Oct. 6, 1931. R. H. STROTHER 1,826,291

CALCULATING MACHINE

Original Filed Aug. 21, 1922 2 Sheets-Sheet 1

Fig. 1

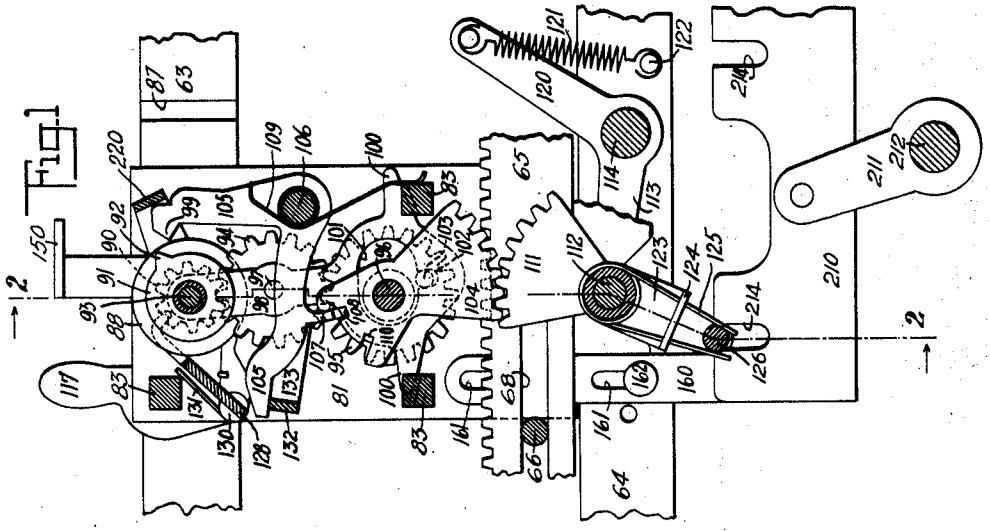


Fig. 2

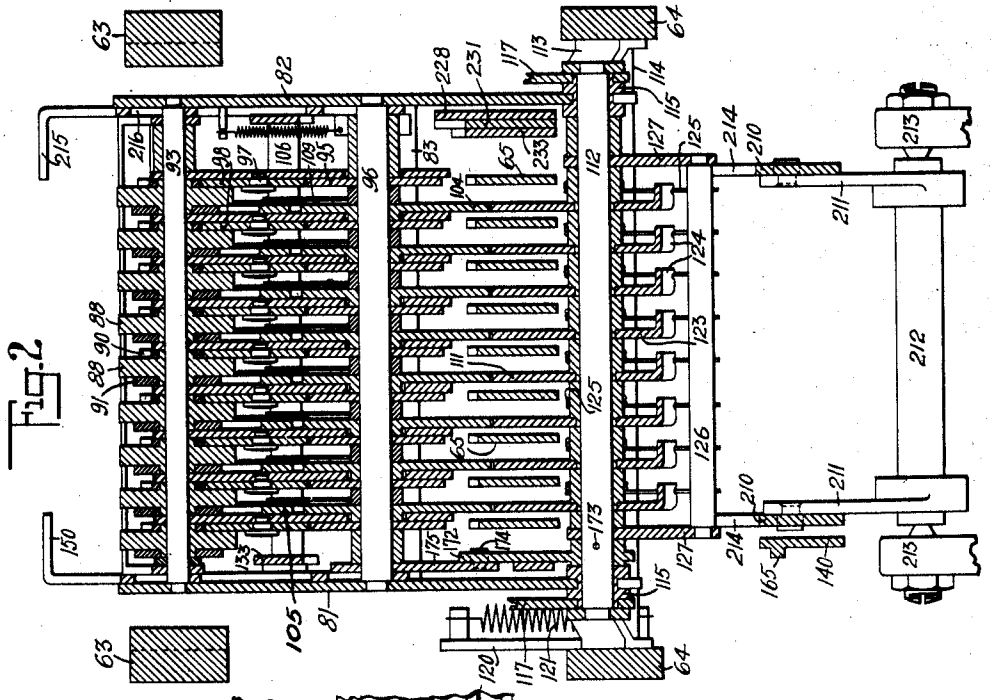
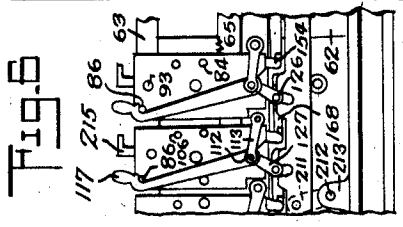


Fig. 5



INVENTOR
Robert H. Strother
BY
Jacob Felbel
ATTORNEY

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Fig. 5

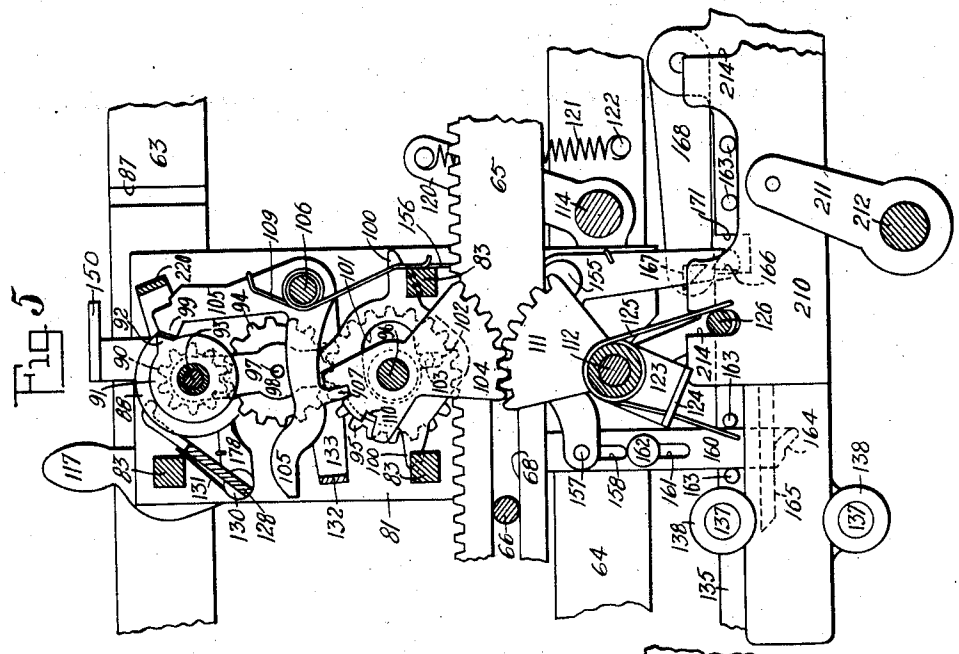


Fig. 4

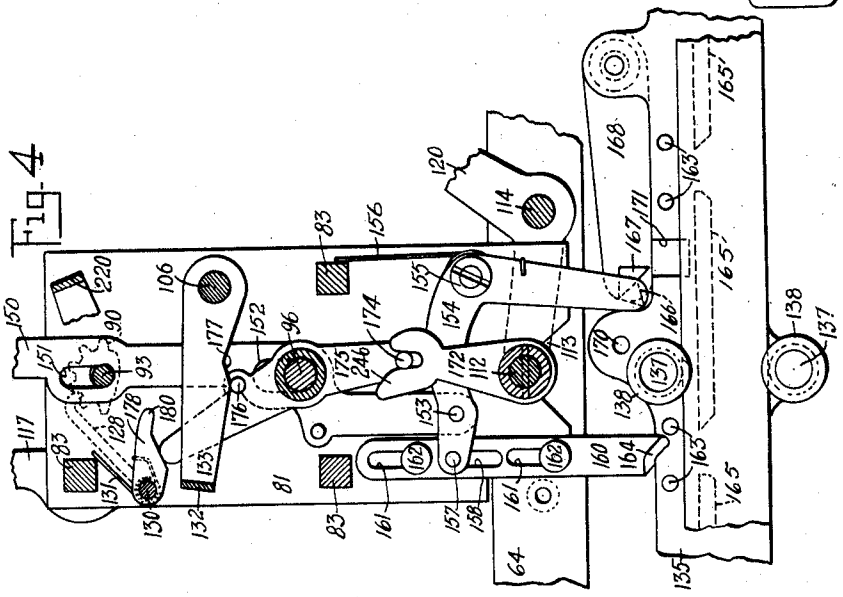
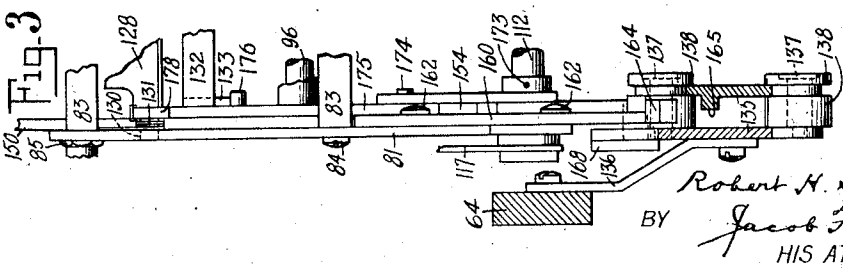


Fig. 3



Inventor.
Robert H. Strother
BY Jacob Felbel
HIS ATTORNEY

Patented Oct. 6, 1931

1,826,291

UNITED STATES PATENT OFFICE

ROBERT H. STROTHER, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO REMINGTON ACCOUNTING MACHINE CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

CALCULATING MACHINE

Original application filed August 21, 1922, Serial No. 583,391. Divided and this application filed July 30, 1925. Serial No. 47,132.

This invention relates to calculating machines. The invention has for one of its principal objects to provide improved register mechanism and especially improved transfer mechanism which operates equally well for addition and for subtraction.

The invention also has minor objects which will appear in the course of the description.

To the above and other ends the invention consists in certain features of construction and combinations and arrangements of parts all of which will be fully set forth herein and particularly pointed out in the claims. The principal features of the invention are of such sort that they can be embodied in forms differing considerably from each other and only one such form has been shown. This application is a division of my prior application for Letters Patent for calculating machines, filed August 21, 1922, Serial No. 583,391, patented November 5, 1929, No. 1,734,538.

That patent discloses a complete computing and recording machine, the present application being confined to the registering or totalizing mechanism and being more especially directed to the transfer mechanism. In the accompanying drawings only so much of the complete machine is shown as is necessary to a disclosure of the registering and transferring mechanism.

Figure 1 is a longitudinal section through one of the totalizers, together with fragmentary views of some of the associated parts.

Figure 2 is a section taken about on the line 2—2 of Figure 1 and looking toward the rear.

Figure 3 is a fragmentary front view of the extreme left-hand part of one of the totalizers and associated mechanism.

Figure 4 is a longitudinal section looking toward the left and showing in side view the mechanism shown in the front view in Figure 3.

Figure 5 is a view somewhat similar to Figure 1 but showing the register depressed into engagement with the rack and some of the mechanism in a position it occupies at a point in the operation of the operating mechanism.

Fig. 6 is a fragmentary right-hand side elevation, partly in sections.

In the said parent application Sr. No. 583,391, there is shown a calculating and recording machine which in most respects is identical with that shown in the reissue patent to Sundstrand, No. 14,237, reissued December 26, 1916, but some of the Sundstrand mechanism has been omitted and other parts of it have been modified and some parts added. The frame of the Sundstrand machine is shown mounted on a base frame which extends some distance forward from the Sundstrand frame and which includes among other things an upper pair of horizontal frame bars 63 and a lower pair of horizontal frame bars 64. The present drawings show only a little more of the framework which will be referred to at the appropriate place in the description.

The totalizers are situated in this forwardly projecting part of the frame between the two frame bars 63 and between the two frame bars 64.

Said totalizers are controlled by a series of differentially movable denominational rack bars 65 which extend from the front of the machine horizontally nearly to the back thereof. These bars are supported for longitudinal movement in any suitable way, the means here shown consisting of cross rods 66 each supported at its ends in certain lugs or brackets projecting up from the base, and said rods passing through longitudinal slots 68 in said racks. The latter may be spaced apart on the rod 66 by suitable washers. The rack 65 may be reciprocated front and back by any suitable means, such means being found in nearly all adding machines having denominational racks. In the parent case the Sundstrand machine is shown provided with its usual digit keys which by the usual Sundstrand mechanism control certain type bars. Said machine contains an operating handle and when the latter is pulled forward said type bars rise each to an extent appropriate to the digit to be added in that denomination, and the bars move downward of the return stroke of the handle.

In said parent case these Sundstrand type

bars are shown connected with the bars 65 in such a manner as that the upward motion of said type bars causes forward motion of bars 65, and downward motion of the type bars causes rearward motion of the bars 65, each to an extent measured in teeth of the rack appropriate to the digit to be added or subtracted by said rack.

The totalizer or registering mechanism is shown in Figs. 1 and 2 in normal position and in Fig. 5 in operating position. The detail construction of each totalizer can be varied considerably within the scope of the invention. As here shown the frame of each totalizer comprises a left-hand end plate 81, a right-hand end plate 82 and cross bars 83 here shown as square bars each fastened at its ends to the frame plates by screws 84; but the uppermost one of the three frame bars shown has the heads of its screws 85, Fig. 3, made of a special shape, each terminating in a pin lying in a slot 87 in the inner face of a frame bar 63. These pins guide the upper part of the totalizer as it moves up and down between its operating position shown in Fig. 5 and its normal position shown in the other figures. The totalizer is preferably covered with a casing plate at front, top and back, with a suitable sight-opening for the dials, but the plate is not shown in the drawings.

Each of the numeral wheels comprises a dial or drum 88, a pinion 90 rigid with said drum on the right-hand side thereof and a transfer disk 91 having a tooth 92 on the left-hand side of said drum. These numeral wheels or dials are strung along a shaft or rod 93 secured at its ends in the frame plates 81 and 82. The totalizers shown in the drawings are arranged for decimal notation and the pinions 90 therefore have each ten teeth. Said pinions mesh continuously with intermediate gear wheels 94 and these in turn mesh with idler gears 95, the latter, together with certain other devices, being strung along and journaled on a cross shaft 96 mounted at its ends in the frame plates 81 and 82. When the totalizer is depressed to its working position shown in Fig. 5, the gears 95 mesh with the racks 65 and when the totalizer is moved to its normal position the racks and gears are disconnected. Each of the intermediate gears 94 is separately movable bodily in its plane in order to transfer. To this end each of said gears is individually journaled on a stud 97 projecting leftward from one of a series of plates 98, said plates 98 being each pivoted on the rod 93 between two of the numeral wheels, with freedom to swing a short distance front and back. These plates 98 may be guided in any suitable way but as here shown each of them at its lower part has projecting wings 100, which are adapted to slide through suitable slots which are cut for the purpose in two of the frame bars 83. Each of said plates is made with an opening 101 through which the shaft 96 passes, said opening being made merely for clearance as the plates in the form here shown have no connection with said shaft.

The swinging motion of each plate or hanger 98 is controlled by means including a slot or notch 102 into which a stud 103 projects leftward from a sector 104. There is a set of said sectors pivoted on the shaft 96 interspersed between the several idler wheels 95; but the extreme right-hand hanger 98 is stationary to which end it may be fastened by any suitable means to one of the frame bars 83. In the present instance the hangers 98 are swung front or back to transfer by springs as will presently appear and their motion is controlled by transfer dogs 105 pivoted on a shaft 106 supported at its end in the end plates 81 and 82. Each of these dogs is in the general form of a bell crank having a horizontal arm extending forward just above the sector 104 and a vertical arm extending behind a transfer disk 91, where it is provided with a tooth 99 adapted to be deflected by the tooth 92 when the wheel turns in either direction through the space between "9" and "0". Each dog is pressed toward the wheel by a light spring 109. The horizontal arm of each dog 105 has a tooth 107 adapted to enter two notches 108 and 110 in the upper edge of the sector 104. The motion of said sector in both directions is limited by prolonging the rear wall of the notch 108 and the front wall of the notch 110 radially so that even when the dog is in its elevated position shown for example in Fig. 1, it is still engaged by one of these prolongations notwithstanding it is lifted out of the notch. In Figs. 1 and 5 a hanger 98 is shown in its rear position controlled by the notch 108 in the sector 104 but it will be seen that with the dog elevated as shown in Fig. 1 said sector can be swung until the notch 110 is under the tooth 107 and that such swinging motion would swing the hanger 98 forward a short distance through the pin 103 and notch 102.

The sectors 104 are actuated by means of a series of gear sectors 111 each having a hub pivoted on a shaft 112, which shaft lies beneath the rack bars 65, the sectors 111 coming up between said rack bars. The shaft or rod 112 is rigidly mounted in the forward ends of two arms 113 fixed to a rock shaft 114, which rock shaft is journaled at its ends in the frame bars 64. The shaft or rod 112 has a hub or collar 115 pivoted thereon near each end thereof. The frame plates 81 and 82 extend downward and each of them has therein a notch that fits over the corresponding collar 115, which collar is grooved as indicated in Fig. 2. The construction is such that any totalizer can be set on to the machine by placing it in position from the top and pushing

down the totalizer until the said notches come into suitable engagement with the hubs 115, meanwhile also guiding the pins or screw-heads 85 into the slots 87. In order to secure the totalizer in place each of the hubs 115 has fixed thereto a hand operated latch 117. These latches extend upward, each terminating at its upper end in a handle and each having a hook or shoulder adapted to hook over one of the screw heads 85, which screw heads may be annularly grooved for the purpose. There is one of these latches on each side of the totalizer and by moving them toward the front of the machine any totalizer may be almost instantly removed by the operator and another put in its place.

The rock shaft 114 above described may have near one or both ends thereof an arm 120 connected by a strong tension spring 121 with a pin 122 on the frame bar 64, this spring or these springs serving normally to hold the totalizer in its elevated or non-working position. It will be seen that the shaft 112 moves up and down with the totalizer so that the sectors 104 and 111 are always in engagement when the totalizer is on the machine but they separate when a totalizer is removed from the machine, the sectors 104 being built into the totalizer and the sectors 111 being built into the non-detachable part of the machine.

Each of the sectors 111 has projecting downward therefrom an arm 123, each of said arms at its lower end being bent off to the right to form an ear 124. Around the hub of each sector a spring 125 is coiled, the two ends of the spring projecting downward and entering notches in the front and back sides respectively of the ear 124. This spring is under tension to cause the two branches thereof to approach each other, but they are normally held apart by being pinched against the ear 124. Said springs project beyond the ears 124 and each of them straddles a cross rod 126 forming part of a bail having also end arms 127, Fig. 2, said arms being pivoted on the shaft or rod 112.

The mechanism of the totalizer includes any suitable means for locking the dial wheels 88 against rotation at certain times. In the present instance this takes the form of a plate or bar 128 of sheet metal pivoted in the end plates 81 and 82 by means of hubs 130 and pressed toward the register wheels by a spring 131. This plate has a series of fingers each at its free end bent to form a tooth to engage between two of the teeth of a pinion 90.

The register also includes a bail bar 132 having arms 133, Figs. 1 and 4, the bar 132 lying beneath the ends of the dogs 105 which are prolonged forward for the purpose. The arms 133 are pivoted on the rod 106.

The general principle of operation of the register and transfer mechanism can be understood from what has been said and from the following: The parts are normally in the position shown in Fig. 1 with the register wheels out of mesh with the racks 65, the dial wheels locked by the bar 128, the dogs 105 elevated by the bail 132, the sectors 104 having the notches 108 in register with the teeth 107 and the bail 126 in its forward position with the springs 125 each pinched together against it. If it is desired to subtract a number from the register that number is set up by whatever means is provided for the purpose, that shown in the parent case consisting of the key-mechanism of the Sundstrand machine. By the use of a key to be presently described the totalizer is next moved down to bring its wheels into engagement with the racks 65. The downward motion of the totalizer first causes the bail 132 to be dropped down from the position shown in Fig. 1 to that shown in Fig. 5, allowing the dogs 105 to swing to their operative positions with their teeth 107 engaging the notches 108 and with their teeth 99 in position to be deflected on occasion by the teeth 92 of the dial wheels; and afterward the bar 128 is caused to be lifted to unlock the pinions 90. The handle is then pulled which first causes the totalizer to be locked in its depressed position and the bail 126 is then swung toward the rear as shown in Fig. 5, which forces the rear branch of each spring 125 rearward: The forward branch cannot follow it because of its engagement with the ear 124, the sectors 104 and 111 being prevented from moving at that time by the transfer dogs 105. At a later stage in the motion of the handle the rack bars 65 move toward the front of the machine, each to the extent of a number of its teeth corresponding to the digit to be registered in that denomination. The racks 65 turn the register wheels 95, 94 and 90 to correspond with the several digits. In case one of the dial wheels passes from "0" to "9" it operates the dog 105 which releases the sector 104 and allows that particular sector to be operated by its spring 125, the ear 124 moving rearward to the rear branch of the spring 125, and bringing the notch 110 into position to be engaged by the tooth 107, which will occur immediately because the tooth 92 does not stop under the tooth 99. When the sector 104 swings in the manner described, its pin 103 swings the hanger 98 forward, moving the axis 97 of the wheel 94 one-half space toward the front of the machine. At this time the wheel 95 is under control of the rack 65, but the wheel 90 is free to turn. If the wheel 95 is standing still at the moment, the lower side of the wheel 94 which engages said wheel 95 will pivot on said wheel 95 and the opposite or upper side of said wheel 94 will be moved a full tooth space turning the dial pinion 90 one space. A similar thing will happen if the wheel 95 is in motion at the time, the action being that the pinion 90 will receive

one tooth more of motion than it would if the hanger had not moved the axis of the wheel 94 forward. It will thus be seen that the transfer takes place whenever a dog 105 is tripped irrespective of whether or not the register is at the time being digitally operated by the rack 65 in the denomination to which the transfer takes place. At the end of the operation the racks 65 or some of them will have been moved different distances toward the front of the machine, depending on the number subtracted and some perhaps of the hangers 98 will have been swung forward to transfer and others will not. At the end of the forward stroke of the handle the totalizer is released and is moved to its upper position shown in Fig. 1 by its spring or springs 121. This motion results in first depressing the bar 128 to lock all of the dial wheels against rotation in either direction and an instant later the bail 132 lifts all of the dogs 105 out of engagement with their sectors. Some of these sectors will perhaps already have swung to their positions where the notches 110 are in register with the teeth 107 but such of them as have not already done so will immediately snap to that position driven by their springs 125 on account of the bail 126 being in its rear position. At the end of the forward stroke of the handle therefore this particular totalizer will be substantially as shown in Fig. 1, except that the bail 126 will be in its rear position, all of the sectors 104 will be in position where the notches 110 are in register with teeth 107, and the hangers 98 will be in their forward positions.

In case any wheel has not received an increment of motion by transfer and its sector 104 has been swung idly after the termination of the subtracting operation, the effect of such idle swinging will be to move the axis 97 of the gear 94 one-half space toward the front of the machine. At this time, however, it is the pinion 90 that is under control and the gear 95 is free. At this time, therefore, the upper side of the gear 94 will pivot on the pinion 90 and its lower side will move one tooth toward the front of the machine, turning the pinion 95 one tooth in counter-clockwise direction.

In the case of a totalizer that was not depressed before the handle was pulled but remained in its upper or non-working position during the forward pull of the handle, its bail 126 would also have been swung toward the rear, carrying all of the sectors 111 with it, and swinging all of the sectors 104 to their positions alternative to the ones shown in Fig. 1. This is true because all of said sectors 104 are free, the dogs 105 being elevated. It will thus be seen that at the end of the forward stroke of the handle all of the totalizers are in their elevated positions with the dial wheels locked, and with the transfer mechanism in the position alternative to that shown in Fig. 1.

In order to add a number on any desired register said register is depressed into engagement with the racks 65 at the beginning of the return stroke of the handle. In this instance as before the act of depressing the totalizer automatically causes the bail 132 to swing downward and all of the transfer dogs 105 to drop into their operative positions, their teeth 107 engaging the notches 110; after which the bar 128 is elevated to unlock the dial wheels. The very first operation of the return stroke of the handle is, by means to be hereinafter described, to depress the totalizer and hold it in its depressed position. The next is to swing the bail bars 126 back to their forward position shown in Fig. 1. In this operation the forward branches of the springs 125 will be operated by said bail bars, but the rear branches will be unable to follow on account of the engagement of the dogs 105. The next step in the operation is to return the racks 65, thus turning the register wheels in the opposite direction to that in which they were turned in the process of subtraction. The transfer mechanism operates in exactly the same way as in subtraction except that it operates in the opposite direction. At the end of the return stroke of the handle the totalizer is released and is elevated by its spring 121. This upward motion first depresses the bar 128 to lock the dial wheels and then operates the bail 132 to lift the dogs 105 out of engagement with the sectors 104. If any one of said sectors had been operated to transfer, it and its co-operating sector 111, would already have been moved to position shown in Fig. 1. Those sectors that were not operated by transfer will move to that position as soon as the bail 132 lifts the dogs 105 out of engagement. The parts will then have been restored to the Fig. 1 position, ready for the addition or subtraction of another number. In case there are several totalizers distributed along the racks 65, it will be seen that any desired number can be added or subtracted in any one of said totalizers or in any combination of said totalizers. It may if desired be added in one totalizer and subtracted in another.

The principle of the transfer mechanism seems to merit a little discussion. Consideration of the mechanism will show that whereas the present embodiment of it includes three gears 90, 94 and 95 in each denomination, the gear 94 is the essential one. In the present instance the gear 95 is little more than a convenient means of communicating the motion of the rack 65 to the gear 94. The turning of the wheel is controlled by the rack 65 and the wheel 95 may be considered a part of such controlling means. The pinion 90 is merely a means to communi-

cate the motion of the wheel 94 to a numbered dial wheel. Many calculating machines have merely the register wheels without dial wheels and if said dials are not desired the operation would not be modified by their omission in the present instance. In the present construction said dial wheels perform mechanically two functions, namely, they carry the teeth 92 which operate the transfer dogs and they are directly engaged by the locking bar 128; but it is obvious that theoretically said locking bar could engage the upper side of the wheel 94 directly and said wheel could itself carry the transfer tooth 92. In that event the gear 94 must of course have a number of teeth that is a multiple of the base of the system of notation—ordinarily ten or a multiple thereof.

The principle of the transfer may therefore be stated as follows: The gear 94 is controlled in its differential turning movement by the gear 95 which engages it on its lower side. The axis of said gear 94 is on occasion moved one-half space in the plane of the wheel and opposed to the direction of motion of the controlling wheel 95. The opposite or upper side of said wheel 94 is thereafter locked or held by the bar 128 acting in the present instance through the pinion 90. The gear 94 is thereafter freed from the control of the gear 95. This could of course be done by lifting said gear 94 out of engagement with said gear 95, but it is done in the present instance by freeing the gear 95 itself from the control of the rack 65. After the upper side of the gear 94 is locked or held and the lower side is freed the axis is returned to its original position. When the axis was originally shifted to transfer it imparted to the upper side of the wheel a unit's motion if the gear 95 was stationary at the time, or an increment of one unit of motion in case the gear 95 was turning at the time. After the gear 94 is locked at its upper side and freed at its lower side and when the axis is restored to its original position, a unit's motion is imparted to the lower tooth of the wheel so that at the end of the operation the wheel, bodily considered, is in its original position, but rotatably considered it has been turned to the extent of one tooth. As far as the general principle of this transfer is concerned it is of course immaterial by what means or what details of mechanism the axis of the gear 94 is given the peculiar motions described.

The means for controlling the motion of the totalizers into and out of operative position can be of any suitable sort, means for this general purpose being well known in the art. That shown in the drawing is shown designed to co-operate with the mechanism of the Sundstrand machine. The left-hand frame bar 64 has a stationary bar 135 secured thereto by means of depending brackets 136. On suitable studs 137 projecting from said bar there are mounted grooved guide rollers 138 adapted to guide a bar 140 for sliding motion front and back. This bar is so connected with the operating mechanism that it moves rearward on the forward stroke of the operating handle and frontward on the return stroke of said handle, the leverage being so designed that the excursion of said bar 140 is about equal to the front and back spacing from one totalizer of the series to the next.

Mounted against the inside face of the left-hand frame plate 81 of each totalizer is a totalizer connecting key 150 projecting above the totalizer and formed with any suitable finger piece. The stem of this key has a slot 151 through which the shaft 93 extends and another slot 152 through which the shaft 96 passes, the construction being such that the key has a limited extent of up and down movement. At its lower end said key is pivoted at 153 to a bell crank 154 pivoted to the side plate 81 on a stud 155 and controlled by a spring 156 which normally holds the key 150 in its upper position. At its free forward end the lever 154 has a pin or stud 157 projecting therefrom into a slot 158 in a vertical sliding piece 160 which piece also has guide slots 161 through which pass headed pins 162 riveted into the side plate 81. The construction is such that this slide 160 is normally held by the pin 157 in its upper position but when the key 150 is depressed said slide can drop down although it is not forced down by the key. The lower end of the slide 160 projects below the totalizer in a position where it is guided in one direction by the fixed bar 135 and in a front and back direction by two studs 163 projecting from said bar. At its lower end the slide 160 has projecting to the right therefrom a lug 164 which when the slide 160 is depressed is adapted to be engaged by one of a series of horizontal flanges 165 on the left-hand face of the bar 140. These flanges are all in alignment but there is between the adjacent ends of two consecutive flanges an opening in a position to allow the lug 164 to drop down between them. The operator pushes down on the key 150 until the latter has moved as far as it can go with respect to the totalizer at which time the lug 164 will not have been depressed far enough to be caught by the flange 165 but if the operating handle is worked with the parts in that position said lug will ride on the top of one of said flanges. In case it is desired to subtract a number the operator does not stop when the key has reached the bottom of its stroke with relation to the totalizer but forces it on down so as to carry the totalizer with it; in other words, pushes it down as far as it will go and while holding down begins to pull the handle. As soon as the handle begins to move the flange 165 moves rearward over the lug 164 as shown in Fig. 5, thereby lock-

ing the totalizer in its depressed position until the handle reaches the end of its forward stroke. At this time the end of that particular flange 165 will have reached the lug 164 and the totalizer will be released and will be thrown up by its spring 121 and the key 150 will be restored to its normal position by the spring 156.

Addition is accomplished on the return stroke of the handle and can be accomplished by pulling the handle forward and depressing the totalizer in the same manner as above described while the handle is held in its forward position and holding the totalizer down until the handle starts on its return motion. For reasons that will hereinafter appear, however, it is preferred to cause addition automatically by merely imparting to the key 150 a downward stroke equal to its motion relative to the totalizer before pulling the handle in the first place, means being provided to hold the key in its depressed position until the handle has reached the forward end of its stroke and for drawing the totalizer down automatically at the very first part of the return stroke of the handle.

The bell crank 154, which is connected with the key 150, has a depending arm projecting leftward from the lower end of which is a triangular lug 166 which normally occupies the position shown in Fig. 4 where it engages the front forward under side or face of a triangular lug 167 which projects toward the right from an arm 168 pivoted at 170 to an ear of the stationary bar 135. Beneath and to the rear of the lug 167 said bar 135 has a square notch or cut-out 171. The lower corner of the triangular lug 167 is just a little to the rear of the forward wall of said slot 171. The construction is such that when the key 150 is depressed the first effect of its motion is to swing the lug 166 toward the rear which cams up the arm 168 until said lug 166 passes the lug 167, when the latter drops down in front of the lug 166 and prevents its return to normal position, thus locking the key 150 in its depressed position. If the parts be left in this position during the forward stroke of the handle the rearward motion of a flange 165 will engage the lug 164, which is made on an incline downward and backward as shown in Fig. 4, and cam upward the slide 160 so that said lug will ride on the upper surface of the flange. At the end of the forward stroke of the handle said flange will run from under the lug and allow the latter to drop down in front of it. On the return stroke of the handle and of the bar 140 the inclined forward end of the flange 165 will engage the inclined lug 164 and will immediately pull the totalizer down to its depressed position from which it will escape at the end of the return stroke of the handle. When the totalizer is thus pulled down the lug 166 will descend into the notch 171 as shown in Fig. 5, and when the totalizer is released the upper corner of said triangular lug will engage under the lower corner of the lug 167, raising said lug and the arm 168 until said lug 166 reaches its upper position when, escaping from the notch 171, it is free to swing to the left under the pressure of the spring 156, restoring the parts to normal position shown in Fig. 4. It will of course be understood that any other suitable means can be provided for causing the totalizer to go through these motions. It will also be understood that in the case of subtraction the lugs 166 and 167 and the notch 171 co-operate in the same way as in the case of addition except that in subtraction there is no use made of the locking function of said lug, the lug 166 proceeding immediately down into the notch 171. It may also be remarked that in case one of the keys 150 has been depressed and locked down and it is desired to release it without operating the machine this can be done by simply pushing it down as far as it will go, carrying the totalizer with it and then releasing it. The extra motion will depress the lug 166 out of control of the lug 167 and unlock the key. It will also be understood that the mechanism above described is repeated in the case of each totalizer.

It has been stated in the description of the principle of the registering mechanism that in the course of the downward movement of the totalizer the first effect is to allow the bail 132 to drop downward and the dogs 105 to lock the transfer sectors, and that subsequently the plate 128 is lifted out of engagement with the pinions 90 to unlock the latter and that the reverse operation occurs in the reverse order on the upward movement of the totalizer. In order to accomplish these functions the shaft or rod 112 is fixedly mounted in the ends of the arms 113 and just inside or to the right of the lever 154, said shaft 112 has an upstanding arm 172 fastened thereon as for example by a pin 173. This arm is forked at its upper end and a pin 174 projects in the said fork from a lever 175 of the first order, said lever being pivoted on the shaft 96. Above said shaft said lever 175 has a pin or stud 176 projecting therefrom and acting cam fashion on an inclined part 177 of the left-hand arm 133 of the bail 132. It is this pin acting on the high part of the incline 177 that normally holds the bail 132 in its elevated position. When the totalizer moves down and up the arm 172, considered with relation to the stationary framework, swings about the shaft 114 as a center; but considered with reference to the totalizer it swings about the shaft 112 as a center and anti-clockwise on the down stroke of the totalizer and clockwise on the upstroke. The incline 177 is so designed that the bail 132 begins to move downward in the totalizer the instant the totalizer itself begins to move

downward, so that the dogs 105 almost immediately engage the sectors 104, and are disengaged from them the last thing in the upward motion of the totalizer. The bail 132 is given an excess of motion over that necessary to control the dogs as indicated in Fig. 5 where the totalizer is shown in its depressed position.

The upper end of the lever 175 co-operates cam fashion with an arm 178 projecting rearward from the pivot piece 130 of the plate 128. The part of said arm 178 that is shown in engagement with lever 175 in Fig. 4 is concentric with the shaft 96 but near the end of said arm there is a nose 180 which is engaged by the lever 175 at the end of the stroke of the latter, such engagement lifting the plate 128 by the last part of the depression of the totalizer and after the transfer sectors have been locked. On the upstroke of the totalizer this plate almost immediately drops into locking position and before the bail 132 lifts the dogs 105.

The means for swinging the bails 126 to control the springs 125 of the transfer mechanism can be varied considerably, and in fact any mechanism will answer that will give the described motions to these bails. As shown, two bars 210 extend horizontally front and back beneath the mechanism above described, and are guided for front and rear longitudinal motion by means including arms 211 rising from a rock shaft 212 pivoted to lugs 213 of the base frame. Each bar 210 is notched at 214, the notches embracing the rods 126 and being of a depth adapted to allow of the vertical motion of said rods. In the parent case the bars 210 are shown actuated by the operating handle, being moved rearward in the early part but not in the very first part of the forward stroke of said handle, and moved forward at the corresponding part of the return stroke of said handle.

The drawings show a key 215, a bail 220, and certain bars 228, 231 and 233; but these are used in the taking of totals and are parts of the invention claimed in the parent case.

When a totalizer standing in the normal position shown in Fig. 4 is removed from the machine by loosening the latches 117 and lifting the totalizer out, the lever 175 is relieved from the control of the forked arm 172, Fig. 4, with the result that the pin 176 thereof is cammed rearward by the incline 177 because the bail 132 is under the pressure of all the springs 109. The result will be that all of the detents 105 will be depressed by their springs to force the teeth 107 into the notches 108 and thus lock the transfer sectors 104 in normal position. The wheels 90 were already locked by the bar 128 and if the lever 175 swung far enough it would release these wheels. In the normal operation of the machine, it will be recalled, the releasing of the locking plate or bar 128 is done by the last part of the motion of the lever 175 and after the dogs 105 have all been depressed. Said dogs therefore are incapable of exerting any pressure on the bail 132 to swing said lever 175 far enough to unlock the register. When the totalizer is lifted out therefore it is automatically locked up.

When the totalizer is put back into the machine the arm 172 is standing in the position shown in Fig. 4. As the totalizer descends into place the pin 174 occupies a position a little to the left of that shown in Fig. 4. The left-hand fork 246 is prolonged and formed with an inclined edge so that as the pin 174 descends it will be cammed over to its proper position. When replacing a totalizer the key 150 must be depressed and the totalizer pushed clear down and released in order to bring lug 166 first down behind and then up in front of the lug 167.

Where in the claims I refer to the axis of a register wheel being moved one-half space to transfer, I mean that said axis is moved one-half as far as a tooth of the wheel would be moved for that purpose if the axis of the wheel were stationary.

What I claim as new and desire to secure by Letters Patent is:—

1. In a calculating machine, the combination of a pair of register gear wheels, a gear for driving the gear wheel of higher denomination differentially in one direction for addition and in the opposite direction for subtraction, spring means for moving on occasion the axis of said higher gear wheel one-half space to transfer, means for causing said spring means to act on said axis in one direction for addition and in the opposite direction for subtraction, a detent for resisting the action of said spring means, and means whereby the lower register wheel trips the detent of the higher register wheel.

2. In a calculating machine, the combination of a totalizer comprising a pair of denominational register wheels, a denominational rack for driving the wheel of higher denomination differentially, means for moving said totalizer to bring said wheel into and out of gear with said rack, means for moving on occasion the axis of said higher register wheel one-half space to transfer while said wheel is in gear with said rack, means for holding said wheel while out of gear with said rack and means for restoring said axis when said wheel is out of gear with said rack.

3. In a calculating machine, the combination of a totalizer including a pair of register wheels, a denominational reciprocatory rack for driving the register wheel, of higher denomination, means for moving said totalizer to bring said register wheel into and out of gear with said rack, transfer mechanism including a spring for moving on occasion the axis of said higher wheel one-half space, means for controlling the action of said

spring, and means for putting said spring under tension in one direction when said rack is moving in one direction and for putting said spring under tension in the opposite direction when the motion of said rack is reversed.

4. In a calculating machine, the combination of a pair of register wheels, a rack for the wheel of higher order, means for moving said rack and register wheel into and out of gear, means for moving said rack differentially back and forth, and transfer mechanism including a device for imparting to said higher register wheel on occasion an increment of motion to transfer, a detent for controlling said device, spring means for operating said device, and means acting at each operation of the machine to put said spring means under tension in one direction prior to the motion of said rack in one direction and to put said spring means under tension in the opposite direction prior to the motion of said rack in the opposite direction.

5. In a calculating machine, the combination of a pair of register wheels, means for actuating said register wheels in one direction for addition and in the opposite direction for subtraction, a transfer device, spring means for operating said transfer device, a reciprocating device which when in one position places said spring means under tension in one direction and when in its other position places said springs under tension in the other direction, and means acting automatically to move said device to one of its positions prior to an adding operation and to the other of its positions prior to a subtracting operation.

6. In a calculating machine, the combination of a pair of register wheels, a rack for the said register wheel of higher denomination, means for moving said rack differentially back and forth, means for moving said higher register wheel into gear with said rack prior to one of the motions of said rack for addition and prior to the opposite motion of said rack for subtraction, and transfer mechanism including a transfer device, spring means for operating said device, and means acting at each operation of the machine to put said spring means under tension in one direction prior to an adding operation and in the other direction prior to a subtracting operation.

7. In a calculatng machine, the combination of a totalizer including register wheels, racks for operating said wheels, and means for moving said totalizer to bring said register wheels into and out of gear with said racks, and transfer mechanism, said transfer mechanism including a wheel in said totalizer individually movable on occasion in its own plane to transfer, spring means for moving said wheel to transfer as recited, a detent for normally holding said wheel against such motion, means for releasing said detent when the wheel of next lower order passes the transfer point, means for releasing said detent when said register wheels are out of gear with said racks, and means for restoring said wheel while said register wheels are out of gear.

8. In a calculating machine, the combination with actuating mechanism and a detachable totalizer, of transfer devices in said totalizer, and individual means in said actuator for operating each of said transfer devices by power other than that derived from the totalizer wheels, said transfer devices and their operating means being separated when the totalizer is detached from the machine.

9. In a calculating machine, the combination with actuating mechanism including denominational racks and denominational transfer operating devices, of a totalizer including register wheels controlled by said racks and transfer devices operated by said transfer operating devices, and means for moving said totalizer and said transfer operating devices together whereby said register wheels move into and out of engagement with said racks but said transfer devices remain in engagement with said transfer operating devices.

10. In a calculating machine, the combination of a totalizer including register wheels and transfer devices, an actuator including register wheel operating devices and spring operated means for actuating said transfer devices, and means for moving said totalizer and said spring operated means whereby said register wheels are moved into and out of gear with their actuating devices but said transfer devices remain in engagement with their actuating devices.

11. In a calculating machine, the combination of a totalizer including register wheels and transfer sectors, an actuator including driving means for said register wheels and sectors for operating said transfer sectors, and means for moving said totalizer and said transfer operating sectors together so as to bring said register wheels into and out of gear with their actuating devices but to retain said transfer sectors continuously in gear with their actuating sectors.

12. In a calculating machine, the combination of a totalizer including register wheels and transfer sectors, an actuator including driving means for said register wheels and sectors for operating said transfer sectors, and means for moving said totalizer and said transfer operating sectors together so as to bring said register wheels into and out of gear with their actuating devices but to retain said transfer sectors continuously in gear with their actuating sectors, said totalizer being detachable from said actuating mechanism.

13. In a calculating machine, the combina-

tion of a totalizer including register wheels and transfer sectors, an actuator including driving means for said register wheels and sectors for operating said transfer sectors, and means for moving said totalizer and said transfer operating sectors together so as to bring said register wheels into and out of gear with their actuating devices but to retain said transfer sectors continuously in gear with their actuating sectors, said totalizer being detachable from said actuating mechanism, and means for locking said transfer sectors when said totalizer is detached.

14. In a calculating machine, the combination of a totalizer including register wheels and transfer sectors, an actuator including driving means for said register wheels and sectors for operating said transfer sectors, and means for moving said totalizer and said transfer operating sectors together so as to bring said register wheels into and out of gear with their actuating devices but to retain said transfer sectors continuously in gear with their actuating sectors, said totalizer being detachable from said actuating mechanism, and means for automatically locking said transfer sectors when the totalizer is detached from the machine and for automatically unlocking said sectors when the totalizer is replaced in the machine.

15. In a calculating machine, the combination with a totalizer including register wheels and transfer devices, and actuating mechanism including register wheel operating means, of a swinging frame for moving said totalizer to bring its register wheels into and out of gear with their actuating means, an arm on said frame, and means controlled by said arm for locking said register wheels and said transfer devices.

16. In a calculating machine, the combination of a detachable totalizer including register wheels and transfer mechanism including transfer dogs, actuating mechanism including means for actuating said register wheels and means for actuating said transfer devices, a swinging frame in the actuating mechanism for moving said totalizer to bring its register wheels into and out of gear with their actuating devices, and means controlled by said swinging frame for locking and unlocking said register wheels and for moving said transfer dogs to and from operative position, said means when the totalizer is detached from the machine automatically causing said locking means to lock said register wheels and said dogs to lock said transfer devices.

17. In a calculating machine, the combination with register wheels, of transfer mechanism including a series of pivoted devices mounted on a shaft, a series of springs having arms projecting from said shaft adapted to be pinched together on arms of said pivoted devices, a bail extending between the branches of each of said springs, and means for swinging said bail first in one direction and afterwards in the opposite direction.

18. In a calculating machine, the combination with a plurality of totalizers each including register wheels, of transfer mechanism including a plurality of sets of pivoted devices, springs for swinging said pivoted devices in both directions, means associated with each totalizer for putting said springs under tension first in one direction and then in the other, and an operating device common to all of said tensioning means.

19. In a calculating machine, the combination with a totalizer including transfer devices and springs for driving said transfer mechanism in both directions, of operating mechanism including an oscillatory shaft, an arm on said shaft, two links operated by said arm, a bar for tensioning said spring in first one direction and then in the other direction, means operated by one of said links for moving said bar in an early part of the oscillation of said shaft in one direction, and means operated by the other of said links for moving said bar in the opposite direction in an early part of the return stroke of said shaft.

20. In a calculating machine, the combination with a totalizer including transfer mechanism having springs that operate in both directions, of operating mechanism including a device movable to one position to tension said springs in one direction and to another position to tension said springs in the opposite direction, a to-and-fro moving part, means whereby said part early in its forward stroke moves said device in one direction and early in its return stroke moves said device in the opposite direction, and pawls for holding said device in each of its two positions, said pawls being released by said to-and-fro moving part.

21. In a calculating machine including actuating mechanism, a totalizer having dial wheels mounted on a fixed axis, a gear 94, an individual support for said gear 94, said support movable parallel to the plane of its gear, a sector 104 for controlling the motion of said support, said sector having two notches 108 and 110, a transfer dog for engaging said notches to control said sector, and means for operating said sector.

22. In a calculating machine, the combination with register wheel actuating devices, of a totalizer including a series of wheels 94 driven by said actuating devices, individual supports for said wheels 94 each movable parallel to the plane of its wheel, means for moving said supports as recited, means whereby the motion of one of said supports is controlled by the registering mechanism of the next lower order to transfer during a calculating operation, and means operated after the completion of a calculating operation to

move all of those supports that had not been moved in transferring operation.

23. In a calculating machine, the combination with actuating devices, of a totalizer including a series of gear wheels 94, individual supports for said gear wheels each movable parallel to the plane of its wheel, means for so moving said supports, dogs 105 for controlling the motion of said supports for transferring, a bail 132 for moving all of said dogs to inoperative position, and means for operating said bail to move the dogs to operative position prior to a calculation, and for operating said bail to move the dogs to inoperative position after a calculation.

24. In a calculating machine, the combination with a totalizer including register wheels, of transfer mechanism including a set of pivoted devices, springs for swinging said pivoted devices in both directions, and an operating device for putting said springs under tension first in one direction and then in the other at each complete operation of the machine.

Signed at the borough of Manhattan, city of New York, in the county of New York and State of New York, this 23d day of July, A. D. 1925.

ROBERT H. STROTHER.