

June 16, 1931.

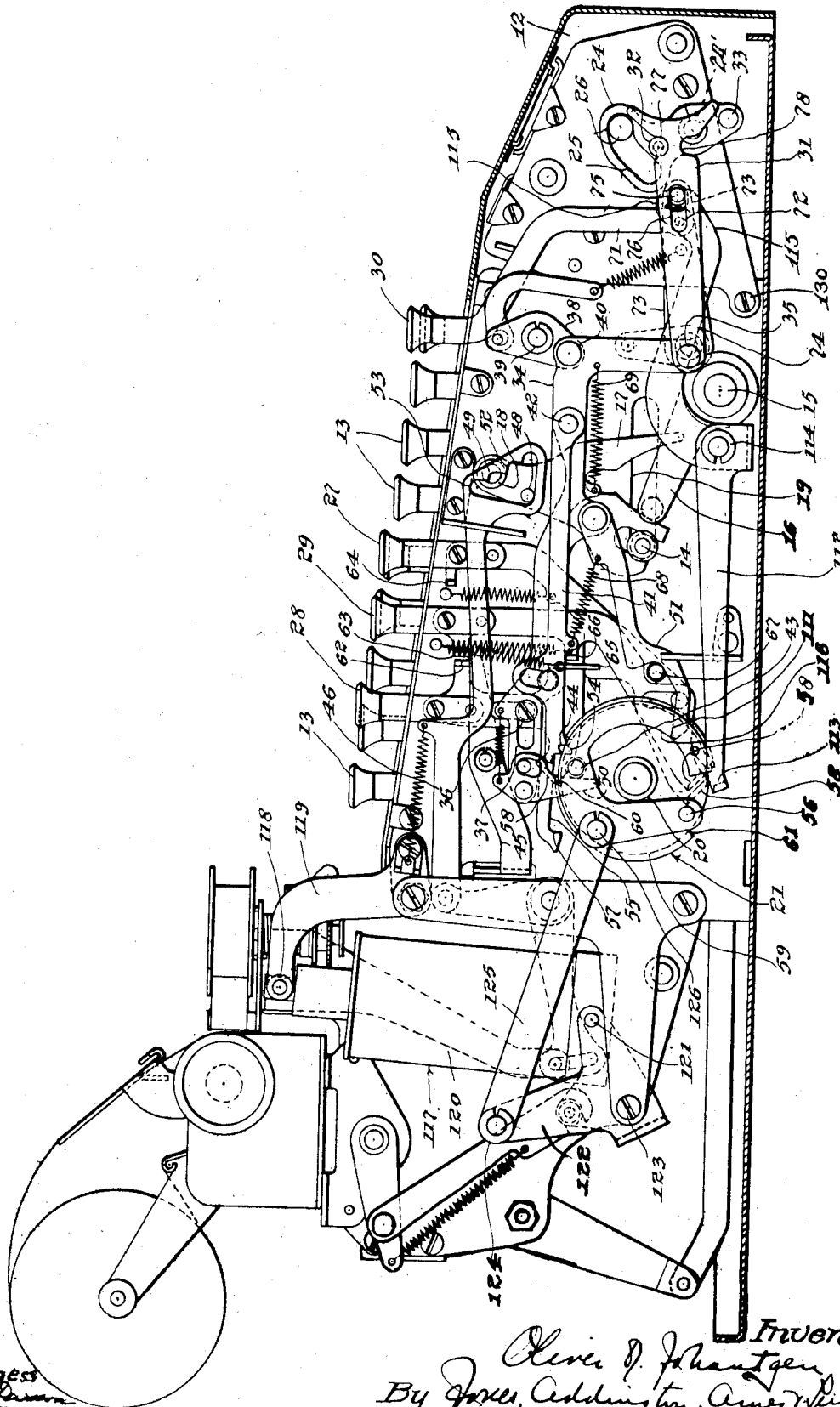
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1,810,213

CALCULATING MACHINE

Filed July 5, 1927

4 Sheets-Sheet 1



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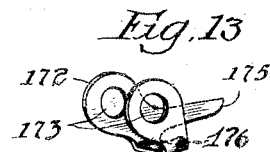
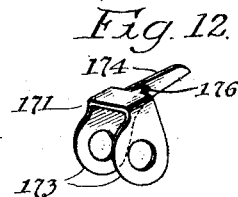
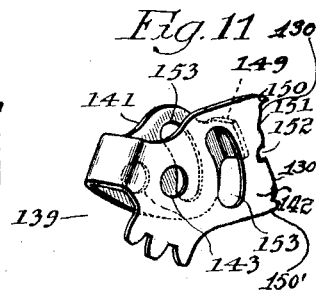
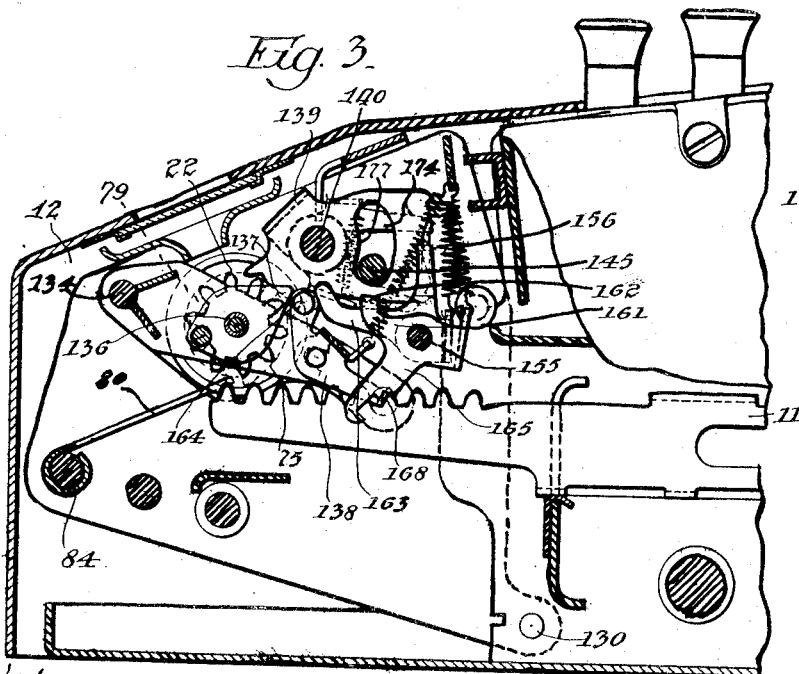
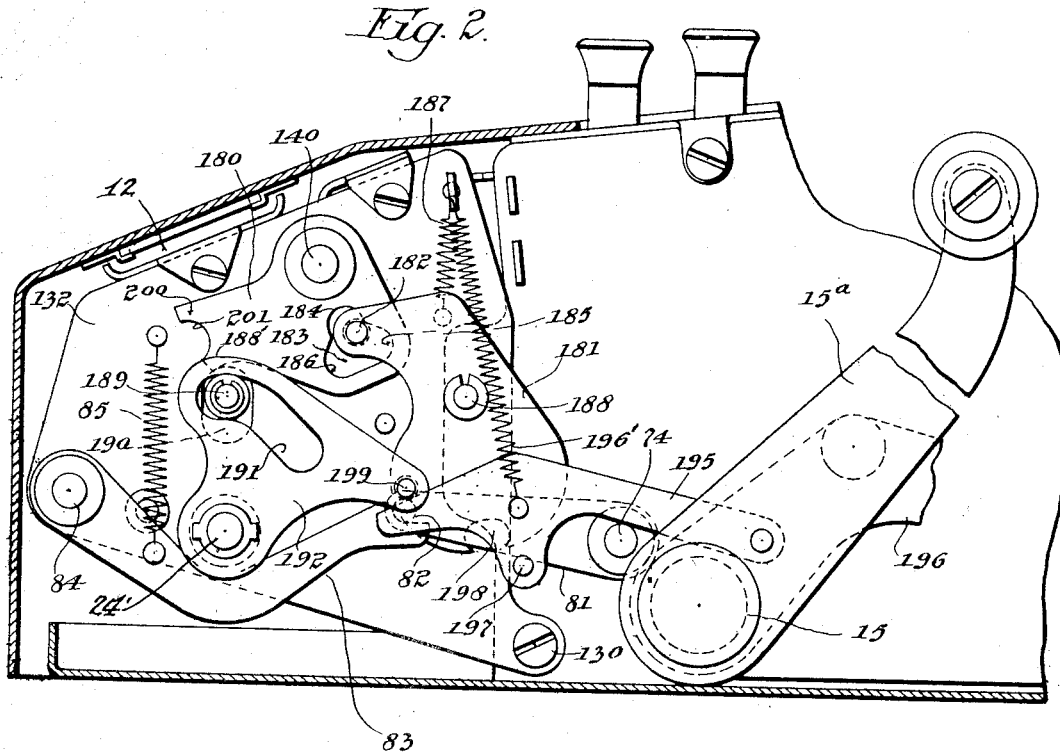
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1,810,213

CALCULATING MACHINE

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4 Sheets-Sheet 2



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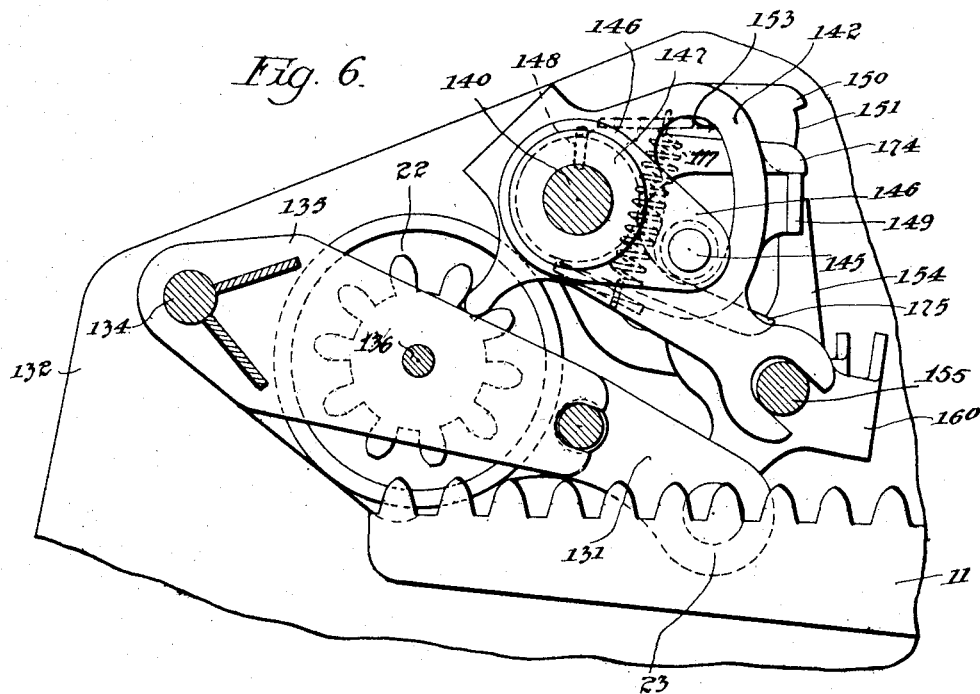
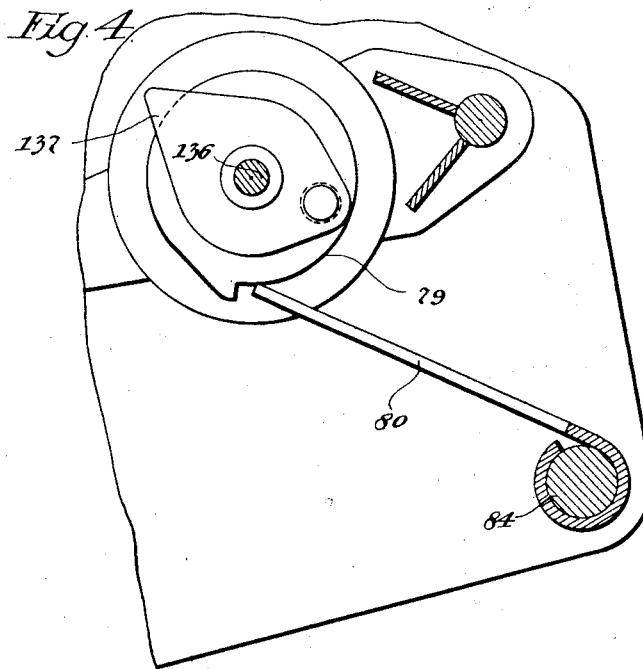
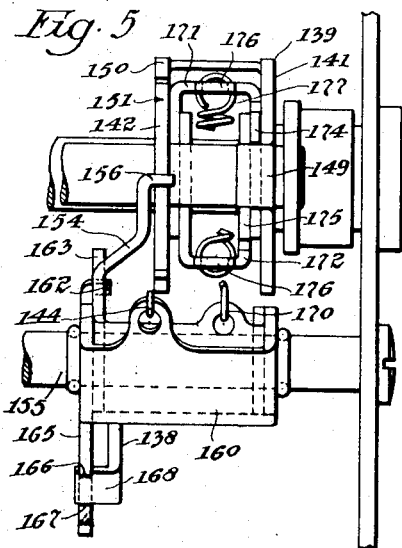
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CALCULATING MACHINE

Filed July 5, 1927

4 Sheets-Sheet 3



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1,810,213

CALCULATING MACHINE

Filed July 5, 1927

4 Sheets-Sheet 4

Fig. 7.

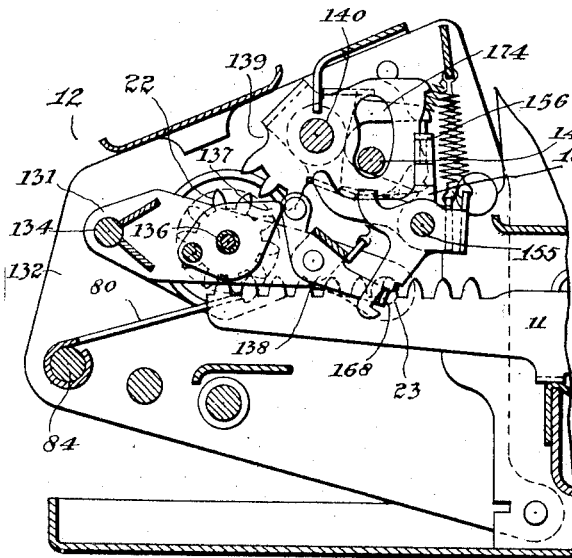


Fig. 8.

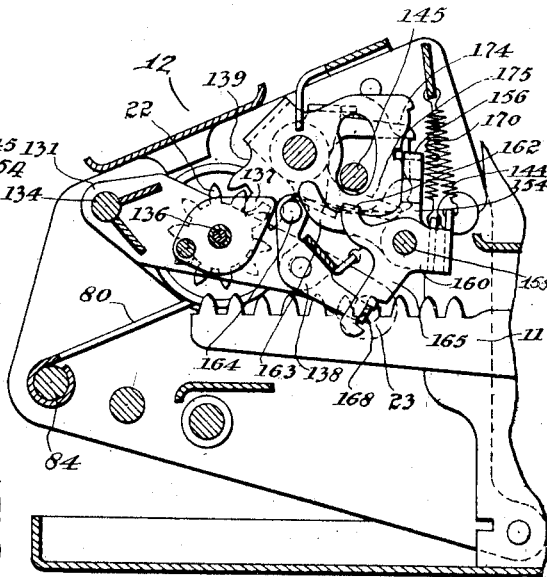


Fig. 9.

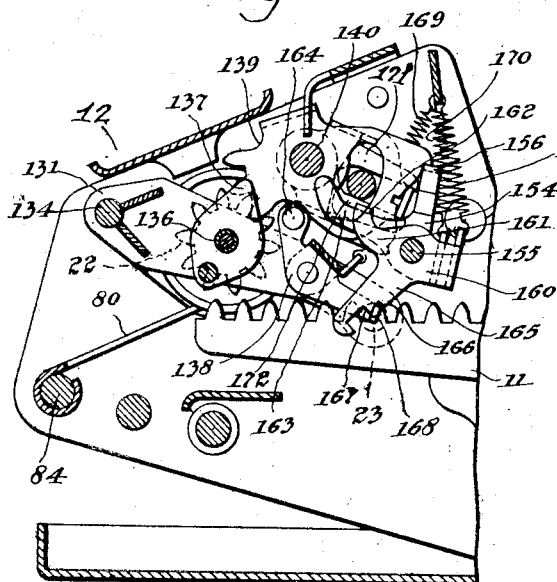
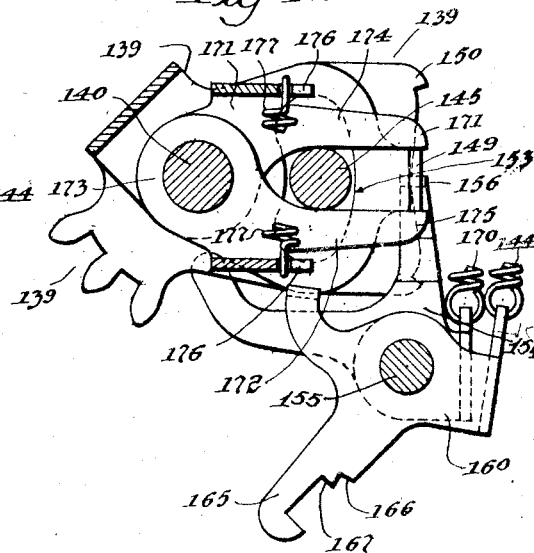


Fig. 10.



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UNITED STATES PATENT OFFICE

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CALCULATING MACHINE

Application filed July 5, 1927. Serial No. 203,464.

My invention relates to calculating machines.

One of the objects of my invention is to provide an improved subtraction mechanism.

A further object of my invention is to provide an improved adding and subtracting machine in which an accumulator wheel is driven for addition in one direction of the movement of the rack and for subtraction in the opposite direction of the movement of the rack.

A further object of my invention is to provide an improvement in the signal type bar.

Further objects of the invention will appear from the description and claims.

In the drawings in which an embodiment of my invention is shown;

Figure 1 is an elevation of the left side of the machine with parts of the casing removed;

Fig. 2 is an elevation of the front right hand part of the machine, parts being broken away;

Fig. 3 is a vertical fore and aft section through the accumulator and associated parts;

Fig. 4 is an enlarged view showing the total stop and associated parts;

Fig. 5 is an enlarged detail showing the carry construction;

Figs. 6, 7, 8 and 9 are vertical sectional views showing various positions which the parts of the accumulator mechanism assume;

Fig. 10 is an enlarged view of the carry mechanism;

Fig. 11 is a perspective view of one of the carry dogs; and

Figs. 12 and 13 are similar views of the co-operating spring controlled detents of the accumulator mechanism.

The construction by which addition, subtracting and totaling is performed is somewhat similar to that shown in my prior Patent No. 1,336,840, dated August 13, 1920, and in my copending application, Serial No. 9327, filed February 14, 1925, and comprises a series of horizontally reciprocable racks 11, one for each order, an accumulator 12 controlled by these racks, rack controlling or number keys 13, a universal rack-controlling and returning

bar 14, accumulator control mechanism and printing mechanism.

I will first describe the parts which are similar to the construction shown in my patent referred to. The rack-controlling keys 13 are depressed to limit the movement of the respective racks 11 which they control. The main shaft 15 is oscillated after the desired keys are depressed by forward and return movement of a suitable handle 15a on this shaft and this oscillation causes the oscillation of the rock arms 16 which, in turn, engage the rock arms 17 mounted on the rock studs 18. These latter rock arms 17 control the movement of the universal rack-controlling and returning bar 14 which slides in slots 19 in the sides of the frame.

The oscillation of the main rock shaft also causes the oscillation of the rock shaft 20 on which the control disk 21 is mounted which controls the operation of the accumulator mechanism 12.

This accumulator mechanism is entirely different from the accumulator mechanism shown in my patent referred to but it carries pinions 22 which can be moved into and out of mesh with the respective racks 11, the accumulator frame being pivotally mounted at 23 and movable about this pivot to bring the pinions into and out of mesh. When the frame is raised the pinions are out of mesh and when it is lowered they are in mesh.

The up and down movement of this accumulator frame is effected by means of a mesh-controlling rock lever 24 having a cam slot 25 therein in which the follower pin 26 in the accumulator frame works. When the upper end of the rock lever 24 is in its rearward position the accumulator pinions 22 are out of mesh with their racks and when the upper end is in the forward position the pinions are in mesh.

The movement of this mesh-controlling rock lever is controlled selectively from the accumulator-controlling disk 21 previously referred to.

Accumulator controlling mechanism

In general, the control disk may exercise any one of five different controls on the mesh-

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controlling rock lever. These five controls are (1) the usual adding operation in which none of the four control keys are depressed; (2) the non-add operation in which the non-add key 27 is depressed; (3) the subtotal operation in which the subtotal key 28 is depressed; (4) the totaling operation in which the total key 29 is depressed; and (5) the subtraction operation in which the subtraction key 30 is depressed.

The first four operations are similar to those disclosed in my patent referred to. Referring first to the usual adding operation, in this the accumulator is out of mesh on the forward movement of the racks and is brought into mesh at the end of the forward stroke and remains in mesh until the end of the return stroke. In the non-add operation the accumulator is out of mesh throughout both the forward stroke and the return stroke. In the subtotal operation the accumulator is brought into mesh at the beginning of the outward or forward stroke and remains in mesh throughout both the forward stroke and the return stroke. In the totaling operation the accumulator meshes at the beginning of the forward stroke and is moved out of mesh at the end of the forward stroke and before the beginning of the return stroke. In subtraction the operation is just the reverse to that of addition; that is, the accumulator is moved into mesh before the beginning of the forward stroke and is moved out of mesh at the end of the forward stroke and remains out of mesh throughout the return stroke. Furthermore, in the subtraction operation, the total stop bar is moved out of the way so as not to interfere with the subtracting movement of the accumulator.

The five different operations referred to are controlled from the control disk through a selective transmission from the control disk to the mesh-controlling lever. This selective transmission comprises a link 31 engageable selectively with one of the two pins 32 and 33 on the mesh-controlling lever 24, a reciprocable bar 34 to which this link 31 is pivoted at 35 and a plurality of dogs or swinging links pivoted to this reciprocable bar 34 and controlled by the various control keys for non-add, total and sub-total and subtraction referred to. The rear end of this reciprocable bar is guided by a pin 36 lying in a slot 37 in the reciprocable bar 34 and the forward end of the bar is guided by a rocker 38, pivotally mounted at 39, to which the reciprocable bar is pivoted at 40.

The dog 41 controlled by the subtotal key is pivoted at 42 on the reciprocable bar 34 and is lowered into position to be engaged by the pin 43 on the control disk 21 when the subtotal key is depressed. The engagement of this pin 43 with the projection 44 (shown broken away) on the pivoted dog 41 causes the mesh-controlling lever 24 to bring the

accumulator pinions into mesh with their respective racks before the beginning of the forward movement of the racks. The depression of this sub-total key also operates the number-key and rack release bar 45 when depressed so that the depressed number keys are returned and the selected racks are allowed to move out when the rack-controlling bar moves forward as disclosed in my patent referred to. The depression of this key also causes the link 46 which controls the movement of the signal type bar (not shown) to be lowered so that when the rock lever 17 is oscillated the pin 48 on this rock lever will engage an intermediate notch 49 in the link.

At the end of the return movement the pin 43 on the control disk engages the dog 50 exerting a pull on the reciprocating bar 34 and throwing the accumulator out of mesh.

When the non-add key is depressed the pivoted dog 51 is depressed so that it will not be engaged by the pin 43 on the control disk at the beginning of its return movement and this will prevent the accumulator gears from being brought into mesh with the racks.

The depression of this non-add key also lowers the link 46 which controls the signal type bar to a position in which the pin 48 on the rock lever will engage an intermediate notch 52. The distance to which the signal type bar is lifted depends on which one of the three notches (52, 49 or 53) is engaged by the pin 48.

When the total key 29 is depressed the totalizer is brought into mesh at the beginning of the forward stroke by the engagement of the pin 43 on the control disk with a projection 54 on the dog 55 which is pivoted at 42 to the bar 34. At the beginning of the return movement the accumulator is moved out of mesh by the engagement of the pin 56 with the hook 57 on the end of the pivoted dog 55. The total key 29, when depressed, also depresses the non-add key 27 so that the pivoted dog 51, controlled by the non-add key, is moved out of the path of the pin 43 on the control disk, thus preventing the accumulator from being moved into mesh at the beginning of the return stroke. The depression of the total key also operates the rock member 45 which permits the return of the depressed number keys and releases the rack bars. The depression of the total key also depresses the link 46 which controls the signal type bar so that the pin 48 on the rock arm engages the upper notch 53 in the link.

All three of the keys, the sub-total, total and non-add, are provided with laterally extending portions 58 which cooperate with flange portions 59 on the control disk so that these keys cannot be moved after the movement of the control disk has started. Thus, if the sub-total key is depressed its lateral projections 58 will be held inside the flange of the disk as soon as the disk starts to move

and cannot be released until the disk has returned to bring the notch or opening 60 in the flange opposite the projection on the key to release this key. Similarly, if the non-add key or total key is depressed, it will bring the lateral projections 58 on these keys outside of the flange on the control disk, thus holding these keys depressed until the control disk has returned to bring the opening 61 in the flange opposite the lateral projections on the keys. This key-retaining flange is similar to that described in my prior patent.

The keys 28, 29 and 27 control the link 46 by means of lugs 62, 63, and 64, respectively, movable with the keys and engaging the upper edge of the link 46. The key 28 controls the dog 41 by means of a lug 65 movable with the key and engaging the under-side of the dog 41. The key 29 controls the dog 55 by means of a lug 66 movable with the key and engaging the under-side of the dog. The key 27 controls the dog 51 by means of the pin 67 movable with the key and engaging the upper side of the dog 51. A spring 68 is provided connecting the dogs 41 and 51. This spring 68 acts to return the dog 51 when permitted by the pin 67 and acts to pull the dog 41 down when permitted by the lug 65. A spring 69 is provided and connected with the dog 55 to pull it down when permitted by the lug 66.

Coming now to the subtraction key 30, this has a downwardly extending projection 71 which is pivoted at 72 to the rock arm 73 which is mounted on a rock shaft 74. This rock arm 73 which moves up and down with the subtraction key is provided with a pin 75 which lies in a slot 76 in the link 31 which acts directly on the mesh-controlling lever 24.

When the subtraction key is not depressed the notch 77 in the upper side of the link 31 engages and receives the upper pin 32 on the mesh-controlling rock lever, and the effect is as though the link were directly pivoted to the lever by this upper pin 32. When the subtraction key is depressed the notch 78 in the lower side of the link 31 engages and receives the lower pin on the mesh-controlling lever and the effect then is as though the link were directly pivoted to this mesh-controlling lever by the lower pin 33. With this construction and with the subtraction key depressed it will be seen that the operation will be just the reverse of that in addition, that is, the accumulator pinions will be in mesh at the beginning of the forward stroke as shown in Fig. 7 and will be moved out of mesh at the beginning of the return stroke by the engagement of the pin 43 on the control disk with the end of the pivoted dog 51 which will shift the reciprocable bar 34 forward and with it the pivoted link 31 thereby shifting the mesh-controlling lever to raise the accumulator out of mesh.

As shown in Figs. 3 and 4, each accumulator pinion 22 is provided with a total stop ratchet disk 79, with which cooperates a universal pivoted total stop pawl member 80, which permits the additive movement of the accumulator, but which does not permit the subtractive movement of the accumulator. It is, therefore, necessary to move this total stop pawl 80 out of the way in subtraction and for this purpose a rock arm 81 (Fig. 2) is secured on the rock shaft 74 and carries a pin 82 which engages an arm 83, secured to the rock shaft 84 to which also is secured the pawl member 80. When the subtraction key is depressed, the rock arm 73 is also depressed and this swings the rock arm 81 causing the pin 82 to move the pawl 80 out of operative relation with respect to the ratchet total stop disk 79. A spring 85 is provided to hold the pawl normally in engagement with the ratchet disk 79. The expression "total stop" is used because the mechanism thus referred to is associated with the taking of "totals." In taking a total, the accumulator wheels are all held in zero position by this total stop when the total is being printed.

In order to hold the subtraction key depressed after the control disk 21 has started its movement, an arcuate retainer 111 is mounted on the control disk to turn therewith and a rock lever 112 is provided which is actuated by the subtraction key 30, and which has an inwardly extending projection 113 for cooperation with the retaining member 111. This rock lever 112 is pivotally mounted on a stud 114 and has a forked end 115 which straddles the pin 75 on the rock arm 73 so that when the subtraction key 30 is depressed the forked end 115 of the rock lever 112 is depressed, and the end provided with the projection 113 is raised so that when the retainer 111 is oscillated its inner arcuate edge 116 will block downward movement of the projection 113 and thus hold the subtraction key depressed.

A dash-pot mechanism 117 is provided for controlling the speed of the return movement. This dash-pot mechanism may comprise a piston rod pivotally connected at 118 to a bracket 119, and a movable cylinder 120 for the piston, the lower end of this cylinder being pivotally secured at 121 to a bell crank member 122. This bell crank member 122 is pivotally mounted at 123 and has an arm pivotally secured at 124 to a link 125 which is pivoted at 126 to the control disk 21.

When the handle 15a is released to permit the return movement the dash-pot 117 cushions and retards this return movement by resisting the rotation of the control disk 21 through the connecting transmission including the bell crank member 122 and link 125.

Adding and subtracting accumulator

This accumulator 12 consists of a series of

toothed wheels or pinions 22, as shown in the drawings, being preferably assembled as a unit, which may be attached to the machine by screws 130, or other suitable means. Each accumulator unit is provided with substantially the same control, and consequently, a description of one only will be given.

The accumulator mechanism includes a swinging frame consisting of two side members 131 pivoted at 23 to side plates 132 attached to the machine at 130. The wheels 22 are carried by this swinging frame and are thrown into and out of mesh with the racks 11 by the control mechanism previously described. The frame may be constructed to swing as a unit with the wheels 22 mounted thereon, by a rod 134 at the forward end tying the side members 131 together, with intermediate spacing plates 135 (Fig. 6) between and separating the wheels 22 and their respective control elements. The wheels 22 are rotatably carried on a shaft 136 secured in side member 131. Mounted to rotate with wheels 22 are lock controlling cam members 137 on shaft 136, which members are adapted to engage and trip a plurality of carry lock release members 138 also pivotally mounted on the accumulator frame, but so located thereon as to be engaged by lock controlling cam members 137 when the latter are rotated by the wheels.

The swinging accumulator frame is provided with movement sufficient to bring the pinions or toothed wheels 22 into mesh with a plurality of toothed carry dogs 139 having a fixed axis on a transverse rock shaft 140 journaled in the side frame members 132. By referring more particularly to Fig. 11, it will be observed that each carry dog is furnished with spaced extensions 141 and 142 having openings 143, for the reception of rock shaft 140. Spaced from and formed about the centers of openings 143 in each carry dog, are the arcuate openings 153, in which rides a transversely disposed restoring and setting rod 145. Rod 145 is secured to and oscillated back and forth, through the arcuate openings 153, by arms 146 (Fig. 6), which are an integral part of hubs 147 fastened to rock shaft 140, by pins 148, at points adjacent to the inside of the side frame members 132. The extensions 141 and 142 are formed slightly different, the extension 141 having a right angular lug 149 formed thereon, while the extension 142 is formed with stops 150 and 150' at the top and bottom of its rear edge 151. A slot 152 is cut in edge 151 at a predetermined point so as to permit the engagement of a carry dog lock 154, whereby to hold the toothed carry dogs 139 locked against a carrying movement.

The carry dog locks 154 are loosely mounted on a transverse shaft 155 secured in the side frame members 132. Each carry dog lock member is furnished with a transversely

bent lug 156 (see Fig. 5) which is adapted to ride against edge 151 of the extension 142 on the carry dogs. When the accumulator is restored, the lug 156 falls into slot 152 to lock the carry dog against movement, and when a "carry" is to be effected, the lug is withdrawn, thereafter serving as means to limit the carrying movement of the carry dog by lying in the path of its stops 150 and 150'.

A plurality of carry dog detents 160 loosely mounted on fixed shaft 155 control the carry dog locks 154. Each detent 160 is formed with an upstanding forward arm 161 having a transverse lug 162 overlying a cooperating arm 163 formed on the carry dog locks 154. The forward end of arm 163 is slightly upturned and is adapted to be engaged by a stud 164 on the carry lock release 138 when a carry is to be effected. A downwardly extended arm 165 on the carry dog detent 160 is furnished with two recessed faces 166 and 167 for engagement by a transverse lug 168 on each carry lock release 138. A spring 169 acts against the carry lock release 138 to hold its lug 168 against either of the faces 166 or 167 of the carry lock detent 160. A second spring 170 functions to hold the carry dog lock 154 forwardly so that its lug 156 will act against the carry dog and its arm 163 will tend to move forwardly toward carry lock release 138. A third spring 144 functions to tilt carry lock detent 160 forwardly so as to cooperate with carry dog lock 154 and carry lock release 138.

Each accumulator wheel includes control mechanism for effecting a "carry" by the carry dog 139. Such mechanism includes a pair of spring controlled detents 171 and 172 loosely mounted upon rock shaft 140 between extensions 141 and 142 of each carry dog. These detents 171 and 172 are illustrated in detail in Figs. 12 and 13. They are each provided with integral spaced apertured bearing arms 173 and are positioned in opposed relation on rock shaft 140, so that finger 174 on detent 171 is oppositely spaced from finger 175 on detent 172. This arrangement permits lug 149 of carry dog 139 to lie between the fingers 174 and 175 at their tips, in the same fashion as the restoring and setting rod 145, which is adapted to oscillate in arcuate openings 153 in the carry dog. As shown in Figs. 3, 10, 12 and 13, each detent is formed with an aperture lug 176 adapted to receive the ends of a spring 177, acting normally to press the detents against rod 145 and carry dog lug 149.

It is now obvious that detents 171 and 172 serve to swing the carry dog 139 in either direction to produce addition or subtraction, as desired, this being accomplished by the spring 177 acting on either detent to press it against the rod 145, so that this detent may move with the rod and swing the carry dog by engaging and moving its lugs 149.

When either subtraction or addition is to be performed, as the case may be, the setting and restoring rod 145 sets the carry dogs to carry, by pressing against one of the detents 171 and 172 to separate the same against the action of spring 177, one of the detents being held upwardly or downwardly by the rod 145, and the other detent being held in the opposite direction by the carry dog lug 149, so that as soon as the lug 156 on the carry dog lock flips out of engagement with slot 152, the latter detent acting against lug 149 throws the carry dog so as to rotate the wheel forwardly or backwardly—to add or to subtract. In other words, lug 149 on the carry dog will always hold one of the detents against the action of spring 177, while the other detent is moved in the opposite direction by the rod. This causes the detent thus held to exert a force against lug 149, so that when the carry dog is released by the carry dog lock, the carry dog will swing about its axis and thereby effect a carry of the register wheel.

During the carrying movement, it will be observed that carry lock release member 138 will be released and its lug 168 permitted to drop into recess 166, so as to be set for the next carry operation, when cam 137 will again engage roller 164. By referring to Fig. 11, it will be noted that edge 151 of each carry dog 139 is provided with upper and lower cams 130 directly in front of stops 150 and 150'. As lug 156 is tripped out of slot 152 to allow the carry dog to carry, it will ride over one of these cams 130, thereby tilting its forward arm 163 upwardly slightly to engage lug 162 and tilt the carry lock detent 165. Such tilting of the carry lock detent allows lug 168 to enter recess 166 from recess 167. Such action occurs whether the carry dog has carried in either direction for subtraction or addition inasmuch as one of these cams 130 will ride against the carry lock lug 156 each time.

The mechanism for operating the setting and restoring rod 145 will now be described. This mechanism may vary in construction, but I prefer, for the purpose of illustration, to use a restoring and setting cam plate 180 fixed to transverse rock shaft 140 on the outside of end plate 132, (see Fig. 2). The purpose of cam plate 180 is to control the position of restoring and setting rod 145 so as to determine not only whether the function of addition or subtraction will be performed, but also to restore the carry dogs 139 after a carry, in order to be in a position for a carry on a subsequent operation. An operating lever 181, pivotally mounted at 188 on the side plate 132 in close proximity to cam plate 180, is provided with a transverse pin 182 co-operatively associated with the cam plate 180 by engaging in an opening 183 furnished therein, which opening may have a plurality of reentrant portions 184, 185 and 186, in

which the pin 182 is adapted to ride. A centering spring 187 normally acts to center operating lever 181. The action of spring 187 to center lever 181 also acts to center cam plate 180, which assists in restoring the carry dogs, but actual restoring of the carry dogs is accomplished by spring 177 of the first unit, shown in Fig. 6. Being fixed to rock shaft 140, the cam plate (when centered) tends to rock the restoring and setting rod 145 upwardly to restore any of the carry dogs 139, which may have carried on the previous operation, this being accomplished by the carrying detent 171 being raised from its position as shown in Fig. 9 to a horizontal or reset position as shown in Fig. 10, at which time lug 156 on the carry dog lock 154 will flip into slot 152 and hold the carry dog reset. For addition, restoring the carry dogs 139 occurs at the beginning of the return stroke of handle 15a when the register wheels 22 drop into mesh with racks 11. The first unit as shown in Fig. 6 is not required to carry, and consequently, its spring 177 is placed under tension whenever rod 145 is moved upwardly or downwardly to effect a carry either on subtraction or addition. The tension of spring 177 will, therefore, always be available to complete the restoring movement, which cam plate 180 tends to assist when it is centered by spring 187.

As illustrated in Fig. 2, during addition when the register wheels remain out of mesh with racks 11, the cam plate 180 is held against the centering action of spring 187, by a shoulder 188' on cam plate 180 engaging a stud 189 carried on the swinging frame of the accumulator. Stud 189 projects forwardly in an opening 190 in side frame to extend beyond shoulder 188' whereby to ride in an arcuate slot 191 in a plate 192 to be controlled by the movement of this plate 192 and of the mesh-controlling rock lever 24 on the opposite side of the accumulator; both of which are fixed on shaft 24'.

A control arm 195 is pivoted to a bar 196, which is movable with operating handle 15a. A spring 196' tends to urge control arm 195 upwardly, so that on the forward and return movements of the handle a transverse pin 197 will tend to engage in a slot 198 in the lower edge of operating lever 181, such engagement serving to rock the latter against the action of spring 187. A pin 199 is carried, however, on plate 192 to hold control arm 195 downwardly against the action of its spring 196' whereby to prevent pin 197 from engaging in slot 198 during the time the register wheels 22 remain out of mesh with racks 11, that is, on addition, during the forward stroke, and on subtraction, during the return stroke. The engagement of pin 197 in slot 198 determines whether the carrying shall add or subtract, by setting the carrying detents 171 and 172 just before completion of

the return stroke on addition, and at end of the forward stroke on subtraction.

Assuming now that the operation of addition is to be performed, the desired keys 13 are depressed and the handle 15a is moved forwardly. The racks 11 are then moved forwardly, and on the return stroke the mesh controlling rock lever 24 and plate 192 are moved forwardly by the action of link 31 on pin 32 carried on this mesh-controlling rock lever 24. Such movement of mesh-controlling lever 24 and plate 192 (being secured on the same shaft 24') lowers the register wheels into mesh with the racks 11. The wheels are accordingly rotated and should such rotation cause the lock controlling cam member 137 to engage the pin 164 on the carry lock release member 138, as shown in Fig. 7, the transverse lug 168 on the latter drops from recess 166 into recess 167. It will be here noted that the lock controlling cam members are carried on the swinging accumulator frame, and consequently, move therewith. The engagement of carry lock release member 138 by the lock controlling cam member 137 tilts the former rearwardly slightly, to be held in such position by its lug 168 dropping from recess 166 into recess 167. Consequently, when the accumulator frame returns to withdraw the register wheels out of mesh with racks 11, the carry lock release member 138 engages arm 163 of the carry dog lock 154 whereby to release it from the carry dog 139 to cause the same to carry. The position of the parts at the time the carry dog lock 154 releases the carry dog 139 is illustrated in Fig. 8, which shows the lug 156 moving out of engagement with slot 152 and the carry dog in mesh with the register wheel.

As hereinbefore mentioned, the position of the restoring and resetting rod 145 relative to the spring controlled detents 171 and 172 determines whether addition or subtraction is to be performed, these spring controlled detents operating to swing the carry dog 139 in either direction according to which detent is acting against carry dog lug 149. As shown in Figs. 7, 8 and 9, the rod 145 is holding the lower detent 172 downwardly, which by the action of spring 177 causes the upper detent 171 to press against carry dog lug 149. With the carry dog lock lug 156 tripped out of slot 152, the upper detent 171 functions to swing the carry dog 139, clockwise, to effect a carry for addition. The position of the parts after this step in the operation is accomplished is shown in Fig. 9. To restore the carry dog 139, the restoring and resetting rod 145 moves upwardly at the beginning of the return stroke of a subsequent operation, whereby the upper and lower detents 171 and 172, respectively, move upwardly until by action of its spring 170 the carry dog lock 154 engages its lug 156 in slot

152 to hold the carry dog 139 reset, this being accomplished before the register wheels move upwardly out of mesh with the racks near the completion of the return stroke. In other words, on addition, restoring is effected at the beginning of the return stroke, resetting is effected during the middle portion of the return stroke, and carrying is effected at the end of the return stroke.

The operation of subtraction is accomplished by the restoring and resetting rod 145 moving upwardly at the end of the forward stroke to raise the upper detent 171 whereby to place the spring tension on the lower detent 172 which then presses against the carry dog lug 149, thereby swinging the carry dog 139 counterclockwise, when the carry dog lock lug 156 is released from slot 152, to effect a carry for this subtracting operation. The action of the carry lock release member 138, the carry dog lock 154 and the carry lock detent 160 is substantially the same for subtraction. It will be understood, of course, that depression of subtraction key 30 places the register wheels in mesh with the racks on the outward or forward stroke, so that subtraction is performed on the forward stroke instead of the return stroke, as in addition. Consequently, the register wheels move upwardly out of mesh with the racks 11 at the beginning of the return stroke, so that any carrying of the wheels will be effected at this time. Restoring of the carry dogs will then take place at the end of the return stroke when the rod 145 will move to an intermediate position of its stroke, as shown in Fig. 10.

Referring again to Fig. 2, the operation of the mechanism for rocking shaft 140 to determine the position of restoring and resetting rod 145 to effect addition or subtraction, is controlled by the movement of the operating handle 15a and by plate 192. Normally, the cam plate 180 is held against the centering action of spring 187 by engagement of shoulder 188' against stud 189 of the swinging accumulator frame. The release of cam plate 180 allows the plate to center, which causes rod 145 to move to its intermediate position to restore any of the carry dogs 139, which may have carried on the previous operation. On addition, this release occurs at the beginning of the return stroke of handle 15a, when the register wheels move downwardly into mesh with racks 11. During the forward movement, stud 199 bears against the upper edge of control arm 195 to keep it depressed, so as to hold its pin 197 out of contact with the lower edge of operating lever 181. On the return stroke, however, swinging of plate 192 and lever 24 forwardly moves stud 189 in slot 191, thereby lifting this plate out of contact with control arm 195, whereupon spring 196' raises the control arm to bring its pin 197 into engagement with slot

198. Return movement of control arm thereupon causes off-centering of operating lever 181 about its pivot 188. This action rocks cam plate 180 clockwise, by pin 182 acting in reentrant portions 184 and 186 of slot 183, bringing the rod 145 to its lower position to reset the carry dogs for a carrying operation at the end of the return stroke. In this position, shoulder 188' of cam plate 180 is directly above stud 189, so that as the pin 197 of control arm 195 drops out of engagement with slot 198 by cam plate 192 bearing downwardly thereagainst, upon completion of the return stroke, the register wheels are moved upwardly out of mesh with racks 11.

On subtraction, depression of subtraction key 30 moves stud 189 downwardly in slot 190, thereby releasing the cam plate 180 to allow it to center and move plate 192 forwardly to release control arm 195. Therefore, upon depression of subtraction key 30, cam plate 192 is moved to release plate 180 to center position to permit restoring and resetting rod 145 to move to its intermediate position to restore any of the carry dogs 139 that may have carried on the previous operation. Forward movement of handle 15a causes control arm 195 to bring its pin 197 into engagement with slot 198 to cause operating lever 181 to effect the counterclockwise rotation of cam plate 180 by its pin 182 riding in reentrant slot 185, so as to raise the restoring and resetting rod 145 to its upper position, thus bearing against the upper detent 171. This places the tension of spring 177 against the lower detent 172 to cause the latter to press against the carry dog lug 149. If any of the carry dog locks 154 are released during the operation, these carry dogs 139 are thereupon swung counterclockwise to effect a carry, this occurring, however, at the beginning of the return stroke and after the register wheels are returned from meshing engagement with racks 11 to meshing engagement with carry dogs 139, such movement being controlled by the mesh controlling rock lever 24 and cam plate 192.

During the return stroke, pin 199 on plate 192 will bear upon control arm 195 to keep its pin 197 out of engagement with the operating lever slot 198. Rod 145 will be returned to its intermediate position, as shown in Fig. 10, only after the carry dogs, which are released, have carried and the register wheels are again lowered out of engagement with the carry dogs, so that the latter may be restored before the completion of the return stroke. Pin 182 will ride out of the reentrant portion 185 and cam plate 180 will be temporarily held until the register wheels lower and allow shoulder 200 to pass the stud 189. The wheels are again raised and the stud 189 may engage the notch 201 at the end of cam plate 180.

It will be remembered that in so far as the present disclosure is concerned, the register

wheels move into and out of engagement with the carry dogs 139 twice during each subtraction operation to permit carrying and restoring of the carry dogs during the return stroke, the carrying being effected at the beginning of this stroke, and the restoring near the end. I do not desire to be limited to the particular structure shown for accomplishing this movement, as it is possible to use other arrangements.

Obviously, the arrangement is simple. The mechanism of the accumulator, permitting the conversion of the function of addition to that of subtraction, consists of a minimum number of parts, which are easily formed and assembled. Their simple arrangement assures positive and accurate operation. The restoring and resetting rod 145 constitutes an exceedingly simple means for placing the spring tension on either of the spring controlled detents 171 and 172 whereby to swing the carrier 139 in either direction so as to produce addition or subtraction. When in its middle position, the rod acts to restore the carriers either for addition or for subtraction. When in lower position, the rod 145 acts to place the tension of spring 177 on the detents to effect a carry for addition. When in its upper position, the rod acts to place this tension on the detents to effect a carry for subtraction. The position of the register wheels at the beginning of the forward stroke determines whether addition or subtraction is to be performed. If these register wheels are placed in mesh with the racks 11, at the outset, by depressing the subtraction key 30, subtraction will be produced, because by so positioning the register wheels, the cam plate 180 will raise the rod 145 to its upper position (instead of to its lower position as on addition) to effect a carry of the carriers in a counterclockwise direction. Otherwise, on mere addition of the machine, the register wheels mesh with the racks at the beginning of the return stroke.

On addition, restoring occurs at the beginning of the return stroke, and carrying occurs at the end of the return stroke.

On subtraction, carrying occurs at the beginning of the return stroke, and restoring occurs at the end of the return stroke.

Without further elaboration, the foregoing will so fully explain the gist of my invention, that others may, by applying current knowledge, readily adopt the same for use under varying conditions of service, without eliminating certain features, which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:

1. In a calculating machine, the combination of an accumulator wheel, a carrier for said wheel, a pair of spring controlled de-

tents, and means for placing the spring tension on either detent to swing said carrier in either direction to produce addition or subtraction, as desired.

5 2. In an adding and subtracting mechanism, the combination with accumulator wheels, of a reciprocatory carrier adapted to move forward and backward to effect carrying from a wheel of lower order to a wheel
10 of higher order either for addition or for subtraction according to the direction of movement of said carrier, spring controlled detents acting against said carrier to move it forward or backward, and means for setting
15 said detents to determine the direction in which said carrier may move.

3. In an adding and subtracting mechanism, the combination with accumulator wheels, of a reciprocatory carrier adapted to
20 move forward and backward to effect carrying from a wheel of lower order to a wheel of higher order either for addition or for subtraction according to the direction of movement of said carrier, spring controlled
25 detents acting against said carrier, one for moving it forward and the other for moving it backward, and means having three positions, one position for setting one of said detents whereby to move the carrier in one direction, a second position for setting the other
30 detent whereby to move the carrier in the opposite direction, and a third position for restoring said carrier after moved by either of the detents.

35 4. In an adding and subtracting mechanism, the combination with accumulator wheels, of a reciprocatory carrier adapted to move forward and backward according to whether addition or subtraction is to be performed, a lock for holding said carrier
40 against movement, and a pair of detents for acting upon said carrier to move it when said lock is released, one of said detents moving said carrier forward and the other detent
45 moving said carrier backward.

5. In an adding and subtracting mechanism, the combination with accumulator wheels, of a reciprocatory carrier adapted to move forward or backward according to
50 whether addition or subtraction is to be performed, a lock for holding the carrier against movement, spring controlled detents arranged to act upon said carrier to move it in either direction, and means for selectively
55 moving one of said detents to place the spring tension on the other detent whereby the latter will move said carrier when said lock is released.

6. In an adding and subtracting mechanism, the combination with accumulator wheels, of a reciprocatory carrier adapted to move in either direction to produce addition or subtraction, a lock for normally holding
60 said carrier against movement, a pair of oppositely spaced detents having said carrier

projecting therebetween, a spring for urging said detents against said carrier, and means for swinging one of said detents against the action of said spring whereby to permit the other detent to move said carrier
70 when released by said lock.

7. In a calculating machine, in combination with an accumulator wheel and a carrier adapted to swing said wheel in either direction to produce addition or subtraction, of
75 two detents for moving said carrier in either direction, and actuating mechanism including a restoring and setting device for said detents, whereby, on addition, said carrier is first restored from a previous operation and
80 thereafter set to carry, and on subtraction, said carrier is first set to carry and thereafter restored.

8. In a calculating machine, in combination with an accumulator wheel and a carrier adapted to swing said wheel in either direction to produce addition or subtraction, of a pair of spring controlled detents for moving
85 said carrier in either direction, and actuating mechanism including a restoring and setting device spaced and operating between said detents to move the same apart for placing the spring tension on either detent whereby to
90 move said carrier.

9. In a calculating machine, in combination with an accumulator wheel and a carrier adapted to swing said wheel in either direction to produce addition or subtraction, of a plurality of detents for moving said carrier in either direction, and actuating mechanism
95 including a restoring and resetting device for positioning said detents either to effect carrying or restoring of said carrier and an oscillatable cam plate having a tendency to produce a restoring position for said detents and
100 oscillating in opposite directions to produce carrying positions for said detents.

10. In a calculating machine, in combination with an accumulator wheel having movement into and out of mesh with an actuator and a carrier adapted to swing said wheel in
110 either direction to produce addition or subtraction, of a plurality of detents for moving said carrier in either direction, and actuating mechanism including a detent operating device, and an oscillatable cam plate for swinging
115 said device, said plate being controlled by the position of said wheel with respect to said actuator and said carrier.

11. In a calculating machine, in combination with an accumulator wheel having movement into and out of mesh with an actuator and a carrier adapted to swing said wheel in
120 either direction to produce addition or subtraction, of detents for moving said carrier in either direction, and mechanism including a device for setting and restoring said detents, and an oscillatable member connected to said device and associated with said accumulator
125 wheel whereby said member may be oscillated
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lated in opposite directions while said accumulator wheel is in mesh with said actuator.

12. In a calculating machine, in combination with an accumulator wheel having movement into and out of mesh with an actuator and a carrier adapted to swing said wheel in either direction to produce addition or subtraction, of a pair of oppositely acting detents for engaging said carrier and to move it in opposite directions, and a spring between said detents acting to urge one of said detents to move said carrier.

13. In a calculating machine, the combination of an accumulator wheel, a carrier for said wheel, locking means for holding said carrier in a position to carry, means for tripping said locking means, and a pair of detents operable to swing said carrier in either direction to produce addition or subtraction when said tripping means releases said locking means.

14. In a calculating machine, the combination of an accumulator wheel, a carrier for said wheel, locking means for holding said carrier against carrying, tripping means for said locking means, and a pair of spring actuated detents operable, when said tripping means is released, to swing said carrier in opposite directions to produce either addition or subtraction.

15. In a calculating machine, in combination with an accumulator wheel and a carrier adapted to swing said wheel in either direction to produce addition or subtraction, of a pair of spring controlled detents for moving said carrier in either direction, and a single locking element for holding said carrier against carrying.

16. Carrying mechanism for an accumulator comprising a loosely mounted carrier, concentrically mounted oppositely acting detents, spring means between said detents, a member on said carrier separating said detents, and a transversely arranged restoring and setting rod extending between said detents.

17. Carrying mechanism for an accumulator comprising a carrier, concentrically mounted oppositely acting detents, spring means between said detents, means associated with said carrier separating said detents, and a transversely arranged restoring and setting rod extending between said detents.

18. Carrying mechanism for an accumulator comprising a loosely mounted carrier, mechanism for normally locking said carrier against a carrying operation, concentrically mounted opposed detents, spring means between said detents, means on said carrier for separating said detents, a transversely arranged restoring and setting rod for placing one of said detents under spring tension by movement of the other said detent, and means for releasing said locking mechanism to cause

a carrying operation of said carrier by the tension exerted by said first detent against said separating means.

In witness whereof, I have hereunto subscribed my name.

OLIVER D. JOHANTGEN.

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