the advance and was left in thrown in position up to the end of the return movement. This rendered necessary the provision of additional actuating members. In order now to simplify the actuation and to reduce the number of actuating members, in the machine according to this invention, the addition control is combined with the totalling control, because in the first calculating operation the counter is thrown in during the return, while in the second calculating operation it is thrown in during the advance. As shown in Fig. 8, the preselecting slide 3 is now shifted through three travel units toward the right. If the value of the register is positive, the sub-total slide 6 is pulled up through the same distance and by means of the check 21 shifts the index slide 4 also through the same distance. Since this latter slide now assumes the same position as during totalling, the totalling bar 49 is again adjusted into its lower position. On the other hand the index bar 47 can now descend also, since now the tooth 22 of the totalling slide 5 which had remained at rest, is not in its way. Therefore the index pawl 46 as well as the totalling pawl 48 are turned towards the right and the counter 42, similarly as in the totalling operation, is thrown in soon after the beginning of the advance and thrown out at its end and is thrown in again, similarly as during an addition operation, soon after the beginning of the return movement and until the operation has come to an end.

If the value of the register in the counter is negative, then similarly as in totalling the negative sum, the blocking lever 11 will lock the sub-totalling slide 6 after it has gone through one travel unit (see Fig. 9). Similarly as in the negative totalling operation, the totalling bar 49 can now descend and the index bar 47 can enter the gap between the teeth 18 and 19. Similarly as in a negative totalling operation, the setting bar 33 descends and in doing so sets the counter for "minus." Thus, apart from this latter circumstance, the setting operations occur in the same way as when effecting the positive sub-totalling.

6. *Printing mechanism*

In the operations described hereabove the setting slides 4, 5 and 6 by means of their catches 23, 24 and 25 adjust the member 28 for the printing of the function symbols. This printing mechanism can assume seven different positions:

Its basic position corresponds to addition since here none of the selecting slides is shifted. The next following position is imparted to the adjusting member 28 during negative totalling, wherein the totalling slide 5 shifted through one travel unit and the index slide 4 carried along by it meet with their catches 23 and 24 the lower step 26 of the adjusting member 23. This member during a negative sub-totalling operation assumes another position corresponding to a shifting of the sub-totalling slide 6 and of the index slide 4 carried along by it also through one travel unit. However since the lip 25 of the sub-totalling slide 6 meets the upper step 27 of the adjusting member 28, the angular movement will be greater than during negative totalling. A still somewhat greater angular movement will occur during a non-adding operation which is characterized by a shifting of the index slide 4 through two travel units, this slide by means of its check 23 turning the lower step 26 through this distance. During positive totalling this step is turned through three travel units since during this function the totalling slide 5 and the index slide 4 are shifted through such a distance, while the step 27 is turned through four travel units during subtraction and the index slide 4 is carried through the same distance. Finally, during a positive sub-totalling operation, the sub-totalling slide 6, having been shifted through three travel units, meets the upper step of the adjusting member 23 and now turns this member through a still greater angle as during subtraction.

The sequence of the symbols of the printing mechanism therefore is:

1. + (addition)
2. $\overset{*}{-}$ (negative total)
3. $\overset{\diamond}{-}$ (negative sub-total)
4. # (non-addition)
5. * (positive total)
6. — (subtraction)
7. ◇ (positive sub-total).

It should be understood that the invention is not limited to the particular combination of means described hereabove and shown in the drawings. The invention can be embodied in widely different ten-key adding machines, full-keyboard calculating machines and book-keeping machines of any kind. Similarly as the preselection of functions by means of a storer, which becomes ready for use during a previously started

operation, can be put to use without employing the particular kind of function setting by means of selecting elements adjustable through different travel distances, this way of introducing functions can also be utilized without any preselection.

Similarly the storer and the selecting and preselecting members, instead of having the form of slides, may have any other suitable forms, being for instance represented by circular or by cylindrical or differently shaped elements. The drivers, notched elements and blocking elements for the sensing members may be shaped differently and this also includes the sensing elements themselves. The combination according to this invention may also be extended to other functions such as multiplication, division and different bookkeeping operations. In these cases different arrangements of teeth and a greater number of selecting and pre-selecting members may be needed, without departing from the invention or sacrificing the advantages thereof.

In every case the invention will lead to a considerable simplification of the machine design and to a material speeding up of the working of the machines.

We claim:

1. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and negative balance, respectively, of the items registered by it; an index slide, a totalling slide and a subtotalling slide, each being capable of occupying a plurality of positions, said totalling and subtotalling slides being each adapted to be shifted into one of its positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; and means rigidly connected to said index slide and arranged to engage any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide, and said subtotalling slide is still being performed, said preselecting slides being capable of shifting said totalling and subtotalling slides after the performance of the preceding function into that position which is determined by the shift-limiting means controlled by said register.

2. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and negative balance, respectively, of the items registered by it; an index slide being capable of occupying a plurality of positions, a totalling slide being capable of occupying a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide having a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides being intended to be shifted into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides to their second operative position when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; and means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide, and said subtotalling slide is still being performed, said preselecting slides being capable of shifting said totalling and subtotalling slides after the performance of the preceding function into that position which is determined by said limiting means controlled by said register.

3. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and negative balance, respectively, of the items registered by it; an index slide having three operative positions corresponding to an addition, a non-addition, and a subtraction, respectively, of an item by said register; a totalling slide capable of occupying a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide having a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides in their first and second operative positions being arranged in staggered relation, respectively, to said index slide when the same is in the positions corresponding to a non-addition and to a subtraction, respectively, of an item by said register, means for shifting said totalling and subtotalling slides into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides to their second operative position when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; and means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide,

said totalling slide and said subtotalling slide is still being performed, said preselecting slides being capable of shifting said totalling and subtotalling slides after the performance of the preceding function by said preselecting slides into the position determined by the shift-limiting means controlled by said register.

4. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and negative balance, respectively, of the items registered by it; an index slide, a totalling slide and a subtotalling slide, each being capable of occupying a plurality of positions, said totalling and subtotalling slides being each adapted to be shifted into one of their positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides when said register is in the second position thereof; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; notched portions formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions to lock the same in their positions during a performance of an operation of the machine; means for keeping said preselecting slides in their preset positions until said locking member has released said index slide, totalling slide and subtotalling slide; and means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said totalling and subtotalling slides being arranged to be shifted by said preselecting slides after the performance of the preceding function into the position determined by said shift-limiting means controlled by said register.

5. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and a negative balance, respectively, of the items registered by it; an index slide, a totalling slide and a subtotalling slide, each being capable of occupying a plurality of positions, said totalling and subtotalling slides being each arranged to be shifted into one of their positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; notched portions formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions to lock the same in their positions during a performance of an operation of the machine; manually operated means for keeping said preselecting slides in the preset positions thereof until said locking member has released said index slide, said totalling slide, and said subtotalling slide; and means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said preselecting slides being arranged to shift said totalling and subtotalling slides after the performance of the preceding function into the position determined by the shift-limiting means controlled by said register.

6. A calculating machine comprising in combination, a register capable of occuping a first position and a second position corresponding to a positive and a negative balance, respectively, of the items registered by it; an index slide capable of occupying three operative positions corresponding to an addition, a non-addition and a subtraction, respectively, of an item by said register; a totalling slide having a first operative position and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide having a first operative position and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides in their first and second operative positions being arranged in staggered relation, respectively, to said index slide when the same is in the positions corresponding to a non-addition and to a subtraction of an item effected by said register, said totalling and subtotalling slides being arranged to be shifted into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides so that the same assume their second operative position when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; notched portions formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions to lock the same in their positions during a performance of an operation of the machine; means for keeping said preselecting slides in their preset positions until said locking member has released said index slide, said totalling slide and said subtotalling slide; and means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby

enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said totalling and subtotalling slides being arranged to be shifted by said preselecting slides after the performance of the preceding function into the position determined by the shift-limiting means controlled by said register.

7. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and a negative balance, respectively, of the items registered by said register; an index slide having three operative positions corresponding to an addition, a non-addition and a subtraction, respectively, of an item by said register; a totalling slide having a first operative position and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide having a first operative position and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides in their first and second operative positions being arranged in staggered relation, respectively, to said index slide when the same is in its positions corresponding to a non-addition and to a subtraction of an item by said register, said totalling and subtotalling slides being arranged to be shifted into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides so that the same assume their second operative position when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; notched portions being formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions to lock the same in their positions during a performance of an operation of the machine; means for keeping said preselecting slides in their preset positions until said locking member has released said index slide, said totalling slide and said subtotalling slide; means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said preselecting slides being arranged to shift said totalling and subtotalling slides after the performance of the preceding function into the position determined by the limiting means controlled by said register, said index and said totalling slides being formed with a plurality of teeth separated by gaps; and sensing members arranged for cooperation with said teeth and gaps and for remaining inoperative when they are in contact with said teeth, but becoming operative when they drop into the gaps between said teeth, said sensing members controlling the functions of the machine.

8. A calculating machine comprising in combination, a register capable of occupying a first and a second position corresponding to a positive and a negative balance, respectively, of the items registered by said register; an index slide being capable of occupying three operative positions corresponding to an addition, a non-addition and a subtraction, respectively, of an item by said register; a totalling slide being capable of occupying a first operative position and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide capable of occupying a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides in their first and second operative positions being arranged in staggered relation, respectively, to said index slide when the same is in the positions corresponding to a non-addition and to a subtraction, respectively, of an item by said register, said totalling and subtotalling slides being arranged to be shifted into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides so that the same assume their second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; notched portions formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions and to lock the same in their positions during a performance of an operation of the machine; means for keeping said preselecting slides in their preset positions until said locking member has released said index slide, said totalling slide and said subtotalling slide; means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said preselecting slides being arranged to shift said totalling and subtotalling slides after the performance of the preceding function into the position determined by the limiting means controlled by said register, said index and said totalling slides being formed with a plurality of teeth and gaps; a setting bar arranged for cooperation with the teeth and gaps of said index slide, said setting bar being arranged for switching said register from its first position to its second position and vice versa; an index bar arranged for cooperation with said teeth and gaps, said index bar being in contact with one of the teeth of said index slide when said index slide performs a non-

addition, but in contact with one of the teeth of said totalling slide when a totalling operation is performed; and a totalling bar arranged for cooperation with the teeth and gaps of said index slide, and in contact with said index slide tooth when said slide is set for any of the adding, non-adding and subtracting operations, said totalling bar being in contact with the gaps of said index slide when the latter is shifted by the means rigidly connected thereto and engages said totalling and subtotalling slides.

9. A calculating machine as claimed in claim 8, in which the index slide has three teeth supporting in adding, non-adding and subtracting positions, respectively, the totalling bar of said index slide, said index slide having a fourth tooth arranged to block said index bar when said index slide is in non-adding position, said index slide having a fifth tooth arranged to block said setting bar in the adding and non-adding positions of said index slide and in the position taken by said index slide under the influence of said totalling and subtotalling slides in the first position thereof.

10. A calculating machine as claimed in claim 9, in which the totalling slide has one tooth of a larger width than the teeth of said index slide, said tooth being arranged to block said setting bar in both the first and second positions of said totalling slide.

11. A calculating machine as claimed in claim 10, in which the totalling slide and subtotalling slide are locked by their notched portions coming into engagement with the locking member when the register is in its second position, the totalling and subtotalling slides being locked by the locking member in positions differing from the corresponding positions of the second and third preselecting slides.

12. A calculating machine comprising in combination, a register capable of occupying a first position and a second position corresponding to a positive and a negative balance, respectively, of the items registered by it; an index slide capable of occupying three operative positions corresponding to an addition, a non-addition and a subtraction, respectively, of an item by said register; a totalling slide capable of occupying a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register; a subtotalling slide capable of occupying a first and a second operative position corresponding to a positive and a negative balance, respectively, of the items registered by said register, said totalling and subtotalling slides in their first and second operative positions being arranged in staggered relation, respectively, to said index slide when the same is in its positions corresponding to a non-addition and to a subtraction of an item by said register, said totalling and subtotalling slides being arranged to be shifted into one of their operative positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides so that the same assume their second operative position when said register is in its second position; a first preselecting slide arranged adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled

therewith; notched portions formed in said index slide, said totalling slide and said subtotalling slide, respectively; a locking member arranged for cooperation with said notched portions to lock the same in their positions during a performance of an operation of the machine; means for keeping said preselecting slides in the preset positions thereof until said locking member has released said index slide, said totalling slide and said subtotalling slide; means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said totalling and subtotalling slides being arranged to be shifted by said preselecting slides after the performance of the preceding function into the position determined by the limiting means controlled by said register, said index and said totalling slides being formed with a plurality of teeth separated by gaps; a setting bar arranged for cooperation with the teeth and gaps of said index slide, said setting bar being arranged for switching said register from its first position to its second position and vice versa; an index bar arranged for cooperation with the teeth and gaps of said index and said totalling slides, said index bar being in contact with one of the teeth of said index slide when said index slide performs a non-addition, but in contact with one of the teeth of said totalling slide when a totalling operation is performed; an index pawl controlled by said index bar; a totalling bar cooperating with the teeth and gaps of said index slide and being in contact with the gaps of said index slide when the latter is shifted by the means rigidly connected thereto and engaging said totalling and subtotalling slides; a totalling pawl controlled by said totalling bar; an operating member arranged for rocking movements about a stationary axle, said index and totalling pawls being pivoted to said operating member, said operating member being arranged for throwing said register in and out according to the positions thereof; a latch pivoted to said operating member; a disc and a main shaft rigidly connected to said disc; and a plurality of studs rigidly connected to said disc and arranged for cooperation with said index pawl, said totalling pawl and the latch pivoted to said operating member, so that said index pawl, said totalling pawl and said latch can be operated by the forward and return motion of said main shaft and said disc.

13. A calculating machine comprising in combination, a register capable of occupying a first and a second position corresponding to a positive and a negative balance, respectively, of the items registered by it; an index slide; a totalling slide and a subtotalling slide, each one capable of occupying a plurality of positions, said totalling and subtotalling slides being arranged to be shifted into one of their positions for carrying out totalling and subtotalling functions, respectively; means controlled by said register for limiting the shift of said totalling and subtotalling slides when said register is in its second position; a first preselecting slide arranged

adjacent to said index slide and elastically coupled therewith; a second preselecting slide arranged adjacent to said totalling slide and elastically coupled therewith; a third preselecting slide arranged adjacent to said subtotalling slide and elastically coupled therewith; means rigidly connected to said index slide and engaging any of said totalling and subtotalling slides when the latter are shifted through a distance exceeding the shift of said index slide so as to impart to said index slide a shift equal to the shift of any of said totalling and subtotalling slides, whichever is the greater, thereby enabling a function of any of said slides to be preset by any of said preselecting slides while the preceding operation of said index slide, said totalling slide and said subtotalling slide is still being performed, said totalling and subtotalling slides being arranged to be shifted by said preselecting slides after the performance of the preceding function into the position determined by the limiting means controlled by said register;

lips of different length forming the ends of said index, totalling and subtotalling slides, respectively; a member having steps arranged for cooperation with said lips, so as to be brought into different positions according to the functions coordinated with said slides; and a part rigidly connected to said stepped member being arranged for setting a printing mechanism for the functions selected by said slides.

KARL WESTINGER.
ERNST ALTENBURGER.
OTTO HIRT.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
990,317	Vincent	Apr. 25, 1911
1,946,572	Crosman	Feb. 13, 1934
2,274,575	Anderson	Feb. 24, 1942
2,377,065	Avery	May 29, 1945