

July 10, 1934.

O. J. SUNDSTRAND

1,965,611

CALCULATING AND PRINTING MACHINE

Filed Oct. 25, 1923

10 Sheets-Sheet 1

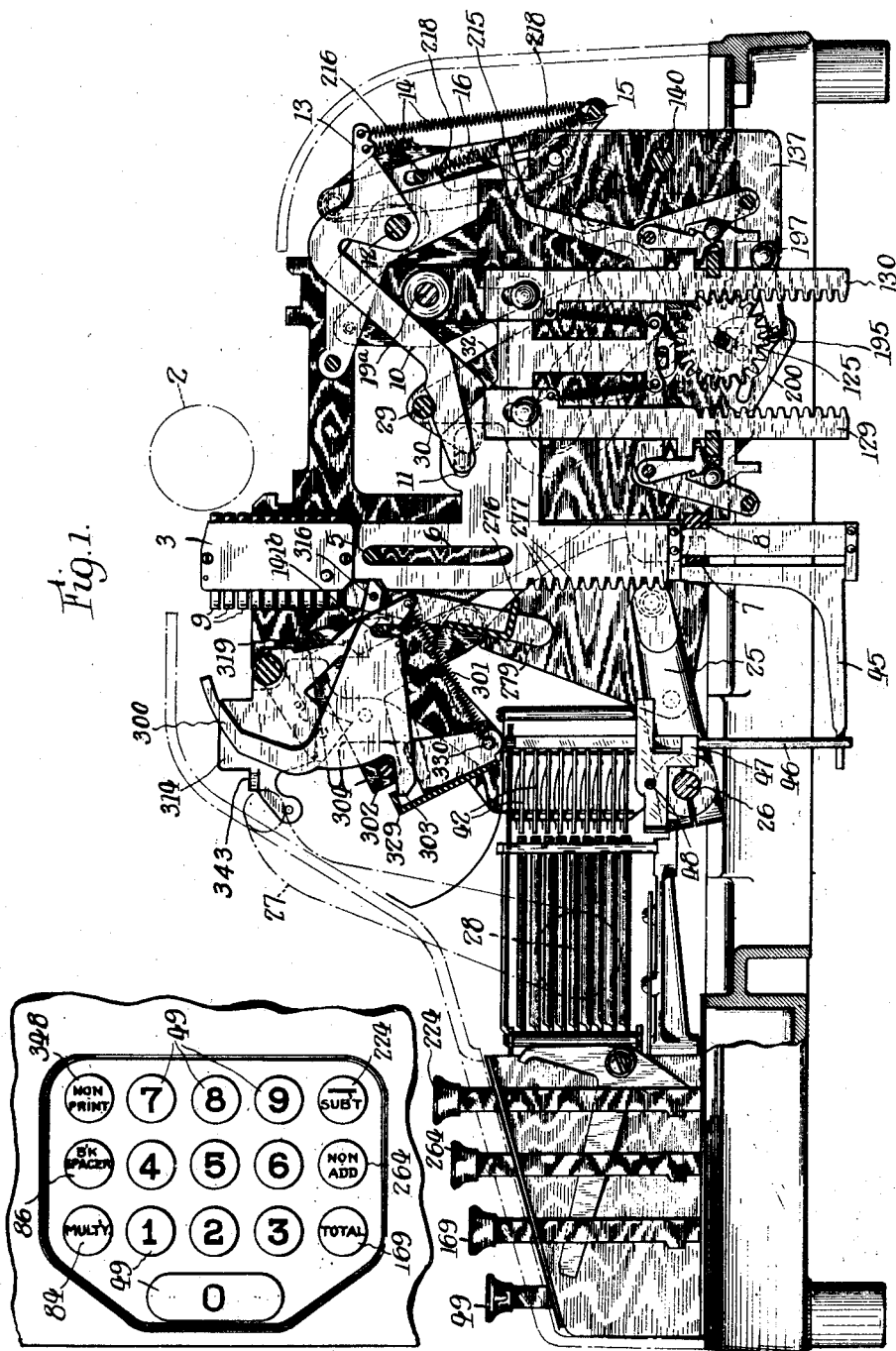


Fig. 1.

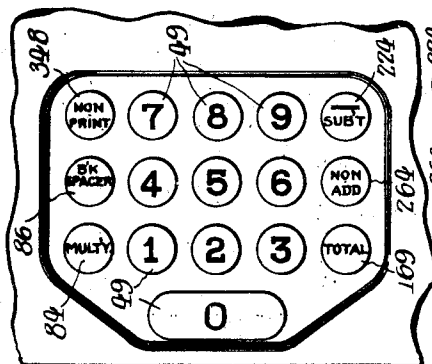


Fig. 2.

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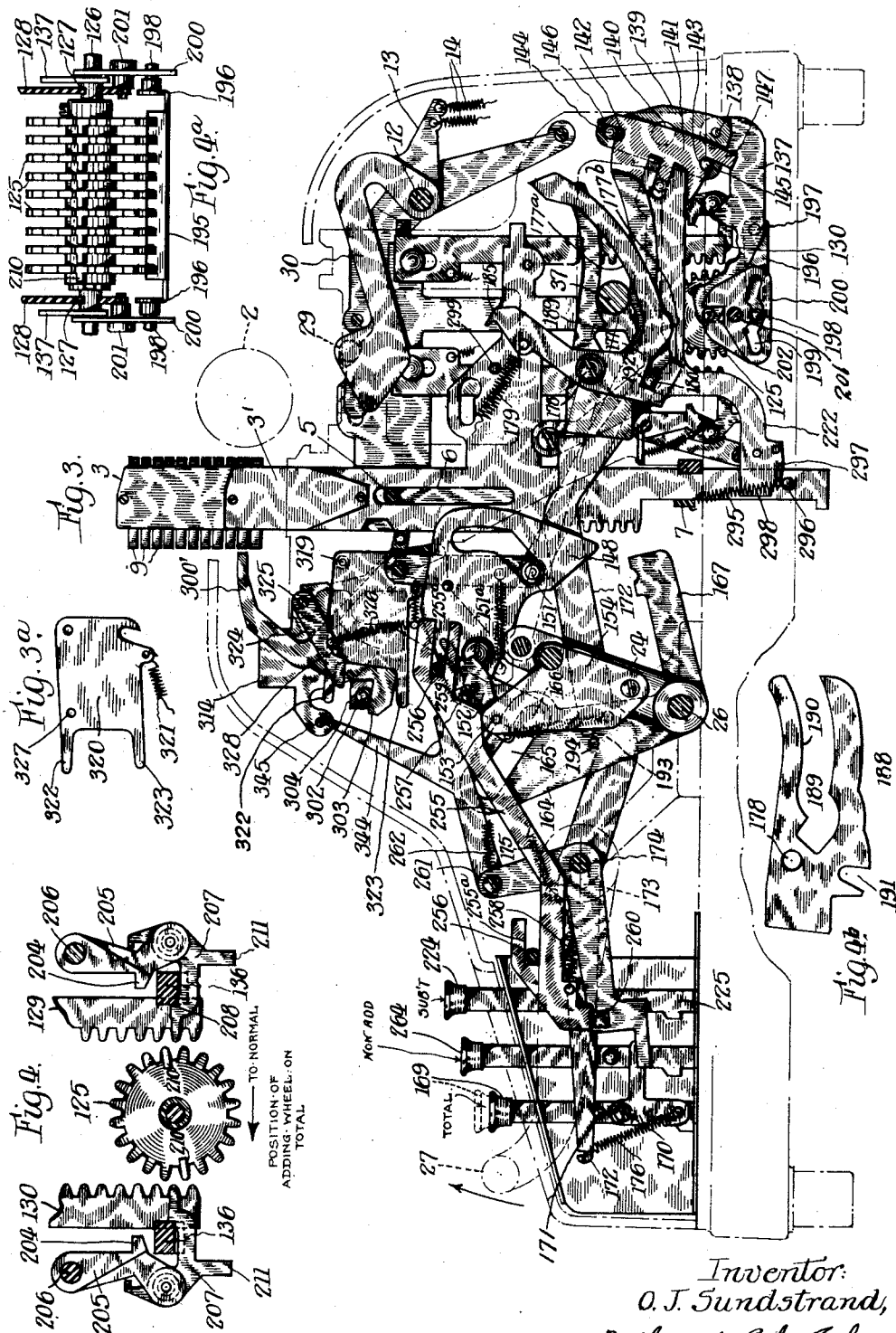
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1,965,611

CALCULATING AND PRINTING MACHINE

Filed Oct. 25, 1923

10 Sheets-Sheet 2



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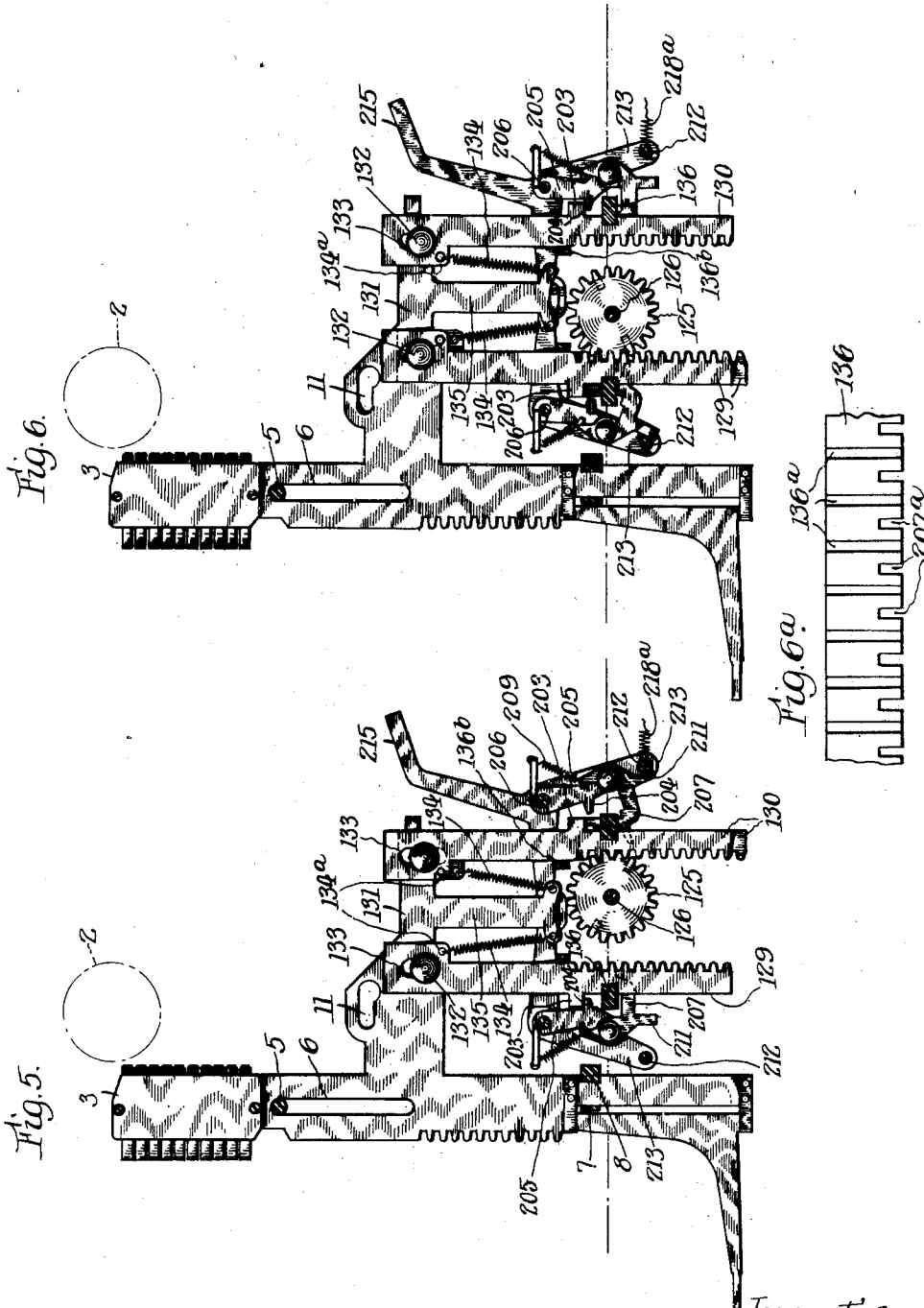
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CALCULATING AND PRINTING MACHINE

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10 Sheets-Sheet 3



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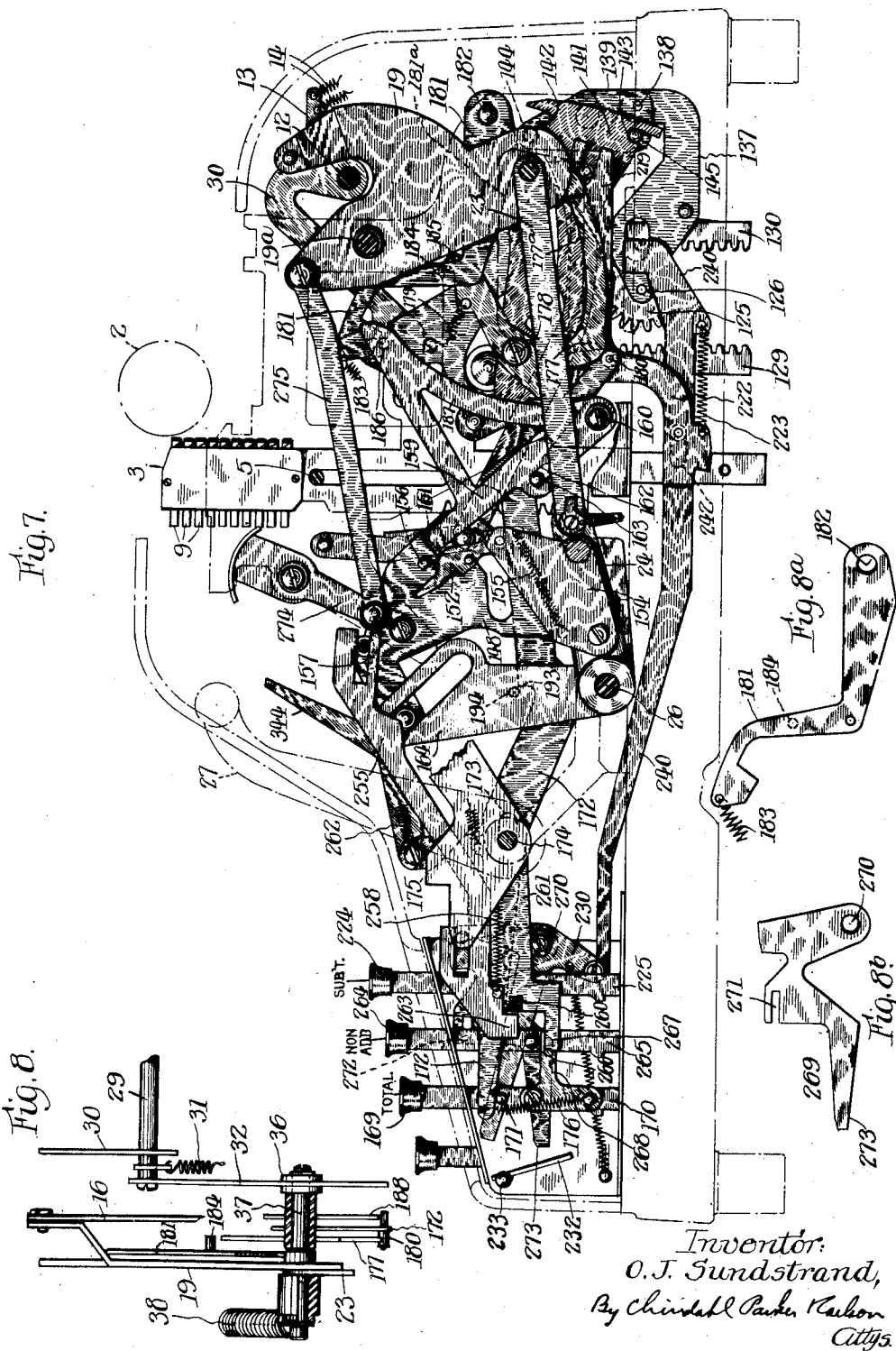
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CALCULATING AND PRINTING MACHINE

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July 10, 1934.

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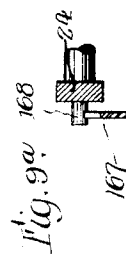
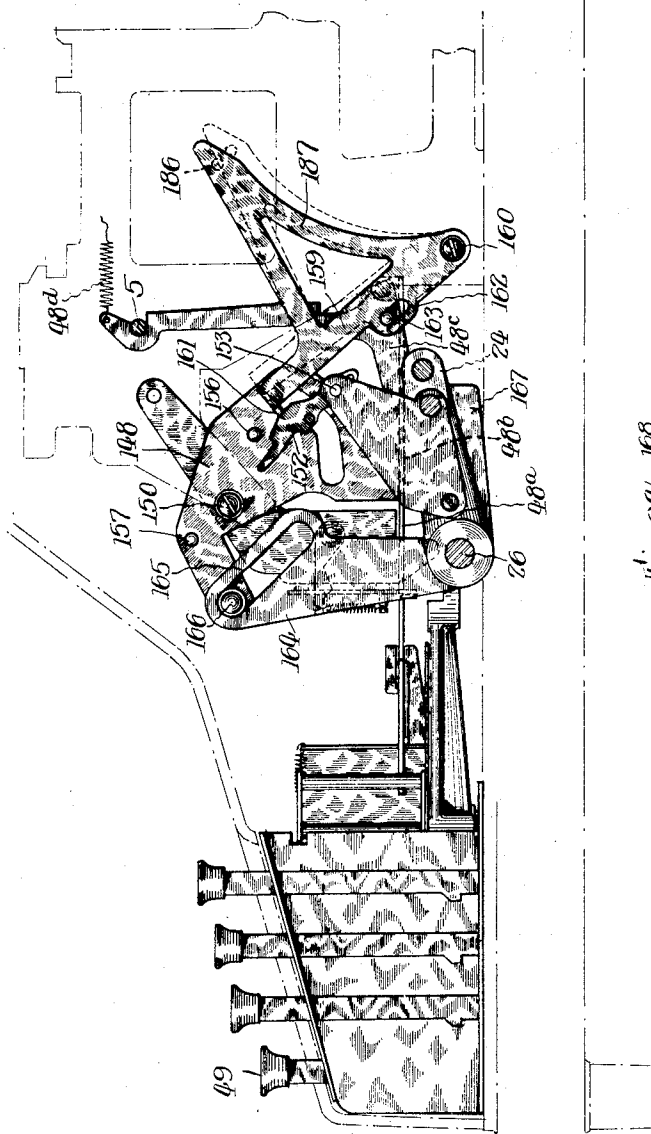
1,965,611

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Fig. 9.



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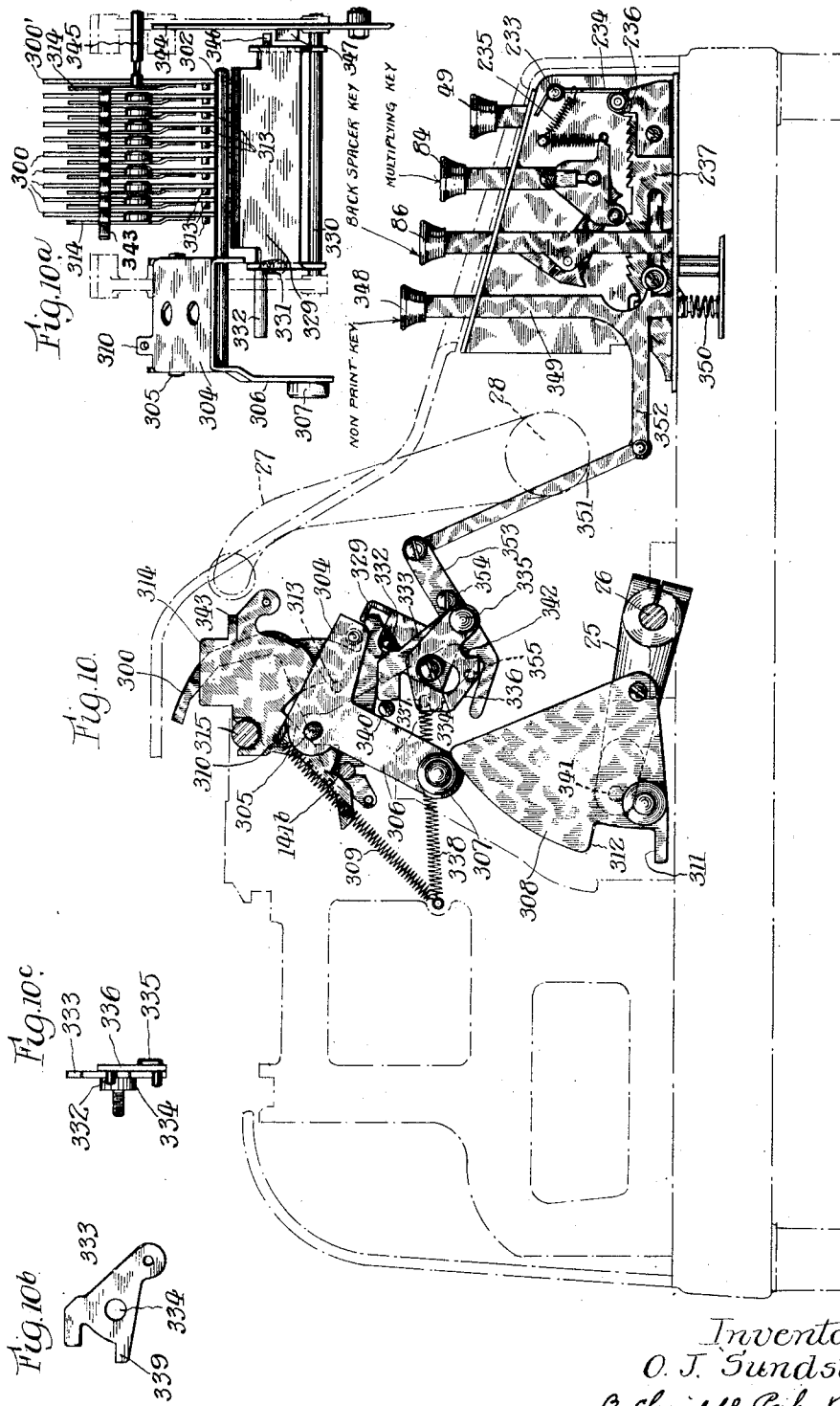
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CALCULATING AND PRINTING MACHINE

Filed Oct. 25, 1923

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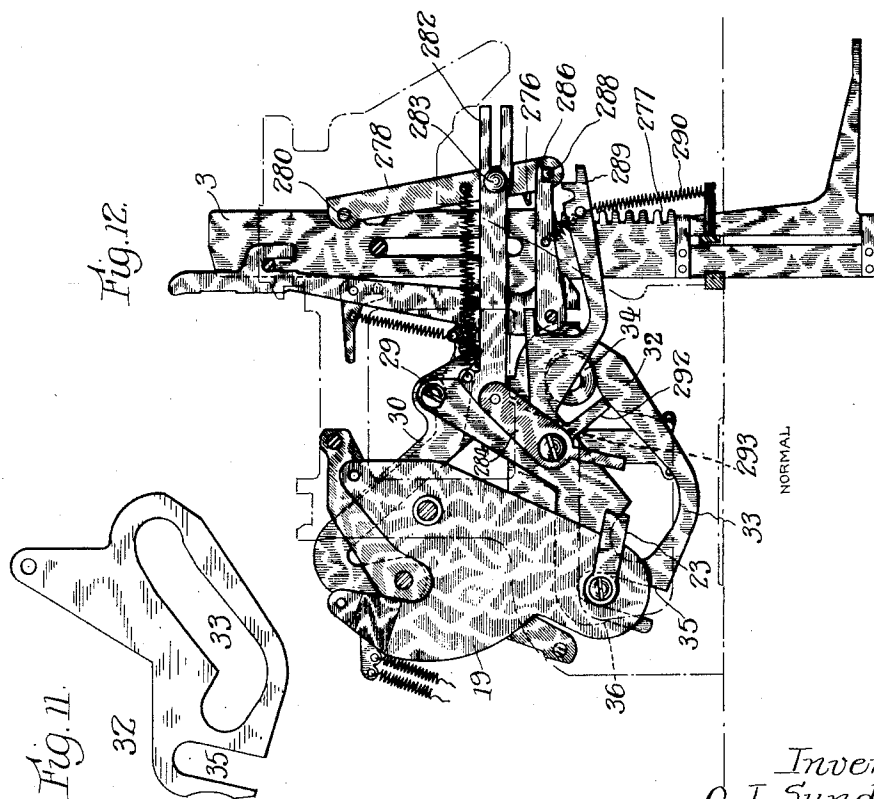
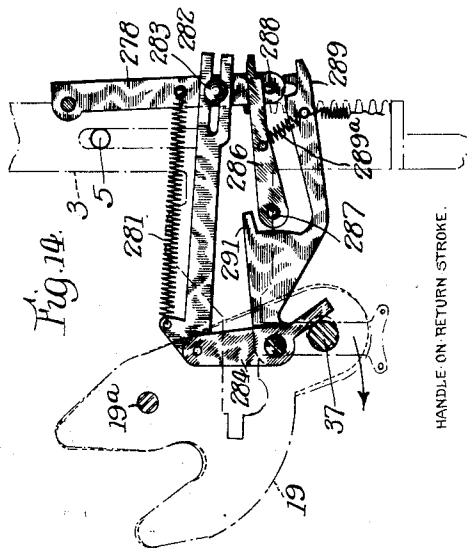
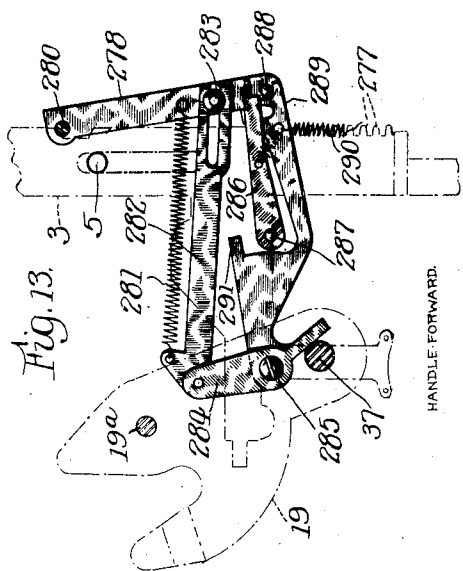
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CALCULATING AND PRINTING MACHINE

Filed Oct. 25, 1923

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Fig. 15.

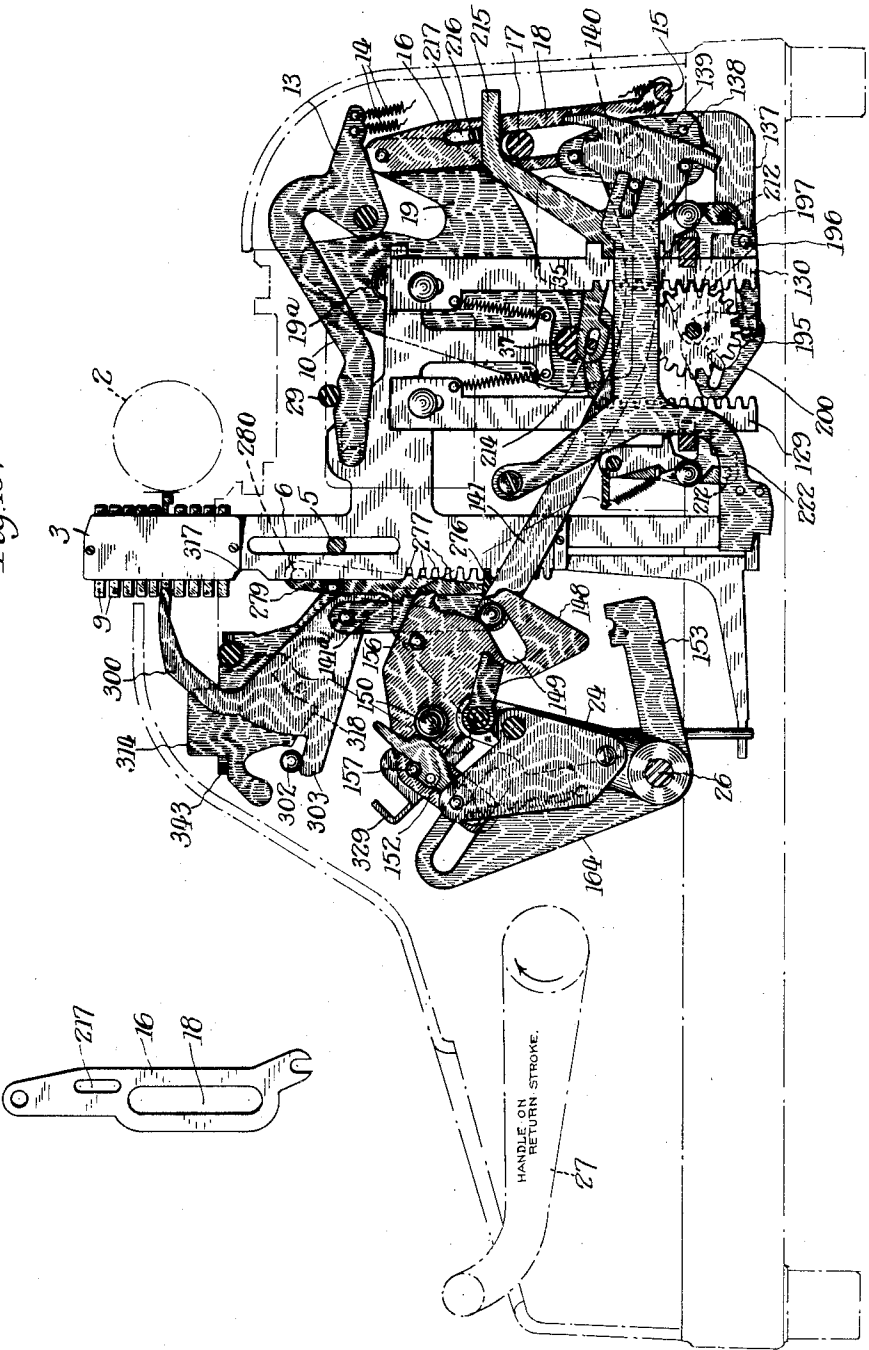
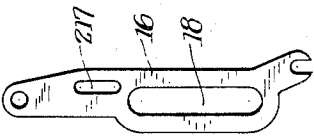


Fig. 16.



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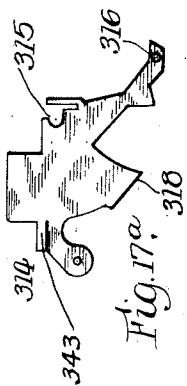
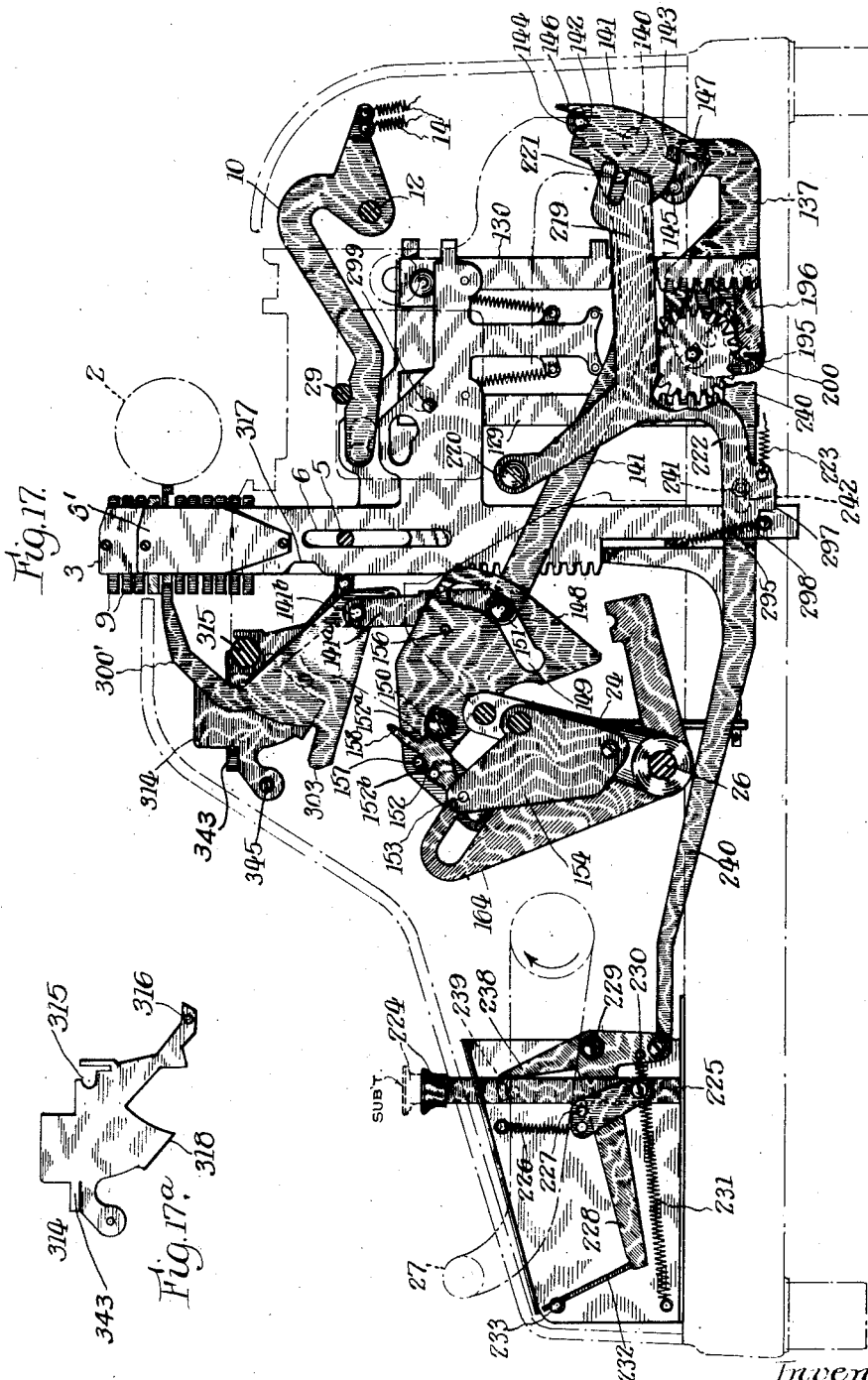
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CALCULATING AND PRINTING MACHINE

Filed Oct. 25, 1923

10 Sheets-Sheet 9



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CALCULATING AND PRINTING MACHINE

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Fig. 18.

$\begin{array}{r} \cdot 50 \\ \cdot 20 \\ \cdot 50 \\ 80 \end{array}$
 $\begin{array}{l} a \\ b \end{array}$

Fig. 19.

$\begin{array}{r} 1.00 \\ 1.10 \\ 1 \\ 10 \end{array}$

Fig. 20.

$\begin{array}{r} 15.69 \\ 69.85 \\ 98.34 \\ 89.12 \\ 284.60 \end{array}$

$\begin{array}{r} 9999988.40 \\ 1 \\ 11.60 \end{array}$

Fig. 21.

$\begin{array}{r} 7596.00 \\ 7596 \\ 7596 \\ 7444.08 \end{array}$

Fig. 22.

$\begin{array}{r} 7596 \\ 7596 \\ 15192 \\ 7596.00 \\ 15192 \\ 7444.08 \end{array}$

Fig. 23.

$\begin{array}{r} 7596.00 \\ 75960 \\ 7596 \\ 7596 \\ 7596 \\ 7596 \\ 7596 \\ 645660 \end{array}$

Fig. 24.

$\begin{array}{r} 45690 \\ 45690 \\ 4569 \\ 868.11 \end{array}$

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UNITED STATES PATENT OFFICE

1,965,611

CALCULATING AND PRINTING MACHINE

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Application October 25, 1923, Serial No. 670,665

39 Claims. (Cl. 235—60)

This invention relates to machines for adding a plurality of items and for printing the items and the total upon a sheet or strip of paper. The invention has special reference to the provision in such a machine of a convenient means for performing calculations in which subtraction is involved.

The invention also relates to an improved means for aligning the selected type in printing position prior to the operation of the hammers.

Other improvements and advantages resulting from the present invention will be apparent as the description proceeds.

In the accompanying drawings Figure 1 is a fragmentary longitudinal vertical sectional view of a machine embodying the features of my invention, the view being taken from the right-hand or handle side of the machine. The machine is shown at rest. Fig. 2 is a plan view of the keyboard. Fig. 3 is a view similar to Fig. 1, but showing the parts in the positions occupied just after the handle has commenced its return stroke. Fig. 3^a is a detail view. Fig. 4 is a fragmentary detail view of the adding and subtracting mechanism, looking from the left-hand side of the machine. Fig. 4^a is a fragmentary transverse view showing the totalizer wheels. Fig. 4^b is a detail view. Fig. 5 is a view showing the parts in position for addition. Fig. 6 illustrates the parts in position for subtraction. Fig. 6^a is a fragmentary underside view of the carrier cross-bar 136. Fig. 7 is a fragmentary side elevation of the machine, the view being taken from the handle side. Fig. 8 is a fragmentary view looking from the right-hand side of Fig. 7. Figs. 8^a and 8^b are detail views. Fig. 9 is a fragmentary right-hand side elevation. Fig. 9^a is a detail sectional view. Fig. 10 is a fragmentary view taken from the left-hand side of the machine and showing principally the hammer mechanism. Fig. 10^a is a front view of the hammer mechanism. Figs. 10^b, 10^c and 11 are detail views. Figs. 12, 13 and 14 illustrate different positions of the aligning mechanism. Fig. 15 is a fragmentary longitudinal vertical sectional view, the hammers having just been fired or released. Fig. 16 is a detail view. Fig. 17 is a fragmentary longitudinal vertical sectional view illustrating the operation of printing a subtraction and credit sign. Fig. 17^a is a detail view. Figs. 18 to 24 illustrate specimens of work done upon the machine.

While the invention is herein disclosed as embodied in a machine of the ten-key type, such as is shown in the Sundstrand Patent No. 1,198,487, certain features thereof are not limited to use in machines of that character.

The sheet or tape on which the items and totals are to be printed and the calculations recorded may be supported in any ordinary or suitable way. In the present instance, a cylindrical

platen 2 is employed. The printing may be effected by any desired means as, for example, vertically reciprocatory slides or type bars 3, one such bar being provided for each numerical order. The machine herein illustrated is adapted to register and print up to 9,999,999.99, hence nine bars, 3, are employed. Said bars are arranged compactly side by side, and they are guided near their upper ends by means of a transverse rod 5 fixed in the framework of the machine, said rod extending through vertically elongated openings 6 in the type bars. The lower ends of the type bars are located between and guided by two transverse fixed bars 7 and 8, the latter being slotted to receive the rear edges of the type bars. Each type bar 3 is provided at its upper end with ten type 9 adapted to print from naught to nine, respectively. The uppermost type is adapted to print "0", the next to the top "1", and so on.

The means herein shown for vertically moving each bar 3 into and out of printing position comprises an arm 10 carrying a headed stud that lies in an elongated opening 11 in the type bar. The arm 10 is loosely mounted on a shaft 12 which is supported in the framework of the machine. Rigid with the arm 10 is an arm 13 which is yieldingly connected through two helically coiled contractile springs 14 to a rod 15. The latter is carried by two side members 16 (Figs. 1, 15 and 16) which are guided for approximately vertical movement by a transverse rod 17 (Fig. 15) fixed in the framework of the machine, said rod extending through elongated openings 18 in the side members 16. Pivoted to the upper ends of the side members 16 are two levers 19 (Figs. 7 and 8) which are mounted in the framework of the machine to swing on the axis 19^a. To the lower ends of the levers 19 are pivoted links 23 (Figs. 7 and 8) the forward ends of which are pivoted to two crank arms 24 and 25 (Figs. 7 and 10) fixed to opposite ends of the main rock shaft 26. The shaft 26 is arranged to be rocked by means of a handle or crank 27 mounted to swing upon the axis 28, said handle being connected to the arm 24 by suitable means, as, for example, that disclosed in the Sundstrand Patent No. 1,611,390, dated Dec. 21, 1926. It will of course be understood that an electric motor may be used to rock the shaft 26, if desired.

When the operator pulls the handle 27 forward, the crank arms 24 and 25 swing upwardly, thereby drawing the lower ends of the levers 19 forwardly and moving the side members 16 and the rod 15 downwardly. The movement of the rod 15 is yieldingly transmitted through the springs 14 and the arms 13 and 10 to such of the bars 3 as are at liberty to rise. When the operator releases the handle upon the completion of the forward stroke, means hereinafter mentioned

returns the handle to its normal position (shown in dotted lines in Fig. 1). The means for positively moving down those bars 3 which were raised in the forward stroke of the handle comprises a transverse rod 29 (Fig. 1) overlying the forward portions of the arms 10. The rod 29 is supported at its opposite ends by two arms 30 (Figs. 1, 3 and 8). The arms 30 are loosely mounted upon the shaft 12. A helically coiled contractile spring 31 (Fig. 8) connected at its upper end to the rod 29 and at its lower end to the framework of the machine tends to draw the rod down. To the ends of the rod 29 are pivoted two cam plates 32 (Figs. 8, 11 and 12) each having a cam slot 33 in which are mounted anti-friction rollers 34 (Fig. 12) that are pivoted in the machine frame. In the rear portion of each cam plate 32 is a notch 35 in which lies an anti-friction roller 36 (Fig. 8) on a stud 37 that projects inwardly from the lower end of the lever 19. These studs are prolongations of the pivots by means of which the links 23 are connected to the levers 19. During the rearward stroke of the handle 27 the cam plates 32 are drawn downwardly and rearwardly over the rollers 34 by the studs 37, whereby the restoring rod 29 is drawn downwardly in proper time relation to the operation of the printing mechanism, thus drawing down those type bars 3 that were raised in the forward stroke of the handle.

The means for returning the handle 27 to its normal or initial position may be of any suitable character, as, for example, a contractile spring 38 (Fig. 8) connected and arranged as in the well known Sundstrand adding machine.

The means herein shown for limiting the extent to which the type bars 3 may rise, and thus to determine which numerals shall be brought to the printing position, and the amount that shall be entered in the calculating mechanism comprises a stationary group of stops 42 (Fig. 1) similar to those employed in the Sundstrand adding machine. For a disclosure of the stop mechanism reference may be made to the Sundstrand Patents Nos. 1,198,487 and 1,583,102. It will here be sufficient to say that each stop is horizontally slidable in a forward and back direction, there being one vertical row or column of nine stops for each numerical order. When moved rearwardly from the position shown in Fig. 1, the stops are in the path of movement of devices carried by the type bars 3 and thereby limit the upward movement of said bars. These devices consist of arms 45 pivoted to the lower portions of the type bars 3, and pins 46 having openings through which the arms 45 extend. The pins 46 are guided for vertical movement in a slide 47 which is mounted on a stationary guide rod 48 extending transversely of the machine. The guide rod 48 is so positioned with reference to the group of stops 42 that the slide 47 is movable to carry the pins 46 from their normal or initial position at the left-hand side of the group of stops 42 into vertical alinement with the columns of stops.

The type bars 3 are normally about one step below the cipher-printing position, a slight movement being necessary to raise the pins 46 against the naught stops 42 or the detent plate 48^a hereinafter mentioned. When a bar 3 is raised until its pin 46 stops against a projected stop 42 in the second horizontal row from the bottom, said bar is in position to print the numeral "1". The stops 42 in the third row from the bottom serve to position the type bars for the printing of the

numeral "2", and so on. As fully disclosed in said patent No. 1,198,487, those type bars 3 which are not needed in printing a given item are prevented from rising when the handle is pulled forward, by the detent plate 48^a (Fig. 9) guided to move in a horizontal plane, said plate being connected through a bar 48^b to a rigid frame 48^c. The frame 48^c is mounted to swing on the axis of the rod 5 and is normally impelled forward by contractile springs 48^d, only one of which is shown in the present drawings. When the slide 47 is in the initial position (that is to say, at the left-hand side of the machine) after a spacing cycle or a total-taking cycle the detent plate 48^a is forward of the vertical plane of the pins 46, as shown in Fig. 4 of Patent No. 1,583,102. When a digit is set up by means of the keyboard the slide moves one step to the right and the detent plate 48^a is moved back far enough to overlie all the pins 46 except the one farthest to the right, as explained in my said Patent No. 1,583,102. Thus in the printing or accumulation of an item, the rear edge of the detent plate 48^a is in the vertical plane of the pins 46 and prevents any pins 46 from rising except those which have been carried by the slide 47 to the right out from under the detent plate.

The means for projecting the stops 42 into the path of the pins 46 comprises ten keys 49 which are numbered from "0" to "9", as shown in Fig. 2. The means whereby movement of the numeral keys 49 is transmitted to the stops 42 may be of any suitable character, as, for example, that disclosed in said Sundstrand Patent No. 1,198,487 or that shown in my said Patent No. 1,583,102.

The repeat or multiplying key 84 (Figs. 2 and 10) may be constructed and arranged in the manner fully disclosed in said Sundstrand Patent No. 1,198,487.

In case the operator, when setting up an item, should strike a wrong numeral key, he may correct the error by operating the back spacer key 86 (Fig. 2) to restore the slide 47 to the position occupied just before the error occurred. The back spacer key 86 may be connected to the slide 47 as in the Sundstrand adding machine. The back spacer key may also be employed when it is desired to set the slide 47 for the printing or entry of a number one-tenth that of the number previously set up, as will appear more fully hereinafter.

The calculating mechanism comprises a series of pinions 125 (Figs. 3, 4 and 4^a) rotatably mounted upon a transverse shaft 126. The shaft 126 is supported for sliding movement longitudinally of the machine. For this purpose the ends of the shaft are extended through elongated openings 127 (Fig. 4^a) in guide plates 128 which form part of the stationary framework of the machine. The set of pinions 125 (of which there is one for each type bar 3) is located between two sets of racks or actuators 129 and 130 (Fig. 1). A rack 129 and a rack 130 are connected to each type bar 3 in the manner to be presently described, and the set of pinions 125 is arranged to be moved into mesh with either set of racks.

Addition is accomplished by means of the set of racks 130. When an item is to be added, the pinions are moved forward into neutral position between the two sets of racks before the type bars 3 are raised, and are moved rearwardly into mesh with the racks 130 just before the bars 3 are moved downwardly. Addition therefore occurs in the down stroke of the racks 130, the extent of rotation of the pinions depending, of

course, upon the extent of movement of the racks.

Subtraction is effected by means of the set of racks 129, the pinions being moved into mesh with said racks just before the latter descend. Subtraction thus takes place in the down stroke of the racks.

The upper end of each rack is attached to a rearwardly extending portion 131 (Fig. 5) of one of the type bars 3 by means of a headed pin or stud 132 extending through a vertically elongated opening 133 in the rack. A contractile spring 134 attached at its upper end to the track at 134^a and at its lower end to a downwardly-extending portion 135 of the type bar tends to move the rack downwardly with relation to the type bar one tooth space for transfer purposes. The backs of the racks slide in grooves 136^a (Fig. 6^a) in stationary guide bars 136. The part 134^a of the rack being virtually a short lever arm, the spring 134 tends to turn the rack on the stud 132 as a pivot, and thus serves to hold the rack in place in its guide groove 136^a. However, in order to prevent the rack from being pulley out of place in case the pinion teeth should stick thereto when the pinion is being moved to central position between the sets of racks, I provide a bar 136^b fixed in the framework and extending adjacent to and transversely of the racks. There are two such bars, one for each set of racks. Normally, there is clearance between the racks and said bars 136^b.

The guide bars 136 are located directly opposite the point of tangency of the racks to the pinions, and hence serve effectively to guide the racks. Even if the racks were slightly bent or bowed, or if there were a tendency to move in a non-reciprocal path, they would be compelled to reciprocate in proper relation to the pinions.

The pinions 125 are moved into and out of mesh with the racks 129 and 130 by means such, for example, as two links 137 (Figs. 3, 4^a and 7), one at each side of the machine, the forward ends of which have bearings to receive the ends of the shaft 126. The rear ends of the links 137 are pivoted at 138 to the lower arms of two levers 139 (Fig. 15) which are rigidly secured to a shaft 140 journaled in the framework of the machine.

When the levers 139 are in the position shown in Fig. 3, the pinions are in neutral position. When the levers 139 swing clockwise out of such position, the pinions move into mesh with the subtracting racks 129, and when the levers 139 swing counterclockwise out of such position, the pinions move into mesh with the adding racks 130.

The means herein shown for swinging the levers 139 to move the pinions into and out of mesh with the racks comprises a link 141 (Fig. 17), the forward end of which is supported by a lever 141^a pivoted on a rod 141^b. The rear end of the link 141 is provided with notches 142 and 143 to receive pins 144 and 145, respectively, on opposite ends of the right-hand lever 139. Rearwardly of the notches 142 and 143 are lugs 146 and 147, respectively, which serve to prevent disengagement of the lever 139 from the link 141. Forwardly of the notches 142 and 143 are curved surfaces adapted to slide in contact with the pins 144 and 145. The link 141 is moved forward and back by means of an oscillatory cam plate 148 having a cam slot 149 therein, the upper portion of said slot being concentric with the axis 150 of said plate. On the forward end of the link 141 is a roller 151 that lies in the slot 149. A contractile spring 151^a (Fig. 3) connected to the lever 141^a and anchored to the machine frame holds the roller 151 against

the front wall of the cam slot 149 and thus takes up play. The tension of the spring overcomes the weight of the cam 148 and the link 141, and thus prevents the weight of these parts from causing the pinions to move out of central position.

The means for oscillating the cam 148 comprises a reversible pawl 152 (Fig. 3) which is pivoted at 153 upon a plate 154 which is rigidly secured to the arm 24. A contractile spring 155 (Fig. 7) is connected at one end to an extension of the pawl 152 and at its other end to the plate 154. The pawl 152 has a shoulder 152^a (Fig. 17) adapted to engage a pin 156 (Fig. 17) set in the cam 148 at one side of its axis 150, and another shoulder 152^b adapted to engage a pin 157 fixed in the cam 148 at the opposite side of its axis. There is a guide finger 158 on the pawl between the shoulders referred to, said guide finger extending into the space between the pins 156 and 157 so as to strike said pins as the arm 24 swings, whereby the pawl is swung to one side or the other of its pivot. The spring 155 tends to swing the pawl into central position. When a number is to be added or subtracted the pawl 152 is permitted to engage the pin 156 when the handle 27 is pulled forward, thereby swinging the cam 148 upwardly and drawing the link 141 forward, thus operating the levers 139 and consequently shifting the set of pinions out of mesh with the racks before the latter rise; and when the handle swings rearwardly, the pawl 152 engages the pin 157 and swings the cam 148 downwardly, thus pushing the link 141 rearwardly with a resultant shifting of the pinions into mesh with the racks before they descend.

When a total (whether subtotal or final total) is to be printed, the pawl 152 is not permitted to engage the pin 156; consequently the cam 148 is not moved during the forward stroke of the handle 27 and the pinions remain in mesh with the racks during the rising of the latter, thereby effecting the positioning of the type bars for the printing of the total.

The means for controlling engagement of the pawl 152 with the pin 156 comprises an arm 159 (Figs. 7 and 9) pivoted at 160 in the machine frame, the upper end of said arm having an angular lug 161 adapted to hold the pawl 152 out of position to engage said pin. In the arm 159 is an elongated opening 162 in which lies a pin 163 fixed to the swinging frame 48^c. As explained in the Sundstrand Patents Nos. 1,198,487 and 1,583,102 after a spacing cycle or a total-taking cycle and before a number has been set up in the group of stops 42, the frame 48^c is in its forward position. As soon as a digit is set up in the machine, the frame 48^c swings back, thereby swinging the arm 159 rearwardly away from the pawl 152 and leaving said pawl in position to engage the pin 156 when the handle 27 is pulled. When a total is to be printed, the frame 48^c is in its forward position, and the pawl 152 is held out of engagement with the pin 156; consequently the cam 148 is not moved during the forward stroke of the handle 27 and the totalizer remains in mesh with the racks during the rise of the latter, thereby effecting the positioning of the type bars for the printing of the total. The printing of the total is thus automatic, that is to say, without any manipulation other than the operation of the handle 27.

I have described the means for shifting the pinions 125 out of mesh with the racks 130 before the latter rise in an item-entering or printing cycle and the means for returning the pinions 150

into mesh with the racks 130 before the latter start down. When a debit or positive total (whether subtotal or final total) is to be printed, the pinions are retained in mesh with the racks 130 during the upward movement thereof, the pawl 152 being automatically held out of position to engage the pin 156, as described. When it is not desired to clear the machine after printing a debit total, the pinions are allowed to remain in mesh with the racks 130 during the downward movement thereof, and therefore during the downward movement of the racks the several pinions are rotated to the positions they occupied just before the taking of the total. When, however, the operator wishes to clear the machine of a debit total, the pinions are withdrawn from the racks 130 before the latter descend. The means for swinging the cam 148 to effect such movement of the pinions comprises a lever 164 (Fig. 3) pivoted on the shaft 26 and having a cam slot 165 in which lies a roller 166 on the cam 148. The lever 164 has an arm 167 which is arranged to be engaged by a pin 168 (Fig. 9^a) on the arm 24. The means for swinging the lever 164 forward to disengage the pinions from the racks 130 is controlled by a clear or total key 169 (Fig. 7) having a stem 170. On the stem 170 is a stud 171 that underlies the forward end of a lever 172. The lever 172 has an elongated opening 173 through which a pivot rod 174 extends, the lever 172 thus being movable longitudinally to a slight extent. A contractile spring 175 tends to slide the lever 172 rearwardly. 176 is a contractile spring stretched between a pin on the stem 170 and the front end of the lever 172 and tending to hold the pin 171 and the lever 172 in contact with each other. During the printing of an item and during the enforced blank or spacing stroke prior to the taking of a total, the lever 172 is held against movement by the spring 176 by means comprising a cam plate 177 (Fig. 7) which is pivoted at 178 and is acted upon by a contractile spring 179. On the rear end of the lever 172 is a pin 180 underlying the cam plate 177. The edge 177^a of the cam plate 177 is arranged to be engaged by the stud 37 (Fig. 8) carried by the adjacent lever 19.

During the printing of an item, and during the spacing stroke preceding the printing of a total, the movement of the cam plate 177 under the influence of the spring 179 is restrained by a detent arm 181 (Figs. 7, 8 and 8^a) pivoted at 182 in the frame work of the machine. A contractile spring 183 normally holds the lower edge 181^a of the arm 181 in contact with the stud 37. On the detent arm 181 is a pin 184 (Fig. 8) adapted to engage a hook 185 (Figs. 3 and 7) on the cam plate 177. When the handle is pulled to print an item or take a blank spacing stroke, the movement of the stud 37 out from under the edge 181^a allows the spring 183 to swing the detent arm 181 down so as to place the pin 184 in the path of the hook 185. When the handle is pulled to print a total, the detent arm 181 is prevented from moving under the influence of the spring 183 into position where the pin 184 is in front of the hook 185, by means of a pin 186 (Fig. 7) on an arm 187 which is rigid with the arm 159. When the arm 159 is in its forward position the pin 186 lies under the front end of the detent arm 181 and holds it elevated. The upper end of the arm 181 is cut away so as to clear the pin 186 when the arm 159 is in its rearward position (as it is when an item has been set up or an enforced blank stroke is to be taken). When a sub-

total is being taken the pin 184 does not interfere with the movement of the plate 177 under the tension of the spring 179, but said plate swings only until the portion 177^b thereof strikes the pin 180. The pin 171 on the total key stem 170 prevents the lever 172 from tilting.

A detent plate 188 (Fig. 4^b) pivoted on the center 178 has a cam slot 189 having a dwell portion 190 in which the stud 37 (Fig. 8) is arranged to run. That portion of the pin 180 which projects from the inner side of the lever 172 underlies the plate 188 (see Fig. 8). In the lower edge of the plate 188 is a notch 191 (Fig. 4^b).

It will be remembered that the stud 37 is connected to swing back and forth with the handle 27. Even if the total key were held depressed while the handle was being drawn forward to print an item, or take an enforced blank stroke, the lever 172 would be held against movement by the spring 176, by the cam plate 177 overlying the pin 180; the spring 179, in turn, being prevented from moving the cam plate 177 by means of the pin 184. But after the blank stroke has been taken, the swinging frame 48^c (and consequently the arm 187) are in their forward position, and therefore if the total key 169 be depressed, the cam plate 177 is free to swing counterclockwise as the stud 37 moves forward, away from the edge 177^a, in the forward stroke of the handle 27 until the pin 180 on the rear end of the lever 172 has risen under the influence of the spring 176 until said pin 180 is in a locking notch 192 (Fig. 3) in the cam plate 177. The pin 180 does not enter said notch 192 until the movement of the plate 188 (Fig. 4^b) under the action of the stud 37 has brought the notch 191 into register with said pin 180, whereupon the spring 176 causes the pin 180 to enter the notches 191 and 192. Very shortly after the handle 27 has commenced its return stroke, the stud 37, acting on the walls of the cam slot 189, swings the plate 188 downwardly, thus pushing the pin 180 and the lever 172 forwardly. On the lever 172 is a shoulder 193 (Figs. 3 and 7) which moves into place directly behind a pin 194 on the lever 164 when the lever 172 is tilted by the spring 176. When the lever 172 is pushed forward by the plate 188, the shoulder 193 pushes the lever 164 forward, thereby swinging the cam 148 upwardly, and thus pulling the link 141 forward. Said link being in engagement with the pin 145 on the lever 140, the pinions are moved out of mesh with the racks 130. As before indicated, this occurs during the early part of the return movement of the handle 27 and before the racks descend, the pinions being therefore left standing at zero, as will appear more fully hereinafter. As the stud 37 continues on its return stroke, it strikes the edge 177^a and swings the plate 177 against the tension of the spring 179, the lower edge of said plate positively camming the pin 180 down, and thus, in conjunction with the spring 175, restoring the lever 172 to its initial or inoperative position. As the arm 24 (Fig. 3) returns to its initial position, the pin 168 thereon engages the arm 167 and restores the lever 164 to its initial position.

When the pinions are withdrawn from the racks 130, the type bars used in printing the total rise to the top limit of their movement, under the influence of the springs 14, if the machine is operated slowly. In the continuation of the back stroke of the handle 27, the racks are drawn down to normal position by the rod 29, as before explained. When the machine is operated at normal speed, the rod 29 comes into action before

the type bars have time to rise above the total-printing position.

To prevent casual rotation of the pinions while they are out of mesh with the racks, I provide a bar 195 (Fig. 4*) extending longitudinally of the series of pinions and adapted to enter between the teeth thereof. Said bar is rigid with two arms 196 which are pivoted on the links 137 at 197 (Fig. 3). At the free ends of the arms 196 are pins 198 which lie in cam slots 199 (Fig. 3) in two cams 200 pivoted to the fixed guide plates 128 at 201. The cam slot 199 in each cam 200 is below the pivot 201. Above the pivot is a notch 202 to receive the projecting end of the pinion shaft 126. Upon reference to Fig. 3, it will be observed that when the pinions are out of mesh with both sets of racks, the pins 198 are in the central dwell portions of the slots 199, and that upon movement of the pinions into mesh with either set of racks, the cams 200 will swing and will cam the pins 198 down, thus withdrawing the locking bar 195 from the pinions. Compare Figs. 15 and 17.

Referring now to the transfer mechanism (best shown in Figs. 4, 5 and 6): There is a set of transfer devices for the racks 130 to carry amounts from one numerical order to the next higher order in operations involving addition, and a set of transfer devices for the racks 129 to carry amounts from one numerical order to the next higher order in operations involving subtraction. It has been explained that the type bars 3 are moved to their normal lower position by the rod 29. The extent of downward movement of the type bars 3 is limited by the rod 5. The extent of downward movement of the racks is limited (except in the transfer operation) by contact of the lugs 203 on the racks with stop lugs 204. When an amount is to be transferred from one order to the next higher order, the stop lug 204 for the rack belonging to such higher order is withdrawn, thereby allowing that rack to descend under the action of its spring 134 until its lug 203 stops against the bar 136 as indicated in the right-hand portion of Fig. 5 and the left-hand portion of Fig. 6. The extent of such further descent of the rack is just sufficient to turn the pinion for that rack through the distance of one tooth. Each stop lug 204 is formed on an arm or pawl 205 which is suspended from a pivot 206 in the frame-work of the machine, said pivot being above the pinions 125. To the lower end of each pawl or latch 205 is pivoted at 205* a dog 207 (Fig. 4) having a tooth 208 adapted to engage the edge of the adjacent bar 136. The dog 207 lies within a groove 207* (Fig. 6*) in the bar 136. A contractile spring 209 (Fig. 5) normally holds the tooth 208 in engagement with the bar 136, the stop lug 204 being then in position to support the corresponding rack.

The means for disengaging the tooth 208 from the bar 136 consists of two diametrically opposite lugs 210 (Fig. 4) fixed to each pinion. (Two lugs 210 are provided because each pinion has twenty teeth). When the amount registered by a pinion reaches 9, continued rotation of the pinion as the rack descends brings one of the lugs 210 against the upper side of the end of the dog 207 associated with the next higher rack, thereby depressing the dog until the tooth 208 is clear of the bar 136, whereupon the spring 209 (assisted by the downward pressure of the rack) pulls the dog and the pawl 205 away from the last mentioned rack until a lug 211 on the

dog stops against a restoring rod 212. The lug 204 is then out of the path of said rack of next higher order, and the latter therefore moves down one tooth space under the influence of its spring 134, the rack being stopped by the bar 136.

It will be seen that, although the dogs 207 are reliably held in engagement with the bar 136 by the springs 209, they may be disengaged from the bar by the lugs 210 with a minimum of effort. Said lugs, by pressing against the upper sides of the inner ends of the dogs, cause pivotal movement of the dogs on the pivots 205* until the portions 208 are free of the bar 136. Such tripping of the dogs requires less power than is needed in prior forms of transfer mechanism wherein the lug on the pinion is obliged to exert a camming action against the transfer pawl or dog to force it aside.

After each transfer operation the pawl 205 and the dog 207 are restored to their normal position by the rod 212, there being one such restoring rod for each of the sets of transfer mechanism. Each rod 212 is carried by two bell crank levers 213 which are pivoted in the framework of the machine at 206. The bell crank levers at each side of the machine are connected for simultaneous swinging movement by a pin and slot connection, as shown at 214 in Fig. 15. The restoring rods 212 are simultaneously moved toward and away from each other by means of two arms 215 each formed integral with one of the bell crank levers 213, said arms 215 extending into the space between the side members 16. A rod 216 (Fig. 15), the ends of which lie in elongated openings 217 in the side members 16 is normally held against the lower end walls of said openings by means of two springs 218 (Fig. 1). When the side members 16 move downwardly in the forward stroke of the handle 27, (and hence as the type bars 3 are moving upwardly), the rod 216 is carried into engagement with the arms 215, as shown in Fig. 15, thereby causing the rods 212 to move toward each other to restore any transfer devices that may have been concerned in a previous transfer operation. When the side members 16 rise, a contractile spring 218* (Fig. 5) returns the rods 212 to the normal position shown in said view. Such normal position is determined by contact of the bell crank levers 213 with the stop rods 136^b.

When the type bars are raised for a printing operation, the racks do not begin to rise until the studs 132 (Fig. 5) engage the upper ends of the elongated openings 133. Those racks, however, which have descended below the normal position, in order to effect a transfer, rise practically simultaneously with the type bars, and thus are lifted before the stop lugs 204 are restored to normal position by the rod 212. So, also, the movement imparted to the type bars during the enforced spacing stroke of the handle 27 is sufficient to raise the lugs 203 to permit the placing of the stop lugs 204 thereunder.

It may be here stated that when any pinion stands at zero, one of the lugs 210 on said pinion lies directly beneath one of the dogs 207 associated with the set of racks 130 if the amount accumulated is a debit or positive amount, or directly beneath one of the dogs 207 associated with the group of racks 129 if the amount accumulated be a credit or negative amount. Therefore, when a total is to be printed, those racks which mesh with the pinions standing at zero cannot rise, the remaining racks rising until the

rotation of their pinions brings the lugs 210 thereon into contact with the lower sides of the respective dogs 207. The type bars 3 are then in position to print the total amount accumulated on the pinions.

The herein-described arrangement of racks and pinions, with springs 134 anchored to a downward extension of the type bar lying between the racks, and cross-bars 136 serving the double function of guiding the racks and cooperating with the transfer dogs 207, has solved the problem of introducing a subtraction mechanism into an adding machine without increasing the overall dimensions of the latter.

Referring now more particularly to the means for controlling the machine during operations involving subtraction: When the machine is clear, the link 141 is in engagement with the pin 145, as in Fig. 7, the pinions being then in mesh with the racks 130. Reciprocation of the link 141 will therefore shift the pinions into and out of mesh with those racks. When an amount is to be subtracted, the link 141 is shifted into engagement with the pin 144 as in Fig. 17. It will be seen that the link 141 is reciprocable in one plane for addition and in a higher plane for subtraction. The means for shifting the link 141 from one plane to another comprises a lever 219 (Fig. 17) pivoted at 220 in the machine frame and having a forked rear end which engages a pin 221 on the link 141. The lever 219 has a downwardly extending arm 222 to which is attached a contractile spring 223 that serves to raise the lever 219 and hence the link 141. The spring 223 is controlled by means including a subtraction key 224 having a stem 225 which is guided for vertical movement. A contractile spring 226 normally holds the subtraction key elevated. On the stem 225 is a pin 227 that overlies a forwardly extending arm 228 pivoted at 229. Rigid with the arm 228 is a downwardly extending arm 230. A contractile spring 231 connected to the arm 230 tends to draw said arm forward. When the subtraction key is depressed, the arm 230 is locked against actuation by the spring 231 by means of a finger 232 fixed to one end of a rock shaft 233 and adapted to overlie the arm 228. On the other end of the shaft 233 is a finger 234 (Fig. 10) which is acted on by a contractile spring 235. The lower end of the finger 234 normally bears against a roller 236 carried by the slide bar 237 that returns the slide 47 to initial position, consequently in the return stroke of the handle the finger 228 is released. (The bar 237 corresponds to the bar 72 fully disclosed in Patent No. 1,198,487. The finger 232 also serves to lock the subtraction key down, there being a hook 238 (Fig. 17) rigid with the arms 228 and 230 which is adapted to engage a pin 239 on the stem 225.

To the lower end of the arm 230 is pivoted a link 240 which has a lost-motion connection with the arm 222 consisting of a headed stud 241 on the arm 222 extending through an elongated hole 242 in the link. The contractile spring 223 is anchored to the link 240, as shown in Fig. 7.

When the machine is clear, and also when there is a debit or positive balance in the machine, the link 141 is in engagement with the pin 145, as shown in Fig. 7. If an item is to be subtracted, the subtraction key 224 is depressed after the item has been set up, thereby pushing the link 240 rearwardly and thus moving the rear end wall of the opening 242 away from the stud 241. When the handle 27 is pulled, the link

141 is drawn forward, as before explained, to withdraw the pinions from the racks 130 before the racks rise. The forward movement of the link 141 causes the lever 139 to rock, as a result of which the pin 144 is brought into register with the notch 142. Thereupon the spring 223 draws the arm 222 rearwardly, thus placing the notch 142 in engagement with the pin 144. In the return stroke of the handle (see Fig. 17), the link 141 is pushed rearwardly, thereby rocking the lever 139 in the direction to place the pinions in mesh with the racks 129 before the latter start down, whereby the pinions are rotated in the reverse direction to subtract the item. If the next item is subtracted, the notch 142 remains in engagement with the pin 144. If, however, the next item is to be added, the notch 143 is placed in engagement with the pin 145 in the following manner: In the forward stroke of the handle, the link 141 is drawn forward to place the pinions in central position before the racks ascend. As soon as the pin 145 comes into register with the notch 143, the spring 231 pulls the link 240 forward, the rear end wall of the opening 242 causing the arm 222 also to move forward, and thereby lowering the link 141 so as to place the notch 143 in engagement with the pin 145. The weight of the link 141 and the lever 219 also assists in lowering said link. In the return stroke of the handle, the link 141 is pushed rearwardly by the cam 148, whereby the lever 139 is swung in the direction to place the pinions in mesh with the adding racks 130 before the racks descend.

It will be noted that the link 141 is shifted into and out of engagement with the pins 144 and 145 when the pinions are in central position, that is to say, out of mesh with both sets of racks.

The printing of a credit or negative total or balance is effected as hereinbefore explained, except that the number "1" (or the so-called fugitive unit) must be first introduced into the totalizer, the subtraction key 224 being held depressed during the introduction of said number and during the taking of the blank or spacing stroke and the total-printing stroke.

The use of twenty teeth on each pinion lends itself well to a simple organization for obtaining a true negative total.

A credit or negative balance having been printed, and it being desired to clear the machine and prepare it for addition, the following described operations are performed: The pinions stand in mesh with the racks 129. The total key is depressed and the handle pulled. The pinions remain in mesh with the racks 129 during the upward movement of the latter, one of the lugs 210 on each pinion stopping against the forward set of dogs 207, whereby the pinions are alined at the zero position. In the return stroke of the handle, the pinions leave the racks 129 before the latter descend, the pinions being thus left with the lugs 210 at each side of the pinions in alinement. As the handle approaches its initial position and after the racks have descended, the pinions are shifted into mesh with the adding racks 130. Now it will be apparent from Fig. 4 that when the lugs 210 at the forward side of the set of pinions stand at zero, the lugs at the rear side of the set of pinions are at the "9" position. Consequently, when the pinions are shifted into engagement with the racks 130, as just stated, the debit or positive number "9999999.99" is in the totalizer. To clear the totalizer for adding purposes, or, in other words, to

bring the lugs 210 at the rear sides of the pinions to zero position, the total key is again depressed and the handle pulled, whereby the number "999999.99" is printed, together with the clear sign, and the totalizer left with the lugs 210 at the rear side thereof disposed in alinement directly beneath the points of the dogs 207 associated with the adding racks 130.

It is sometimes desirable to print an item without introducing it into the totalizer wheels 125. This may be accomplished by means acting to prevent the pawl 152 (Fig. 15) from engaging the pin 157, so that the pinions 125 shall not be thrown into mesh with the racks at the beginning of the down stroke. A slide 255 (Fig. 3) is mounted on two guide studs 256 for movement longitudinally of the machine, the slide being slotted at 255^a to receive said studs. On the slide 255 is a cam surface 257. A contractile spring 258 tends to draw the slide 255 rearwardly to bring the cam surface 257 into such position that when the pawl 152 is carried forward a pin 259 on said pawl shall engage the surface 257, thus holding the pawl down so that on its return stroke the shoulder 152^b (Fig. 17) shall be unable to engage the pin 157. The slide 255 is normally locked in its forward position by a stud 260 (Fig. 7) on a bell crank 261 pivoted on the axis 174. A contractile spring 262 normally holds the bell crank in such position that the stud 260 lies behind a lug 263 on the slide 255. The means for withdrawing the stud 260 from said lug comprises a non-add key 264 having a stem 265 which is guided for vertical movement. On the stem 265 is a pin 266 that overlies a lug 267 on the bell crank 261. The spring 176 that normally holds the total key up serves also to hold the non-add key elevated, there being a lug 268 on the total key stem which underlies the pin 266. The non-add key is locked in depressed position by means of a lever 269 (Fig. 8^b) pivoted at 270 and having a notch 271 to receive a pin 272 on the non-add key stem. The free end 273 of the lever 269 is arranged to be engaged by the locking finger 232 (Fig. 7).

The slide 255 is restored to its forward position by means of the lever 274 (Fig. 7) that actuates the ribbon feed mechanism, the lower end of said lever lying behind the rear end of the slide. The lever 274 is connected to the adjacent lever 19 through a link 275.

When a number is to be printed, but not added, the operator depresses the non-add key 264 and pulls the handle 27 forward. Depression of the non-add key withdraws the stud 260 from the lug 263. As the handle 27 swings forward, the ribbon-feed lever 274 swings rearward, thus allowing the spring 258 to draw the slide 255 to its rearward position, that is to say, until the end walls of the slots 255^a stop against the studs 256. As the handle 27 makes its forward swing, the pin 259 on the pawl 152 engages the cam surface 257, whereby the pawl is depressed to such an extent that on the return stroke of the pawl it fails to engage the pin 157. The pinions therefore are not thrown into mesh with the racks at the beginning of the downward stroke of the latter, and consequently the number set up and printed is not added. As the handle makes its rearward swing, the pin 168 (Fig. 9^a) on the arm 24 engages the arm 167 and restores the lever 164 to initial position, thereby returning the pinions into mesh with the racks. In the return stroke of the handle, the lever ribbon-feed 274 pushes the slide 255 forward to its normal position, as in

Fig. 7. As the handle is approaching its initial position, the locking finger 232 (Fig. 7) is disengaged from the lever 269, whereupon the non-add key springs up to its normal position, thus allowing the spring 262 to place the stud 260 behind the lug 263 on the slide 255.

Means is provided for insuring correct alinement of the type representing the number to be printed. Said means comprises an alining blade 276 (Fig. 15) adapted to enter notches 277 formed in the forward edges of the type bars 3. The alining blade 276 is fixed to two arms 278 and 279 (Figs. 12 and 15) pivoted on the axis 280 in the framework of the machine. A contractile spring 281 (Fig. 13) tends to place the alining blade in the notches 277, and a bar 282 serves to push the blade out of said notches. The forward end of the bar 282 is slotted or forked to receive a headed stud 283 on the arm 278. The spring 281 is anchored to the rear portion of the forked bar 282. The rear end of said bar is pivoted to the upper arm of a lever 284 which is pivoted at 285 in the framework of the machine. The lower arm of the lever 284 is in the path of the stud 37 on the adjacent lever 19. 286 is a detent pivoted at 287 which is adapted to engage a pin 288 on the arm 278. Below the detent 286 is a detent 289 pivoted at 285 and also adapted to engage the pin 288. A contractile spring 289^a connecting the detents 286 and 289 assists gravity in holding the detent 286 down. A spring 290 normally holds the detent 289 away from the pin 288, the action of the spring being limited by contact of a lug 291 on said detent with the detent 286. Rigid with the detent 289 is a finger 292 (Fig. 12) lying in the path of the aforesaid stud 37.

The position of the aliner when the machine is at rest is shown in Fig. 12. In the forward movement of the handle, the stud 37 strikes the lower arm of the lever 284 and draws the forked bar 282 rearwardly, thus tensioning the spring 281; but the alining blade is prevented by the detent 286 from moving into engagement with the type bars. At the end of the forward stroke of the handle, the stud 37 engages the finger 292 and lifts the detent 289 into contact with the detent 286, both detents rising until the detent 289 has engaged the pin 288, as in Fig. 13. At the beginning of the return stroke of the handle (see Fig. 14), the stud 37 leaves the finger 292, the spring 290 drawing the detent 289 down, and the pin 288 slipping between the detents under the influence of the spring 281. The alining blade 276 is thus inserted into the notches 277 promptly after the handle 27 commences its return stroke. At a subsequent stage in the return stroke of the handle and before the hammers have struck the type, the stud 37 leaves the lever 284, the spring 281 pulling the forked bar 282 forward until the closed end of the fork engages the stud 283, after which the continued pull of the spring 281 tends to bring the forked bar 282 and the lever 284 into alinement, the result of such tendency being to push the point 283 forward, whereby the alining blade is withdrawn from the type bars. This, of course, occurs before the type bars start down. The withdrawn position of the alining blade is determined by contact of the rear portion of the bar 282 with a stud 293 (Fig. 12) on the framework of the machine.

It will be observed that the alining device engages the type bars after the forward stroke of the handle has been completed, thus giving the

type bars time to complete their upward movement and stop vibrating before the alining blade enters the notches 277. The provision of alining means lessens the necessity for accuracy in manufacture and for rigorous inspection, and thus reduces the cost of manufacture.

The machine is preferably arranged to print items and totals in contrasting colors, as, for example, items in blue and totals in red. The means for shifting the ribbon to print in the desired color may be of any suitable character, as, for example, that employed in the Sundstrand adding machine, and therefore has not been disclosed herein in detail.

If desired, means may be provided for printing a distinguishing character in connection with certain imprints, as, for example, in connection with a final debit total, or a credit total, or an item which is printed but not added to the previous items, or an item which is subtracted. Herein is shown a special sign-printing bar 3' (Figs. 3 and 17) which is constructed and mounted substantially like the type bars 3. The bar 3', however, carries only two type, the imprint of the upper type being the total sign when in red and the non-add sign when in blue, and the imprint of the lower type denoting a subtracted item when in blue and a credit or negative balance when in red. A contactible spring 295 attached to the bar 7 and to a pin 296 on the type bar 3' tends to raise the latter. The extent to which the type bar 3' may rise is determined by the arm 222, said arm having a shoulder 297 that is engaged by the pin 296 to define the position of the type bar when the clear and non-add signs are to be printed, and a shoulder 298 to determine the position wherein the negative sign is printed. When the link 141 is in position to shift the pinions into and out of mesh with the adding racks 130, the shoulder 297 is in the path of the pin 296, as in Fig. 3. When said link is in position to shift the pinions into and out of engagement with the subtracting racks 129, the shoulder 298 is in the path of the pin 296, as in Fig. 17.

After each printing operation the sign-printing bar 3' is pushed down to its normal position by engagement of the adjacent arm 30 with a pin 299 on said type bar.

The hammer mechanism will now be described. While various other forms of hammer mechanism may be employed, I prefer that illustrated in the drawings, inasmuch as it does not cause any pressure or friction on the type bars as the latter are being elevated. Referring now to Fig. 10^a, for each type bar 3 and 3' there is a hammer 300, 300', respectively. The shape of these hammers is best shown in Fig. 1. The hammers are pivoted on the rod 141^b, and are impelled against the type by individual contractile springs 301. After each printing operation those hammers which took part therein are restored to normal position, or "cocked", by a rod 302 arranged to overlie lugs 303 on the hammers. The rod 302 is attached to a sheet-metal stamping which virtually constitutes an arm 304 pivoted at 305 in the machine frame. Said stamping comprises an arm 306 (Fig. 10) carrying a roller 307 that runs on a cam 308 fixed to the arm 25. A contractile spring 309 attached to a lug 310 on the arm 304 assists to hold the roller in contact with the cam. As the cam 308 completes its upward swing the surface 311 positively forces the rod 302 to the upward limit of its move-

ment. As the cam swings downwardly, the surface 312 positively forces the rod 302 down.

On the left-hand side of each hammer is a pin 313 (Fig. 10). At the left-hand side of each hammer is a latch 314 (Fig. 17^a) pivoted on the center 315. The forward ends of the latches 314 are heavier than the rear ends thereof. The rear ends of the latches extend into the spaces between the type bars; and each latch carries on its right-hand side a pin 316 adapted to engage the forward edge of the adjacent type bar. The upper portion of said edge has a notch 317 (Fig. 15) therein which registers with the pin 316 when the type bar is down and which is above the pin when the type bar is raised to print the numeral 1 or a higher numeral.

Referring now to Figs. 15 and 17^a, it will be noted that each latch is provided with a projection 318. When the pin 316 on the latch stands in contact with the edge of a raised type bar, the projection 318 is out of the path of the pin 313 on the associated hammer, but when the pin 316 is in the notch 317 the projection 318 is in the path of said pin 313.

Although the weight of the forward ends of the latches tends to place the pins 316 against the type bars, they are not allowed to engage the type bars until near the end of the forward stroke of the handle 27, at which time those type bars which are to take part in the printing operation have reached printing position. By thus avoiding friction on the type bars, the latter rise more promptly and are sure to reach printing position before the aliner acts, thereby rendering possible very rapid operation of the machine without danger of inaccurate registration and printing. The means for restraining the latches until the type bars have reached printing position comprises a universal bar 319 (Figs. 1 and 3) lying behind the lower portions of the latches and carried by two plates or arms 320 (Fig. 3^a), one at each side of the set of hammers and latches. The arms 320 are pivoted on the rod 141^b. Contractile springs 321 tend to raise the arms 320 and thus move the bar 319 rearwardly away from the latches.

On the forward end of each arm 320 are lugs 322 and 323 arranged to be engaged by the bar 302. As the bar 302 rises, it engages the lugs 322 and positively moves the rod 319 away from the latches, leaving the latter free to swing into engagement with the type bars. In the downward movement of the bar 302 it engages the lugs 323 and positively places the rod 319 in position to restrain the latches from moving into engagement with the type bars.

In order that the rod 319 shall not move out of latch-restraining position until the type bars have moved to printing position, I provide two fingers 324 (Fig. 3), one at each side of the group of hammers and latches, which fingers are pivoted at 325 and are held by contractile springs 326 against pins 327 on the arms 320. The fingers 324 are notched at 328 to receive the pins 327. When the machine is at rest, the forward ends of the fingers 324 bear against the pins 327 and hold the rod 319 in latch restraining position. In the upward movement of the bar 302 said bar engages the lugs 322 and raises the arms 320 against the tension of the springs 326 until the pins 327 pass into the notches 328 in the fingers 324, thus moving the rod 319 out of latch-restraining position and holding it there until the rod 302 in its downward movement strikes the lugs 323 and forces the pins 327 out of the

notches 328, when the springs 326 complete the movement of the rod 319 into latch-restraining position.

A universal latch 329 (Figs. 10 and 10^a) adapted to engage the lugs 303 is pivoted at 330 and is normally held in position to restrain the hammers by means of a contractile spring 331. The latch 329 carries a stud 332 which is normally held by the spring 331 against the upper arm of a lever 333 pivoted at 334 in the machine frame. To the lower arm of the lever 333 is pivoted at 335 a catch 336 carrying a pin 337. A contractile spring 338 connected to the pin 337 normally holds said pin against a lug 339 (Fig. 10^b) on the lever 333 and thus holds the upper arm of said lever against a stop pin 340 on the machine frame. The arm 25 has a stud 341 which in the upward swing of said arm engages the beveled lower side of the catch 336 and raises said catch against the tension of its spring 338, the catch turning on its pivot 335. As the stud 341 completes its upward movement it slips into a notch 342 in the catch 336. As the arm 25 begins to return, the stud 341 causes the catch 336 and the lever 333 to turn on the pivot 334, thereby forcing the universal latch 329 away from the lugs 303, the stud 341 soon thereafter leaving the notch 342.

The notches 317 are of such length that the movement of the type bars into position to print ciphers does not carry said notches above the studs 316; consequently, when a cipher is to be printed other means must be employed to hold the projection 318 out of the path of the pin 313 on the hammer that is to cause printing of the cipher. The means herein shown for this purpose consists of a lug 343 (Fig. 10^a) on each latch 314 (except the one for the sign-printing hammer) arranged to overlie the latch next to the left. When any latch 314 is held up by engagement of its stud 316 with an elevated type bar, all the latches to the right are likewise supported in position to permit operation of their hammers.

In summarizing the operation of the hammer mechanism, reference will be made to Fig. 1, which shows the machine at rest, the type bars being down, the hammers being held cocked by the restoring rod 302, and the latches 314 being held with their pins 316 away from the type bars. A number having been set up, the handle 27 is pulled. As the restoring rod 302 rises the hammers move slightly until the lugs 303 are stopped by the universal latch 329. When the surface 311 (Fig. 10) engages the roller 307 the rod 302 completes its upward movement, the engagement of said rod with the lugs 322 causing the latch-restraining rod 319 to move back away from the latches 314, whereupon said latches swing by gravity until the pins 316 stop against the type bars. In the case of those type bars which are at the left of the type bars needed in printing the number set up (and which consequently have not been raised) the pins 316 swing far enough to enter the notches 317 of said non-elevated type bars, thus placing the projections 318 in the path of the pins 313 on the hammers for those type bars. In the case of those type bars which have been raised, the pins 316 stop against the edges of said type bars below the notches 317, whereby the projections 318 are prevented from moving into the path of the pins 313 on the hammers for said type bars and any type bars to the right thereof. At the beginning of the return movement of the handle

27, the pull of the stud 341 on the catch 336 causes the universal latch 329 to swing forward away from the lugs 303, whereupon those hammers which are not restrained by the projections 318 are driven by their springs 301 against the type representing the number set up. In the return movement of the handle the rod 302 restores the released hammers, the lower corners of the hammers being beveled so as to slip past the universal latch 329, and said latch being moved by its spring 331 into effective engagement with the lugs 303 as soon as the lugs on the released hammers have been drawn down below the latch. As the rod 302 completes its downward movement it engages the lugs 323 and pulls the arms 320 down until the pins 327 leave the notches 328, whereupon the springs 326 complete the downward movement of the arms 320 and thus place the rod 319 in latch-restraining position.

The sign-printing bar 3' (Fig. 3) is normally in position to print the total sign and the non-add sign. There being no upward movement of said type bar to be availed of to restrain the latch 314 when these signs are to be printed, I provide a stop finger 344 which is rigid with the bell crank lever 261. When the total key 169 or the non-add key 264 is depressed, the stop finger 344 swings with the bell crank lever 261 into position to support a pin 345 on the latch 314 for the sign-printing hammer 300', whereby said latch is prevented from interfering with the movement of said hammer when the latter is released by the universal latch 329.

In order to hold the totalizer lever 172 against effective movement after the handle 27 has started back to initial position, and also to prevent depression of the non-add key 264 after the handle has commenced to return, I provide a lug 346 (Fig. 10^a) on the universal latch 329 which moves into place over a lug 347 on the stop finger 344 when said latch is disengaged from the hammers. After the hammers have been released the machine cannot be cleared, nor addition prevented.

When it is desired to add or subtract an amount without printing it, the hammer mechanism may be disabled by means comprising a non-print key 348 (Fig. 10). The stem 349 of said key is guided for vertical reciprocation, the key being normally held elevated by a spring 350. A link 351 is pivoted at one end to an arm 352 rigid with the stem 349, and is pivoted at its other end to a lever 353 which is pivoted in the machine frame at 354. The rear arm of the lever 353 underlies a pin 355 on the catch 336. When the non-print key is depressed the lever 353 lifts the catch 336 out of the path of the stud 341, thereby preventing the universal latch 329 from being disengaged from the hammers.

Inasmuch as the hammers are released in the return stroke of the handle, the operator is enabled to correct an error in setting up a number by depressing both the non-add key 264 and the non-print key 348 at any time up to the beginning of the return movement of the handle.

The capabilities of the machine are indicated by the specimens of work reproduced in Figs. 18 to 24. In these views dotted lines are employed to indicate red imprints. Referring first to Fig. 18, the red imprint *a* is a sign denoting that the machine is clear. Fig. 18 shows that the operator first set up, printed and added an item of 50¢. There being an item of 20¢ to be subtracted, the operator set up the item by means

of the keyboard, then depressed the subtraction key 224, and then pulled the handle 27, whereupon the item of 20¢ and the subtraction sign b were printed. Another item of 50¢ was then set up, printed and added. The handle was then pulled twice, whereupon the debit or positive balance of 80¢ was printed. It will be seen that the item of 20¢ was automatically subtracted, and that the debit balance was printed automatically, that is to say, without any manipulation other than the operation of the handle 27.

To produce the work shown in Fig. 19 the item of \$1.00 is set up, printed and added in the usual manner, after which the item of \$1.10 is set up, printed and subtracted automatically. Since the balance contained in the totalizer is a credit or negative balance, it is necessary in order to print the true credit balance to introduce the fugitive 1, the subtraction key being depressed in connection with such operation. After taking a spacing stroke the true credit balance of 10¢ may be printed.

Fig. 20 illustrates an instance where the operator has a number of items to add and subtract and may not know at the time when she desires to take the total whether the total be a debit total or a credit total. Upon taking the subtotal in the regular way the operator obtains a total representing all the numerical orders the machine is adapted to handle. Realizing, therefore, that the machine must contain a credit balance, she introduces the fugitive 1, holds the subtraction key down while taking the spacing stroke, and then obtains the correct credit balance on the next operation of the handle.

Fig. 21 illustrates a method of deducting a discount. Assuming that it be desired to deduct 2% from \$7596.00, the operator first sets up the item of \$7596.00, depresses the multiplying key 84, and operates the handle 27 to print said item. The back spacer key 86 is then depressed two times so as to reduce the number set up on the keyboard to one one-hundredth of the amount originally set up. The operator then depresses the subtraction key 224 and pulls the handle, thereby subtracting 1% from the amount first set up. By pulling the handle a second time (the multiplying key being first released), another 1% is subtracted from the item first set up. The debit or balance remaining in the total may then be printed by operation of the handle 27.

Fig. 22 illustrates another method of deducting a discount. If it be desired to deduct 2% from \$7596.00, the operator first calculates what the 2% will amount to. This she does by setting up 1% of the principal, depressing the multiplying key 84, pulling the handle 27 once, releasing the multiplying key and pulling the handle 27 a second time. By operation of the handle 27 and the total key 169, the operator ascertains that the 2% amounts to 151.92, and clears the machine. The operator then sets up, prints and adds the minuend 7596.00, then sets up the subtrahend 151.92, depresses the subtraction key 224 and pulls the handle 27 to print the subtrahend and subtract it from the minuend. By operating the handle 27 twice the operator obtains the remainder of 7444.08.

Fig. 23 illustrates the operation of deducting 15% from \$7596.00. The operator first sets up the minuend 7596.00, depresses the multiplying key 84 and pulls the handle 27. By depressing the back spacer key 86 once the operator reduces

the number set up on the keyboard to one-tenth of the minuend. After depressing the subtraction key 224 the operator subtracts from the minuend 10% thereof. By again depressing the back spacer key 86 the operator reduces the number set up on the keyboard to 1% of the minuend. This 1% the operator then proceeds to subtract five times by pulling the handle that number of times, releasing the multiplying key before pulling the handle the fifth time. Having thus subtracted 15% from the minuend the remainder is obtained by pulling the handle twice.

Fig. 24 illustrates the manner in which multiplication may be performed by repeated addition followed by subtraction. If it be desired to multiply \$45.69 by 19, the operator sets up the number 45.69, then depresses the naught key and the multiplying key, and then pulls the handle 27 twice, thereby introducing into the machine a number equal to twenty times 45.69. By depressing the back spacer key once, the operator reduces the number set up in the keyboard to 45.69, releases the multiplying key, depresses the subtraction key and pulls the handle 27, thereby subtracting 45.69 from the amount in the machine. Operation of the handle will then result in the printing of the product 868.11, which is equivalent to twenty times 45.69, minus 45.69.

While the present embodiment of the invention has been described in considerable detail, it should be understood that the invention is not limited to the particular construction and arrangement of the parts and mechanisms shown, and that various modifications coming within the scope of the appended claims will suggest themselves to those skilled in the art.

The term "counting element" is employed in some of the following claims to denote a pinion or a rack.

The hammer mechanism is claimed in my divisional Patent No. 1,747,743, dated February 18, 1930.

In compliance with an official requirement of division, the transfer mechanism is claimed in my divisional application Serial No. 669,633.

I claim as my invention:

1. A ten-key adding and subtracting machine having, in combination, stops, a set of type bars rearwardly of the stops and arranged to be controlled by said stops, said type bars being rectilinearly movable vertically, each type bar having a rearwardly extending portion, two racks connected to each of said rearwardly extending portions, the racks being arranged in two sets, pinions located between said sets of racks and arranged to mesh with the racks, a shaft located rearwardly of the group of racks and pinions, arms mounted on said shaft and connected to the type bars, and means for operating said arms to raise and lower the type bars.
2. A calculating machine having, in combination, counting elements, a lever pivoted between its ends, said lever being connected to said counting elements to shift the latter, a member arranged to engage the opposite ends of said lever alternately, means to reciprocate said member to place the counting elements in and out of operative position, a lever connected to said member to shift the latter into and out of engagement with the opposite ends of the first lever, a link having a lost-motion connection with the second lever, a spring connected with the second lever for moving the latter in one direction, and a subtraction key arranged to operate said link, and

means to lock the subtraction key in depressed position.

3. A calculating machine having, in combination, counting elements, a lever pivoted between its ends, said lever being connected to said counting elements to shift the latter, a member arranged to engage the opposite ends of said lever alternately, means to reciprocate said member to place the counting elements in and out of operative position, a lever connected to said member to shift the latter into and out of engagement with the opposite ends of the first lever, a link having a lost-motion connection with the second lever, a spring connected to the second lever for moving the latter in one direction, and a subtraction key arranged to operate said link.

4. A calculating machine having, in combination, counting elements, a lever pivoted between its ends, said lever being connected to said counting elements to shift the latter, studs on opposite ends of said lever, a link having a notch for each of said studs and arranged to engage the studs alternately, means to reciprocate said link to place the counting elements in and out of operative position, and means to shift said link into and out of engagement with said studs to shift the counting elements from adding position to subtracting position, and vice versa.

5. A calculating machine having, in combination, counting elements, a lever pivoted between its ends, said lever being connected to said counting elements to shift the latter, a link arranged to engage the opposite ends of said lever alternately, means to reciprocate said link to place the counting elements in and out of operative position, and means to shift said link into and out of engagement with the opposite ends of said lever to shift the counting elements from adding position to subtracting position, and vice versa.

6. A calculating machine having, in combination, counting elements, a lever pivoted between its ends, said lever being connected to said counting elements to shift the latter, a member arranged to engage the opposite ends of said lever alternately, an oscillatory cam for reciprocating said member to place the counting elements in and out of operative position, and means to shift said member into and out of engagement with the opposite ends of said lever to shift the counting elements from adding position to subtracting position, and vice versa.

7. A calculating machine having, in combination, counting elements, means to shift the latter into and out of position for addition and subtraction, said means including a member reciprocable in one plane for addition and in another plane for subtraction, and means to shift said member from one plane to another.

8. A calculating machine having, in combination, counting elements, means to shift the counting elements into and out of position for addition and subtraction, said means including a member reciprocable in one plane for addition and in another plane for subtraction, a lever connected to said member to shift the latter from one plane to another, a link having a lost-motion connection with said lever, a spring connected to said lever for moving the latter in one direction, and a subtraction key arranged to operate the link.

9. A calculating machine having, in combination, counting elements, means to control said elements, said means including an oscillatory cam plate, an oscillatory member arranged to engage and swing said cam plate in opposite directions,

and non-add means arranged to control engagement of said member with said cam plate.

10. A calculating machine having, in combination, counting elements, means to control said elements, said means including an oscillatory cam plate, an oscillatory member arranged to engage and swing said cam plate in opposite directions, and means dependent upon the condition of the setting-up mechanism for controlling engagement of said member with said cam plate.

11. A calculating machine having, in combination, counting elements, means to shift the counting elements into and out of position for addition and subtraction, said means including a member reciprocable in one plane for addition and in another plane for subtraction, a lever connected to said member to shift the latter from one plane to another, said lever having a downwardly extending arm, a spring connected to said lever for moving the latter to shift said member from one plane to another, a link having a pin-and-slot connection with said downwardly extending arm, a spring normally acting upon said link to restrain the first-mentioned spring, and a subtraction key arranged to shift said link against the influence of the second-mentioned spring.

12. A calculating machine having, in combination, counting elements, means to control said elements, said means including an oscillatory cam plate, two pins on said cam plate at opposite sides of its axis, an oscillatory arm, a pawl pivoted on said arm and having shoulders on opposite sides of said pawl, each shoulder being adapted to engage one of said pins, said pawl comprising a guide finger located between said shoulders, said finger being arranged to engage said pins, a spring tending to hold said pawl in central position, and means dependent upon the condition of the setting-up mechanism for controlling engagement of said pawl with one of said pins.

13. A calculating machine having, in combination, counting elements, means to control said elements, said means including an oscillatory cam plate, two pins on said cam plate at opposite sides of its axis, an oscillatory arm, a pawl pivoted on said arm and having shoulders on opposite sides of said pawl, each shoulder being adapted to engage one of said pins, said pawl comprising a guide finger located between said shoulders, said finger being arranged to engage said pins, a spring tending to hold said pawl in central position, means dependent upon the condition of the setting-up mechanism for controlling engagement of said pawl with one of said pins, and non-add means arranged to control engagement of the pawl with the other pin.

14. A calculating machine having, in combination, counting elements, means to shift the counting elements into and out of position for addition and subtraction, said means including a member reciprocable in one plane for addition and in another plane for subtraction, a lever connected to said member to shift the latter from one plane to another, a spring connected to said lever for moving the latter to shift said member from one plane to another, a link connected to said lever, a spring normally acting upon said link to restrain the first-mentioned spring, and means to shift said link against the influence of the second-mentioned spring.

15. A calculating machine having, in combination, counting elements, means to shift the counting elements into and out of position for addition

and subtraction, said means including a member reciprocable in one plane for addition and in another plane for subtraction, a lever connected to said member to shift the latter from one plane to another, means for moving said lever to shift said member from one plane to another, a link connected to said lever, a spring normally acting upon said link to restrain the first-mentioned spring, and a subtraction key arranged to shift said link against the influence of the second-mentioned spring.

16. A calculating machine having, in combination, a total lever, a pivoted cam plate arranged to engage the rear end of said lever, a spring tending to swing said cam plate, a spring-actuated detent arm, a hook on said cam plate arranged to engage said detent arm, and means to prevent engagement of said cam plate by said detent arm.

20 17. A calculating machine having, in combination, a total lever 172, a pivoted cam plate 177 arranged to engage the rear end of said lever, a spring 179 tending to swing said cam plate, a spring-actuated detent arm 181, a pin on said detent arm, a hook 185 on said cam plate arranged to engage said pin, and an arm 187 having a pin arranged to engage the detent arm 181 and thus prevent said detent from detaining said cam plate.

30 18. A calculating machine having, in combination, two sets of racks, a set of pinions arranged to mesh with either set of racks, two sets of transfer devices, one set for each set of racks, said sets of transfer devices being at opposite sides of the group of racks and pinions, said transfer devices being arranged to be operated by said pinions, two pairs of levers, a rod carried by each pair of levers, said levers being connected to move said rods toward and away from each other to restore the transfer devices, means for reciprocating the racks, said means including two reciprocatory side members, a rod yieldably carried by said side members, and arms on two of said levers extending into position to be engaged by the last mentioned rod in the downward movement of said side members.

50 19. A calculating machine having, in combination, a set of pinions, each pinion having twenty teeth, two sets of racks, one at each side of the set of pinions, two independent sets of transfer devices, one set for each set of racks, each pinion having two diametrically opposite parts adapted to operate either set of transfer devices, means for simultaneously reciprocating both sets of racks, means for shifting the pinions into and out of mesh with one of the sets of racks, and means to determine with which set of racks the pinions shall mesh.

30 20. In a calculating machine, a vertically reciprocatory type bar, a rearward extension of the type bar, two racks having a pin-and-slot connection to said extension, means for guiding said racks for parallel vertical movement, springs connected to said racks and said extension, said springs tending to move the racks downwardly with relation to the type bar, and independent transfer devices associated with said racks for controlling said springs.

70 21. A calculating machine having, in combination, type bars, two racks connected to each type bar for longitudinal movement relative to each other and to the type bar, each rack moving in the same direction as the other upon movement of the type bar to printing position, springs tending to move the racks longitudinally in the same

direction with relation to their type bars, pinions shiftable into and out of mesh with the racks, and transfer devices operable by the pinions and serving to control said springs.

80 22. A calculating machine having, in combination, two sets of racks, one for debit item-entering and debit total-taking and the other for credit item-entering and credit total-taking, a set of pinions arranged to mesh with either set of racks, and two sets of transfer devices, one set for each set of racks, said sets of transfer devices being at opposite sides of the group of racks and pinions, said transfer devices being arranged to be operated by said pinions.

90 23. In a calculating machine, in combination, a type bar having a rearward extension, two racks having a pin-and-slot connection with said extension, said rearward extension having a downward extension between said racks, a guide for each of said racks, and contractile springs connecting the upper portions of said racks with said downward extension, said springs tending to hold said racks in said guides.

100 24. In a calculating machine, in combination, a type bar having a rearward extension, two racks having a pin-and-slot connection with said extension, said rearward extension having a downward extension between said racks, and contractile springs connecting the upper portions of said racks with said downward extension.

105 25. In a calculating machine, in combination, a type bar having a rearward extension, two racks having a pin-and-slot connection to said extension, said rearward extension having a downward extension between said racks, a pinion between said racks and arranged to mesh with either, a guide for each of said racks, said guides being opposite the point of tangency of the racks to the pinion, and contractile springs connecting the upper portions of said racks with said downward extension.

120 26. A calculating machine having, in combination, a plurality of bars which reciprocate in the accumulation or printing of an item, said bars having a series of notches therein, an alining plate arranged to enter said notches, a handle and connections for positioning said bars in the forward stroke of the handle, a part reciprocating with the handle, a lever arranged to be moved by said part, a bar connected to said lever and having a stud-and-slot connection with said alining plate, a contractile spring connected to said plate and said bar and tending to hold said stud against the end wall of said slot, a pin connected to said alining plate, a detent arranged to engage said pin to hold the alining plate out of engagement with said notches, a pivoted detent also arranged to engage said pin, said part being arranged to swing the last mentioned detent against the first mentioned detent and thus lift the latter away from said pin and place the second detent in engagement with said pin, and a spring to withdraw the second detent from said pin in the return stroke of the handle.

140 27. A calculating machine having, in combination, a plurality of reciprocatory bars, said bars having a series of notches therein, an alining plate arranged to enter said notches, a handle and connections for positioning said bars, a part reciprocating with the handle, a lever arranged to be moved by said part, a bar connected to said lever and having a stud-and-slot connection with said alining plate, a contractile spring connected to said plate and said bar and tending to hold said

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stud against the end wall of said slot, a pin connected to said alining plate, a detent arranged to engage said pin to hold the alining plate out of engagement with said notches, a pivoted detent also arranged to engage said pin, said part being arranged to swing the last mentioned detent against the first mentioned detent and thus lift the latter away from said pin and place the second detent in engagement with said pin, and a spring to withdraw the second detent from said pin.

28. A calculating machine having, in combination, a plurality of reciprocatory bars, said bars having a series of notches therein, an alining plate arranged to enter said notches, a reciprocatory part, a lever arranged to be moved by said part, a bar connected to said lever and having a stud-and-slot connection with said alining plate, a contractile spring connected to said plate and said bar and tending to hold said stud against the end wall of said slot, a pin connected to said alining plate, a detent arranged to engage said pin to hold the alining plate out of engagement with said notches, a pivoted detent also arranged to engage said pin, said part being arranged to swing the last mentioned detent against the first mentioned detent and thus lift the latter away from said pin and place the second detent in engagement with said pin, and means to withdraw the second detent from said pin.

29. In a calculating machine, a type bar, two racks having a pin-and-slot connection with said type bar, springs connected to said racks and type bar, said springs tending to move the racks with relation to the type bar, and independent transfer devices associated with said racks for controlling said spring.

30. A calculating machine having, in combination, a set of type bars, two sets of racks, one rack of each set being connected to each type bar, pinions located between said sets of racks and arranged to mesh with the racks, and two sets of transfer devices, one set for each set of racks, said sets of transfer devices being at opposite sides of the group of racks and pinions, said transfer devices being arranged to be operated by said pinions.

31. A calculating machine having, in combination, a set of totalizer pinions, each having twenty teeth and two diametrically opposite transfer lugs, two sets of racks facing each other and adapted to engage opposite sides of the set of pinions, two sets of transfer devices, one set for each set of racks, said devices being arranged for actuation by said transfer lugs, and a single set of carriers to which both sets of racks are attached.

32. A ten-key adding and subtracting machine having, in combination, a set of type bars which are rectilinearly movable vertically, each type bar having a series of notches in its forward edge, alining mechanism including a blade arranged forward of the type bars to enter said notches, accumulating mechanism including vertically movable racks located rearwardly of and attached to said type bars, and arms connected to said type bars for raising and lowering the same, said arms being arranged to swing on an axis located rearwardly of and above the accumulating mechanism.

33. In a calculating machine, a series of reciprocatory type bars, each type bar having a rearward extension, two sets of racks, one rack of each set having a pin-and-slot connection with one of said extensions, springs connected to said racks and said extensions, said springs tending to move

the racks downwardly with relation to the type bars, a set of totalizer pinions arranged to be rotated by either of said sets of racks, and two sets of transfer devices each associated with one of said sets of racks for controlling said springs in transferring from one totalizer pinion to another.

34. In a calculating machine, a type bar, an adding rack and a subtracting rack each having a pin-and-slot connection with said type bar, springs connected to said racks and type bar, said springs tending to move the racks with relation to the type bar, a pinion arranged to be driven by either of said racks, and independent transfer devices associated with said racks for controlling said springs.

35. A computing and printing machine comprising a number of pinions arranged in denominational orders; a set of toothed elements for rotating said pinions in one direction to add; a set of toothed elements for rotating said pinions in the opposite direction to subtract, said pinions being shiftable into and out of mesh with either of said sets of elements; a set of type carriers the positioning of which in the printing of totals is controlled by said sets of elements, each of said pinions having twenty teeth and two diametrically opposite transfer lugs; and transfer means operable by said lugs to effect transfer of tens and arranged to stop said lugs in one position to position the type carriers for the printing of a positive total and to stop said lugs in another position to position the type carriers for the printing of a negative total.

36. A computing and printing machine comprising a set of type bars; two sets of toothed elements connected with the type bars; a number of pinions arranged in denominational orders, one of said sets of toothed elements being arranged to rotate said pinions in one direction to add and the other set of toothed elements being arranged to rotate said pinions in the opposite direction to subtract, said pinions being shiftable into and out of mesh with either of said sets of elements, each of said pinions having twenty teeth and two diametrically opposite transfer lugs; and transfer means operable by said lugs to effect transfer of tens and arranged to stop said lugs in one position to position the type bars for the printing of a positive total and to stop said lugs in another position to position the type bars for the printing of a negative total.

37. A computing and printing machine comprising a set of type bars; two sets of toothed elements connected with the type bars and capable of movement relative to the type bars for transfer purposes; a number of pinions arranged in denominational orders, one of said sets of toothed elements being arranged to rotate said pinions in one direction to add and the other set of toothed elements being arranged to rotate said pinions in the opposite direction to subtract, said pinions being shiftable into and out of mesh with either of said sets of elements, each of said pinions having twenty teeth and two diametrically opposite transfer lugs; and transfer means operable by said lugs to effect transfer movement of said toothed elements relative to the type bars and arranged to stop said lugs in one position to position the type bars for the printing of a positive total and to stop said lugs in another position to position the type bars for the printing of a negative total.

38. A calculating machine having, in combination, type bars, an adding and a subtracting

rack connected to each type bar for longitudinal movement relative to the type bar for transfer purposes, each rack moving in the same direction as the other upon movement of the type bar to printing position, spring means tending to move the racks longitudinally in the same direction with relation to their type bars, pinions shiftable into and out of mesh with the racks, and transfer devices operable by the pinions and serving to control the spring means, said transfer devices including one set of parts operable by the pinions when the latter mesh with the adding racks, and another set of similar parts operable by the pinions when said pinions mesh with the subtracting racks.	39. A calculating machine having, in combination, two sets of racks, one for debit item-entering and debit total-taking and the other for credit item-entering and credit total-taking, a set of pinions shiftable into and out of mesh with either set of racks, and transfer mechanism including parts located at opposite sides of the set of pinions, the parts at one side being operable by the pinions when the latter are in mesh with one set of racks, and the parts at the other side being operable by the pinions when said pinions mesh with the other set of racks.	80
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