F. C. RINSCHE.

ADDING AND LISTING MACHINE.

APPLICATION FILED DEC. 15, 1911.

1,172,484.

Patented Feb. 22, 1916.

5 SHEETS—SHEET 1.

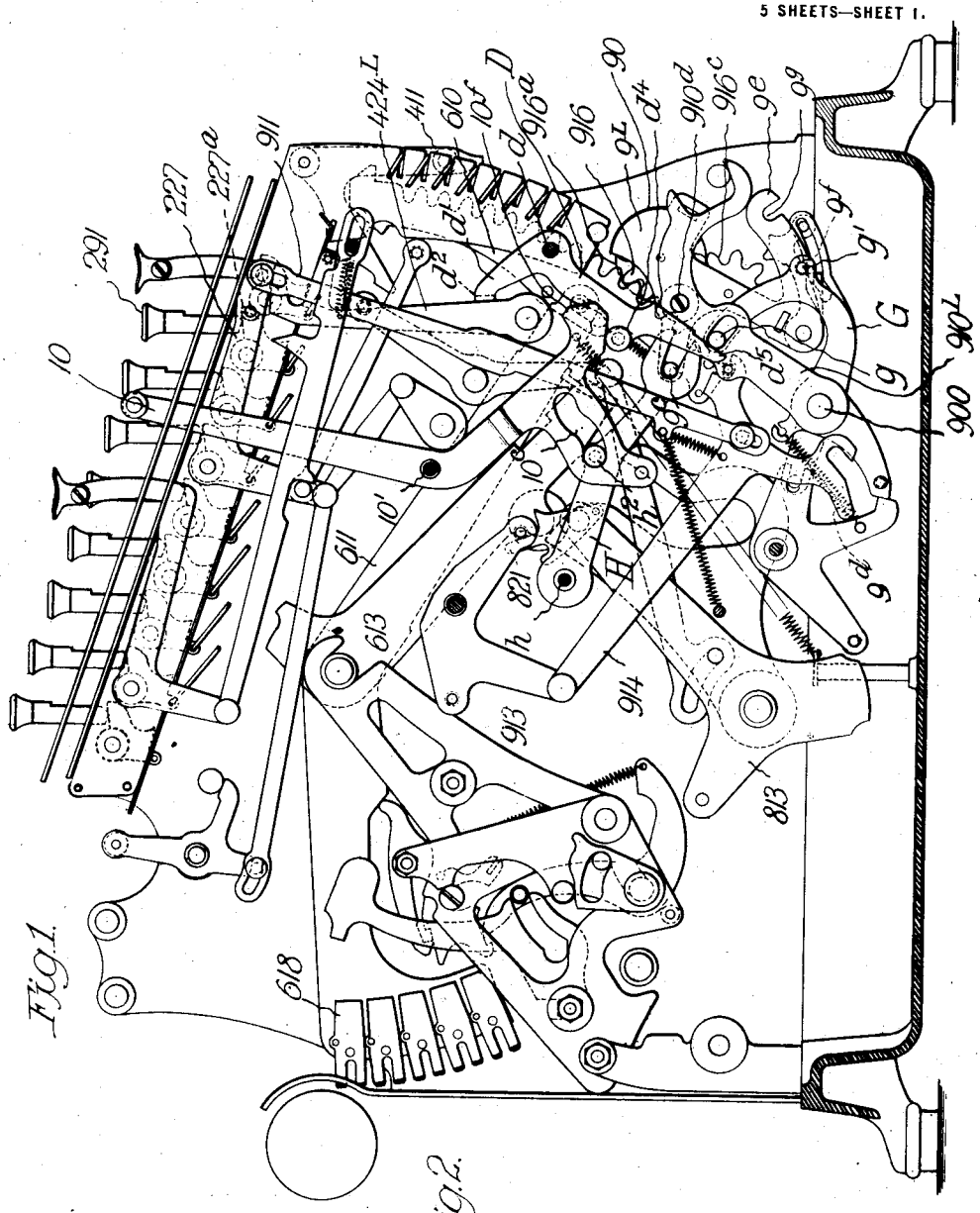


Fig. 1.

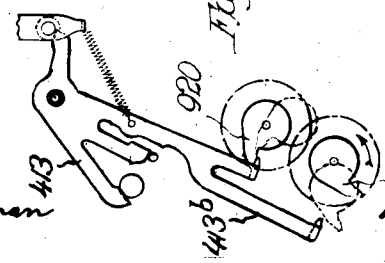


Fig. 2.

Witnesses:

E. R. Barrett.

Robert Dobberman

Inventor

Frank C. Rinsche

by Bakewell Kissenbrink & Thornley

his Attys.

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5 SHEETS—SHEET 2.

Fig. 3.

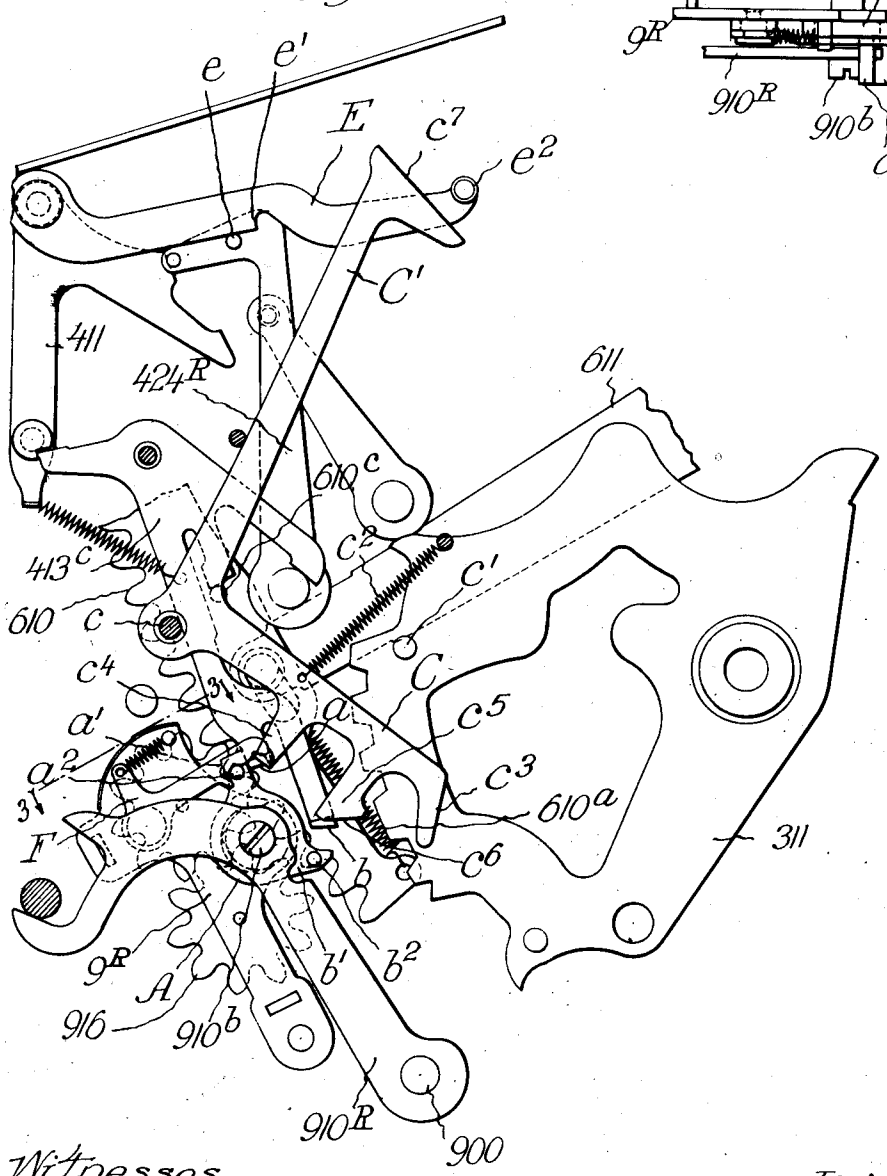
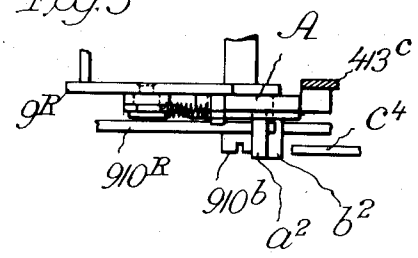


Fig. 3a



Witnesses
E. R. Barrett
Robert Dobberman

Inventor
Frank C. Rinsche
by Redfield Kissinger & Thomas
his Attys

F. C. RINSCHE.

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5 SHEETS—SHEET 3.

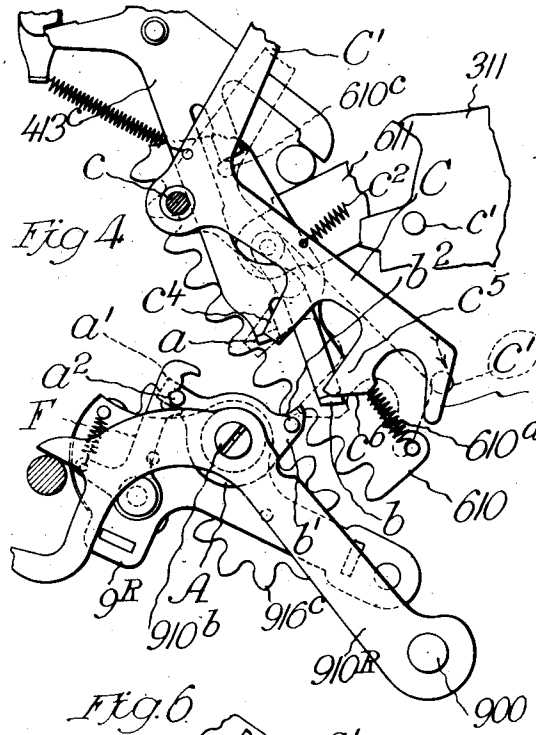


Fig 4

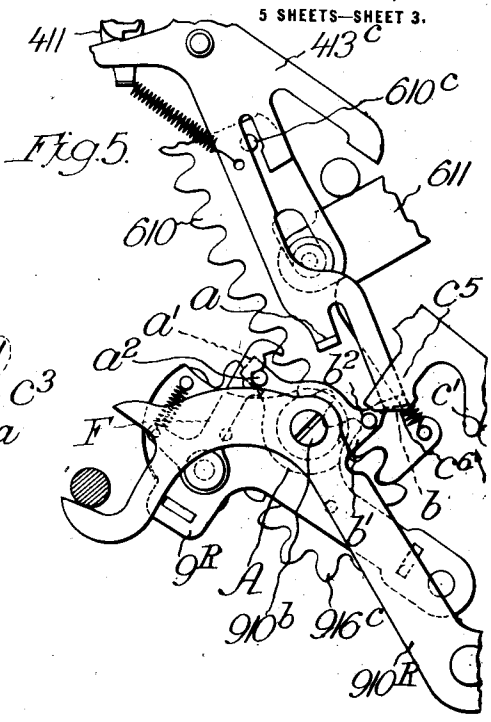


Fig.5.

Fig.6

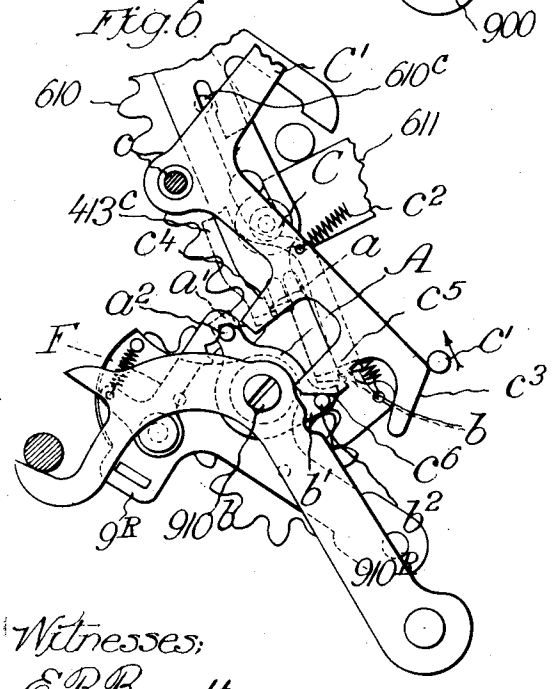


Fig.10

DEPOSITS	WITHDRAWALS	BALANCE
100.00	75.00-	
200.00	210.00-	
175.00	200.00-	100.00*
300.00	30.00-	
180.00	25.00-	
400.00	50.00-	775.00*

Witnesses:
E. R. Barrett
Robert Dobberman

Inventor
Frank C. Rinsche
by Richardson Wentworth Baxley
his Attys

F. C. RINSCHE.

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5 SHEETS—SHEET 4.

Fig. 7.

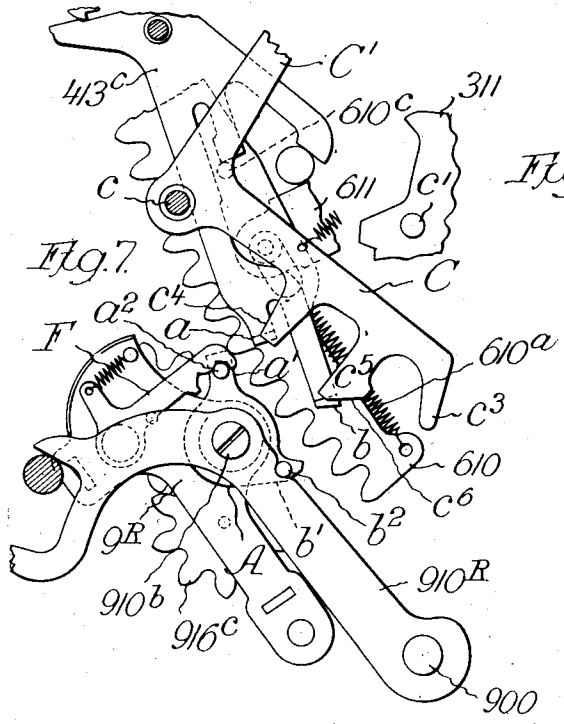


Fig. 8.

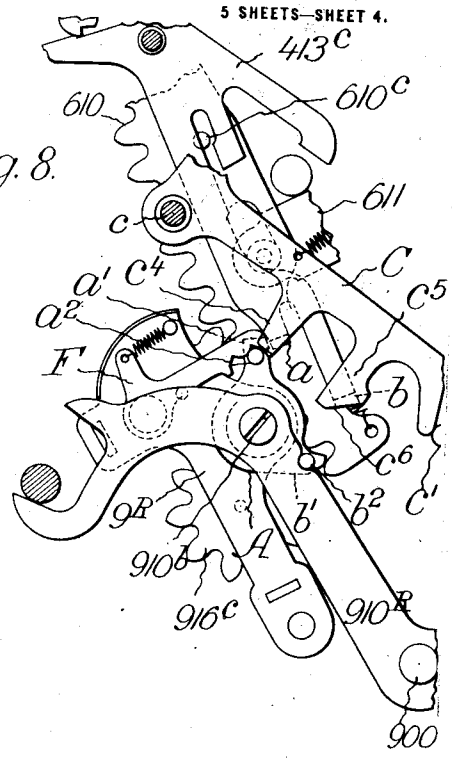
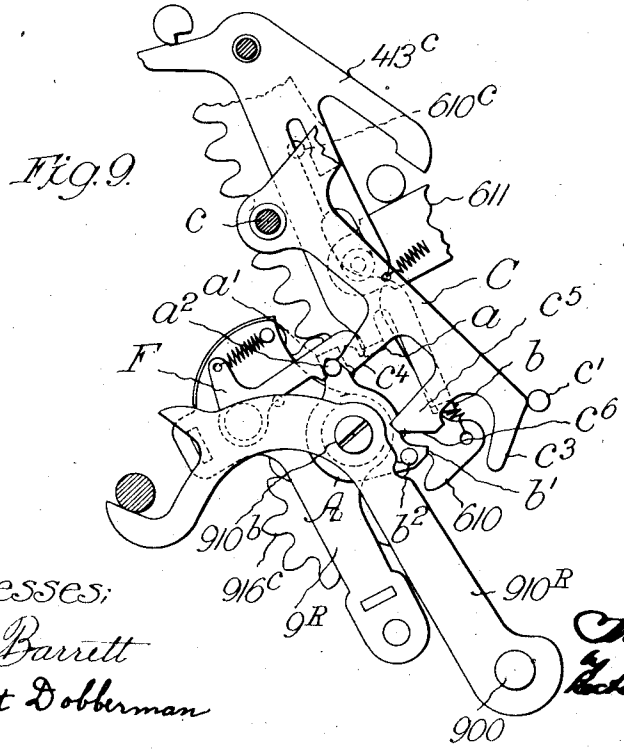


Fig. 9.



Witnesses:
E. R. Barrett
Robert Dobberman

Inventor
Frank C. Rinsche
by Richard Allen Davis
& Macauley
his Attys.

F. C. RINSCHE.

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1,172,484.

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5 SHEETS—SHEET 5.

Fig. 11.

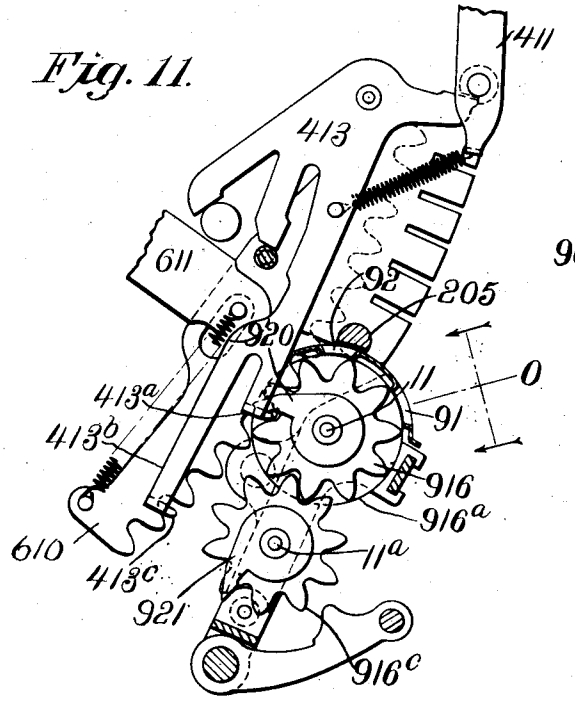


Fig. 13.

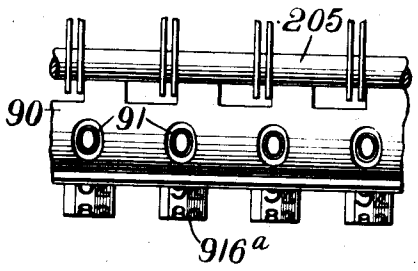


Fig. 14.

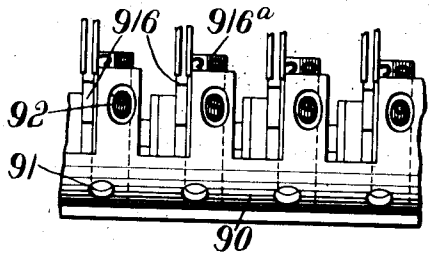


Fig. 12.

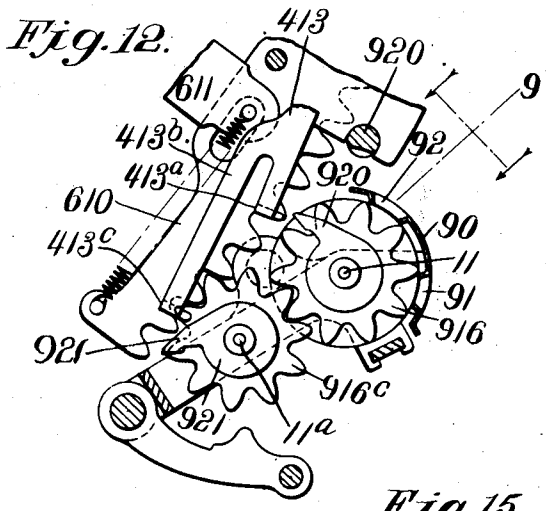
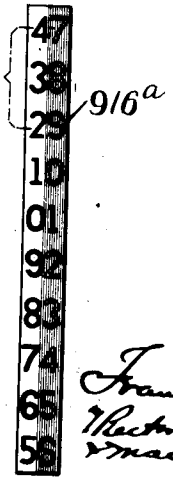


Fig. 15.



WITNESSES

J. A. Brophy

Robert Dobberman

INVENTOR

Frank C. Rinsche

by Richardson Dann Macauley & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

FRANK C. RINSCHE, OF DETROIT, MICHIGAN, ASSIGNOR TO BURROUGHS ADDING MACHINE COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

ADDING AND LISTING MACHINE.

1,172,484. Specification of Letters Patent. Patented Feb. 22, 1916.

Application filed December 15, 1911. Serial No. 665,899.

To all whom it may concern:

Be it known that I, FRANK C. RINSCHE, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Adding and Listing Machines, of which the following is a specification.

This invention relates to adding and listing machines equipped for direct subtraction, as distinguished from subtraction by complemental adding.

The object of the invention is to accomplish the printing of a true "negative total",—that is to say, an overdraft, automatically.

In my prior application, Serial No. 648,683, filed September 11, 1911, I show and describe an adding and listing machine with a subtraction equipment, and the printing of such negative total is there provided for, but requires manipulation of a special key. By the present invention this is done away with, the work that was accomplished by said special key being performed automatically as an incident to the operation of the machine as a whole. Direct subtraction is provided for in my prior construction by the employment of an additional set of pinions which are constantly in mesh with the pinions of the registering wheels. The two sets of pinions are mounted in a cradle carried by a rocking frame such as that ordinarily found in adding and listing machines. The cradle is movable in the frame, so that the pinions of the registering wheels may directly engage with and disengage from the actuating racks in the rocking of the frame, or the additional set of pinions may so engage with and disengage from said racks. In the latter case it will be obvious that the registering wheels will be turned by the racks oppositely to their turning when their own pinions directly engage with the racks. Thus subtraction may be accomplished, determined in amount by the use of the same regular keys that serve ordinarily for addition. Furthermore, the same transfer mechanism will serve for borrowing that ordinarily serves for carrying. Transfer projections on the extra set of pinions, however, will necessarily be located differently from the regular transfer projections on the pinions of the registering wheels, for the reason that in adding, the transfer mechanism should be tripped off when the registering wheels move from "9" to zero, whereas in subtracting the transfer mechanism should be tripped off when the registering wheels move backward from zero to "9". The setting up of the usual total as a plus or positive quantity involves backward rotation of the registering wheels until their transfer projections encounter shoulders of the transfer pawls. This is a very familiar way of causing the type carriers of these machines to set up in type what the wheels have been registering. The extra set of pinions will necessarily rotate oppositely to the pinions of the registering wheels, and so may be considered as turning forward during subtraction. When so turning, these pinions would be engaged with the racks. Obviously, such forward turning of these pinions would be complemental to the backward turning of the registering wheels. Conversely, backward turning of the extra set of pinions accompanies forward turning of the registering wheels, so that the extra set of pinions would in effect be always registering the complement of what said wheels register. Consequently the turning of the extra set of pinions backward, after the manner of the turning backward of the registering wheels in an ordinary totaling operation, would set up in type the complement of the registration on the wheels. If there had been an overdraft on the wheels, they would not have shown the amount of the overdraft, but the complement thereof. Hence, the amount set up and registered by the above mentioned backward turning of the extra pinions would be the overdraft itself, or negative total. However, if this is all that is done, this negative total will be one unit short. In my former construction this was compensated for by causing the before mentioned special key to impart a unit of movement to the pair of lowest order pinions prior to operating the machine for the printing of the negative total.

According to the present invention, the supplying of the needed unit of movement

is accomplished automatically as a result of preparing the machine to do subtraction. I here show and describe the same arrangement of pinions as in my aforesaid application, and I have provided for the setting up of certain tripping devices by the rocking of the cradle. Then when the machine is operated a pawl, such as that ordinarily employed in these machines for transfer purposes, will be tripped to permit the rack of the lowest order to partake of a one-step movement and so supply the needed unit in the registration. This necessarily affects both sets of pinions, and consequently the tripping arrangement is made double-acting, so that when the cradle is rocked the other way, the unit which was added to the negative total will be subtracted and the registration restored to what it was before.

In the accompanying drawings, which illustrate a preferred form of embodiment of my invention, Figure 1 represents in left side elevation a sufficient portion of the machine of the well known Burroughs type to show the application of my invention thereto; Fig. 2 illustrates in a diagrammatic way certain transfer elements; Fig. 3 is a right side elevation of the particular portion of the machine where the parts occur for embodying the present invention; Fig. 3ª is a sectional detail on line 3—3 of Fig. 3; Figs. 4, 5, and 6 are views somewhat similar to Fig. 3, and illustrate steps in operation under a subtracting condition; Figs. 7, 8 and 9 are views similar to Figs. 4, 5 and 6, illustrating the corresponding stages in operation under an adding condition; Fig. 10 shows an example of work; Figs. 11 and 12 are sectional left side elevations of the accumulating department of the machine and particularly the carrying mechanism, Fig. 11 showing an adding adjustment and Fig. 12 a subtracting adjustment; Figs. 13 and 14 are fragmentary front elevations representing the view had of the inscriptions on the registering wheels by the user of the machine under the adding adjustment (Fig. 13) and under the subtracting adjustment (Fig. 14); Fig. 15 represents a developed periphery of one of the registering wheels.

In the drawings the reference numeral 291 designates the depressible amount keys of the ordinary kind, and the numeral 610 designates the customary racks, whose excursions are measured by stops set by said keys. These racks, as usual, are carried upon the forward ends of levers 611 whose rear arms carry the type plates 618. The numeral 916 designates a set of pinions adapted to cooperate with the racks in the ordinary way for performing addition and setting up in type a positive total. These pinions are fastened respectively to the wheels 916ª, which exhibit registrations through openings in the cover plate 90. The numeral 916ᶜ designates an additional set of pinions constantly in mesh with the pinions 916 and having the same number of teeth and being adapted to transmit movement to said pinions 916 in subtracting operations. Both sets of pinions are carried in a cradle which comprises side members 9^L and 9^R and suitable connecting tie-pieces. This cradle is arranged between and pivotally mounted upon side members 910^L and 910^R of a rocking frame such as that ordinarily employed in a Burroughs machine to carry the single set of pinions. The pinions 916 are journaled above the rocking center of the cradle, and the pinions 916ᶜ are journaled below said rocking center, so that when one set of pinions is moved toward the racks by the rocking of the cradle, the other set is moved away from the racks.

It will be clear, from the above, that if the cradle is set in one of its above indicated positions, and the machine operated in the ordinary manner, the pinions 916 will perform as usual in adding up successive amounts, whereas if the cradle is set in the other of its two positions, the racks will take effect directly upon the extra set of pinions, and the registering wheels will therefore be turned backward for subtraction purposes.

Each of the wheels 916ª is peripherally inscribed with two series of numerals and ciphers (Fig. 13–15), one series running reversely to the other and the two so related that numerals representing an accumulation will be displayed under an adding adjustment and numerals representing the complement of the accumulation will be displayed under a subtracting adjustment. The cover plate 90 has two series of sight openings 91 and 92 circumferentially spaced a distance corresponding with two teeth of a pinion 916, see Fig. 12, and the two series being staggered with relation to each other (Fig. 14) so that the openings 91 aline with the adding series of numerals and the openings 92 aline with the subtracting or complementary series of numerals. The latter are illustrated in the drawings on shaded portions of the wheels and in Fig. 15 a wheel periphery is shown developed and a bracket designates the relation between the series which provides for a numeral of the adding series (2) shown at an opening 91 while the complemental numeral (7) is at an opening 92. The shield or cover plate is fixedly mounted upon the cradle and so simply rocks with it, but it is so located thereon that when the upper pinions 916 are in mesh with the racks the openings 92 are concealed from view and the openings 91 are presented to the view of the user disclosing the addition numerals, or the ciphers of the addition series as illustrated in Fig. 13, whereas when

the cradle is rocked to put the lower pinions 916^c in mesh with the racks, the other set of openings 92 will be presented to the view of the user and the openings 91 will be carried practically out of range so that the numerals or ciphers of the complemental series will be exposed as illustrated in Fig. 14, wherein a series of 9's show as complemental to the zeros of Fig. 13.

As to transfer mechanism, the racks 610 are slotted as usual to provide for one-step movements thereof relative to the levers 611, and springs 610^a tend to so move them. Pawls 413 normally prevent such movement, and are arranged, as usual, to be displaced by transfer projections or cams 920 on the pinions 916 which act against feet 413^a of the pawls (Fig. 11). In the present instance the pawls 413 have downward extensions 413^b (Figs 2, 11 and 12) with feet 413^c for coöperation with transfer cams or projections 921 on the pinions 916^c for borrowing purposes. When the latter pinions are coacting directly with the racks (Fig. 12), their said transfer projections are in position to act upon the transfer pawls, whereas transfer projections 920 of the regular pinions 916 are forward, so that the pawls are out of their range. Conversely, when the regular pinions are coacting directly with the racks (Fig. 11), their transfer projections are in position to act upon the transfer pawls, and the latter are out of range of the transfer projections on the pinions 916^c. This is illustrated in Fig. 2 by full and dotted lines, and it will be obvious that the transfer action of the racks is the same, whichever set of pinions is directly coöperating with them, though the registering wheels turn one way in the one case and the opposite way in the other case. Fig. 2 also illustrates the different positioning of the transfer projections on the two sets of pinions, which matter was alluded to in the opening paragraphs of this specification. In this figure of the drawings it will be noted that the transfer projection 920 is against the upper foot of the transfer pawl, which means that the corresponding registering wheel is at zero. It will be noted that the transfer projection 921 of the companion pinion is one step away from the lower foot of the transfer pawl, which means that it is in effect registering "9." Obviously, it would move through nine spaces turned in the direction of the arrow in said figure of the drawings, until its transfer projection encountered the upper side of the lower foot of the transfer pawl. This necessarily means that if the registering wheel 916^a was showing zero, and the companion pinion 916^c was put in mesh with the associated rack, and a totaling operation of the usual kind practised, the "9" type would be brought to the printing line. The same thing would necessarily hold good if the registering wheel happened to be showing something else. For example, if the wheel showed "5," the "4" type would be brought to the printing line. It must be apparent, therefore, that a totaling operation practised with the extra pinions in mesh with the racks would result in the setting up of the complement of what the wheels were registering, and if the registration represented an overdraft, there would be set up the negative total, though, for the reasons above stated, such negative total would be one unit short.

Coming now to the improvement supplied by the present invention, I mount upon the cradle pivot stud 910^b, at the right-hand side of the machine (Fig. 3), a tappet-piece A which is frictionally engaged with the cradle to be shifted thereby and is adapted to produce a one-step movement of the rack 610 of the lowest numerical order, for the purpose of supplying the unit needed to bring the negative total up to its true value. Ordinarily, in these machines, this lowest order rack does not have such movement as do the other racks, because there is no transferring to the lowest order wheel. It does, however, have the same slot-and-pin connection with its lever 611 that the other racks have with their levers, this being necessary for the bringing of a cipher to the printing line in the lowest numerical order. Ordinarily a fixed stop prevents upward movement of this lowest order rack beyond its normal position. In the present instance, however, a transfer pawl 413^c (Fig. 3) is associated with the said rack to perform a function similar to that performed by the transfer pawls 413 already mentioned. Thus, it normally engages a stud 610^c on the lowest order rack to restrain the spring 610^a of the latter. This pawl 413^c has laterally turned portions or feet a and b at different elevations for coöperation with the tappet-piece A. The latter has an upwardly projecting finger a' to act against the foot a, and a lower rearwardly projecting finger b' to act against the foot b. The finger b' serves, under a subtraction adjustment of the machine, to trip the pawl, whereas the finger a' serves, under an adding adjustment of the machine, to trip the pawl.

To explain the negative total unit-supplying operation of parts thus far pointed out, let it be supposed that the machine has been operated to add up a series of items, and that it is then put into the subtracting condition by rocking the cradle to disengage the pinions 916 from the racks and put the pinions 916^c in position for direct operation with the racks. Such rocking of the cradle would shift the tappet-piece A from the position shown in Fig. 3 to the position shown in Fig. 4, where it will be observed that the

finger b' is brought into line with the foot b. Now, the first thing that happens after the handle of the machine has been drawn forward and starts back, whether amount keys have been depressed or not, is a rearward rocking of the main accumulator frame carrying the pinions 916^c into mesh with the racks and at the same time carrying the finger b' of the tappet-piece against the foot b, thereby displacing the pawl 413^c, as illustrated in Fig. 5. The handle being then still most of the way forward, and the familiar restoring frame 613 for the levers 611 therefore down, no movement of the units rack would immediately ensue except such as it might have as a result of depression of a key in its bank or row. However, the acting portion of the pawl 413^c will have been moved out of line with the stud 610^c and so held by a latch 411 of the familiar type. Consequently, when the handle goes on back to normal, the units rack will partake of a one-step movement beyond its own normal position, and the intermeshed pinion 916^c will be turned one step. Therefore the registration which may be considered as carried by the pinions 916^c as a complement to the registration that was exhibited by the wheels 916^a, will be increased by one unit, the registration which shows on the wheels 916^a being correspondingly decreased by one unit. In this way the true negative total will become registered on the pinions 916^c when subtracting operations have overdrawn the registration that was on the wheels 916^a, so that by then practising a totaling operation of the usual character, but with the pinions 916^c controlling descent of the racks, the true negative total will obviously be set up and printed.

It will be understood, of course, that so long as the total that the wheels 916^a are registering represents a plus or positive quantity, no totaling operation should be practised with the pinions 916^c engaging the racks. Therefore the taking of a negative total would not in the above example follow immediately upon the putting of the machine in a subtracting condition, for one or more subtracting operations would necessarily be performed before an overdraft occurred. A negative totaling operation might, however, be in order after putting the machine in subtracting condition and without then performing any subtraction, for the work in hand might very well call for changing the machine to adding condition with the overdraft still in registration, and an amount or amounts then added might not make up the overdraft. In either case it would be sufficient theoretically to supply the needed unit for the negative total just before a totaling operation, but I have found it a better mechanical proposition to supply this unit in the first operation of the machine following its conversion into subtracting condition, whether that first operation is merely a so-called blank operation preceding a totaling operation or is an operation which performs subtraction.

Whenever the machine is changed back to an adding condition, the unit that was added on the pinions 916^c and subtracted from the wheels 916^a as a result of previous operation in subtracting condition, must, of course, be retaken from the pinions 916^c and added on the said wheels 916^a. This would be so whether the latter wheels were registering a positive total or the complement of a negative total. It will, of course, be understood that after one or more subtracting operations, addition may be resumed without any overdraft having occurred and without there having been any occasion for a totaling operation, and, even though an overdraft had occurred, resumption of adding operations may take up the overdraft and cause the total to become again positive. Thus, adding and subtracting operations may go on indefinitely, and the total may change back and forth between positive and negative, but with each change from addition to subtraction the unit will be taken from the registration on the wheels 916^a, whether it be that of a positive total or the complement of a negative total, and, likewise, the unit will be restored to the wheels 916^a whenever the machine is changed from a subtracting to an adding condition. The latter effect is produced by reason of the fact that when the cradle is rocked from a subtracting to an adding position, the tappet-piece A is rocked so as to move its finger a' toward the foot a of the pawl 413^c (Fig. 7) and far enough in that direction to provide for action of said finger upon said foot when in the ensuing operation of the machine the main accumulator frame is rocked rearward to engage the pinions 916 with the racks (Fig. 8). Obviously, this results in displacing the pawl 413^c and permitting the units rack to move upward one step beyond its normal position, turning the units wheel 916^a one step forward.

In case of displacement of the pawl 413^c either by the finger a' or the finger b', there must not be repeated displacement of said pawl in further operations of the machine under the same condition. Therefore means are provided for automatically moving the tappet-piece A to a neutral position during the same operation in which the pawl is displaced, so that in further operations of the machine the rocking of the main accumulator frame will have no effect upon said pawl. Said means comprise a lever C pivoted upon a frame stud c, and a stud c' on the familiar full-stroke sector 311. Said lever is normally retracted by a spring c^2, and is vibrated twice in every operation of

the machine by reason of the stud c' wiping over and past the upper edge of the lever during the forward pull of the operating handle and similarly acting upon the angular rear edge c^3 of the lever during the return stroke of the operating handle. The lever has a forwardly and downwardly projecting finger c^4 which is adapted to act upon a stud a^2 of the tappet-piece A, and said lever has at a lower point a similarly projecting finger c^5 formed with a cam edge c^6 to act upon a stud b^2 on said tappet-piece. The studs a^2 and b^2 are on opposite sides of the rocking center of the tappet-piece A and associated respectively with the fingers a' and b' of the latter.

When the cradle is rocked to the subtracting position shown in Fig. 4, the stud b^2 is put in line with the cam edge c^6, but is so far spaced therefrom that in the forward swing of the lever C, which occurs during the forward stroke of the operating handle, the finger b' will not be rocked out of line with the foot b by any action of said cam edge upon said stud. See dotted line position of lever C in Fig. 4. When the main accumulator frame is rocked rearward during the first part of the return stroke of the operating handle, the lever C stands in its retracted or normal position, the stud c' having gone considerably beyond the lever in the forward stroke of the operating handle and not having more than reached the lever in the return stroke of the handle (see Fig. 5.) Meantime the finger b' will have displaced the pawl 413^c, and the stud b^2 will have moved back and taken up a position in close proximity to the cam edge c^6 (Fig. 5.) Then the stud c' acts upon the angular edge c^3 of the lever C, forcing the latter forward and effecting a camming action of the edge c^6 upon the stud b^2 (Fig. 6), whereby the tappet-piece A is moved to a neutral position in which its finger b' is out of line with the foot b and the finger a' is still sufficiently retired to be inactive upon the foot a. A similar action occurs when the cradle has been rocked to the adding position and the finger a' has been advanced (Fig. 7) for action upon the foot a. During the first ensuing forward stroke of the operating handle, in such case, the stud a^2 is so far spaced from the end of the finger c^4 that the vibration of the lever C has no effect upon the tappet-piece A (see dotted lines Fig. 7), but the rearward rocking of the main accumulator frame in the first part of the return stroke of the operating handle, while causing the finger a' to displace the pawl 413^c by action upon the foot a (Fig. 8), at the same time moves the stud a^2 up to the end of said finger c^4, so that thereafter in the forward swinging of the lever C the tappet-piece will be rocked by the action of the said finger upon the said stud and put into the neutral position above defined, as illustrated in Fig. 9.

The frictional means before alluded to as connecting the cradle and the tappet-piece A takes the form of an arm F (Figs. 3, 3^a, 4 to 9) which is pivoted to the right side member 9^R of the cradle, and has a notched or fluted rear portion engaging over the stud a^2. A spring f connects a branch of said arm to an upper portion of said cradle side-member, and the formation at the rear portion of the arm comprises two notches with a rounding edge between them; also limit-lugs beyond the notches. The tappet will have its stud a^2 forced out of one notch into the other by the action of the before described neutralizing means, to wit, the lever C with its two arms c^4 and c^5.

It will be understood that the tappet-piece is always in a neutral position except immediately after a change of the machine from adding to subtracting condition, or vice versa, and during the forward stroke and the first half of the back stroke of the operating handle in the ensuing operation of the machine.

It will be noted that under the adding condition illustrated in Fig. 3, the stud a^2 is engaged with the forward notch of the holding arm F. In the rocking of the cradle to subtracting position (Fig. 4) this engagement continues, and the said arm rocks the tappet-piece to bring the finger b' into line with the foot b. In the neutralizing action illustrated in Fig. 6, the stud a^2 is forced out of said forward notch and into engagement with the rear notch. Then when the cradle is rocked to the adding position (Fig. 7), the latter engagement continues and the tappet-piece is rocked to move the finger a rearward so that in the ensuing rearward swing of the main accumulator frame said finger will act on the foot a (Fig. 8). The neutralizing action that follows forces the stud a^2 back into the forward notch again.

No totaling operation should be possible immediately following the setting of the accumulator cradle in either of its two positions, for a totaling operation means the engagement of one set of pinions or the other with the racks for the initial or downward movement thereof when the needed unit will not have been supplied to a negative total nor restored to a positive total. Hence, provisions are made for preventing a totaling operation until the machine has been otherwise operated. Then there are the usual provisions for preventing a totaling operation until racks carried upwardly beyond normal for transfer purposes have been restored, and this in the present instance would apply to the units rack. Hence, two successive blank strokes of the operating handle would have to be taken be-

fore the totaling operation could be had immediately following the change of the machine from adding to subtracting condition, or vice versa. The first such blank stroke would restore the racks to normal (advanced an extra step for transfer purposes), and would supply the needed unit, and the second such blank stroke would restore the units rack to normal.

The preventing means above referred to are of the following description: The reference numerals 424^L and 424^R designate the two side members of the usual total-key locking-bail that is swung rearward whenever any amount key 291 is depressed, and is held rearward so long as any transfer latch 411 remains displaced, and this in the present instance would apply to the transfer latch which is associated with the pawl 413^c. Additional means are provided in the present instance for swinging said bail rearward to locking position and holding it there, such additional means coming into play as an accompaniment to the rocking of the accumulator cradle. The rocking of the latter is done (through connections hereinafter pointed out) by a lever 10 (Fig. 1) which is pivoted upon a frame stud 10′, and, when swung one way or the other, vibrates an arm D which is pivoted upon another frame stud d and has an upwardly extending branch d' with a laterally turned end portion d^2 directly in front of the side member 424^L of the aforesaid locking bail. Obviously then the shifting of the lever 10 causes the arm D through its branch d' to swing the said bail rearward to locking position if it is not already occupying that position as a result of depression of amount keys or that and displacement of the transfer latches. Said bail is spring-drawn forwardly, as usual, and therefore, if forced rearwardly by the said arm D, it would immediately return and unlock the total key in the absence of some means for preventing this. (It will be noted that vibration of said arm D is effected by the action upon its roller d^4 of a double cam nose 10^f on the lever 10, one side edge of said nose or the other acting upon the roller and then passing by the same, the end edge of the nose also passing by the roller so that the arm D is free to return after having acted upon the bail.) The means provided for detaining the bail, when rocked rearward by the arm D, comprise a gravity catch E (Fig. 3) pivoted on the cross-rod which supports the transfer latches 411, and a stud e on the side member 424^R of the bail. Normally the stud is forward of the detaining shoulder e' of said catch, but when the bail is forced rearward said stud passes said shoulder and the catch drops. For the purpose of releasing the bail from the catch, I make use of the before described lever C, which has an upwardly extending branch C′ with a widened end portion c^7 whose upper edge is adapted to act with a camming effect upon a roller e^2 on the catch. It will be remembered that the lever C is vibrated during the forward stroke of the operating handle. The first part of such vibration would carry the widened end portion c^7 against the roller e^2, and the catch E would be lifted and disengaged from the bail.

Coming back to the left-hand side of the machine (Fig. 1), and referring to the means operated by the lever 10 for rocking the cradle, it is first to be explained that the arm D, which was before described as vibrated by said lever 10, has other functions than heretofore ascribed to it. A lower extension d^5 of said arm extends down behind the head of the cradle pivot stud 910^d, so that when said arm is forced forward by the lever 10, this lower extension will act upon said stud and throw forward the main accumulator frame. The purpose of this is to disengage from the racks whichever set of pinions happens to be in mesh therewith. It would be obviously inexpedient to rock the cradle without first disengaging the engaged set of pinions. The lower extension of the arm D also serves to unlock the cradle from either of its two set positions. Thus, said extension acts upon a stud g of a curved locking arm G which is journaled upon the pivot shaft 900 of the main accumulator frame and carries a locking stud g' for engagement with notches 9^f and 9^g in a segmental branch 9^e of the side member 9^L of the cradle. A spring 9^d applied to said arm G draws it upward to engage its stud g' with one or the other of said notches. The stud g extends through a slot in the side piece 910^L of the main accumulator frame, alongside which the lower extension of the arm D works. At the beginning of movement of the lever 10 the arm D acts upon said stud g and unlocks the cradle, which is thereupon shifted and becomes relocked as the lever 10 completes its movement.

The rocking of the cradle is effected through the medium of a lever H and a cam slot 10^c in the lower widened part of the lever 10. Said lever H is pivoted on a frame stud h and is forked at its forward end to embrace a stud 9^c on a rearwardly extending branch of the side member 9^L of the cradle. Said lever carries a roller stud h^2 engaging the cam slot 10^c. The latter has short end portions concentric with the pivot stud 10^a to provide for a preliminary movement of the lever 10 without affecting the lever H, during which preliminary movement the main accumulator frame is thrown forward while the cradle is relatively stationary. The middle portion of the slot 10^c acts with a camming effect upon

the roller stud h^2 to rock the cradle one way or the other, according to the direction in which the lever 10 is moved.

The totaling system is that commonly employed in machines of this type, said system comprising the total-key bell-crank lever 227 with locking stud 227^a to coöperate with the bail member 424^L; pendent link 911; forked pitman 914 notched for engagement with studs on the main accumulator frame above and below the shaft 900; three-armed lever 913, to which the pitman is pivoted; rocking arm 813; and wiper pawl 821.

Referring to the example of work afforded by Fig. 10, it may be assumed that the first operation consists in registering $100 as a deposit and the next operation consists in subtracting $75 and so on, alternating additions and subtractions, with periodical totaling operations as indicated. Assuming a nine bank machine, the changing the adjustment of the machine from one for addition to one for subtraction, with the wheels registering 0000100.00, and then operating the machine, would have the effect of changing that registration to 0000099.99, if no amount keys were used, but in the example under consideration there is in this operation a subtraction of 75.00 so that a remainder-registration results which, if viewed through the addition sight opening 91, would be 0000024.99. Upon then restoring the machine to an adding condition and operating without using amount keys this remainder would be raised to 0000025.00. But amount keys are used to add 200.00, as indicated in the example, so that a totaling registration of 0000225.00 would result. Then, upon again putting the machine in subtracting condition and using amount keys for a subtraction of 210.00, this registration would be reduced to 0000014.99, but upon again putting the machine in adding condition and operating the machine, this remainder would be raised to 15.00, and with the accompanying addition of 175.00 the total would show as 0000190.00. Upon changing the machine to subtracting condition and using amount keys for subtraction of 200.00, this registration would be effaced and a complemental over-draft registration would result which as seen through the addition sight opening 91 would be 9999989.99. This of course represents an actual over-draft of 10.00 which would show upon the registering wheels 916^a under the subtraction adjustment, that is to say through the upper series of openings 92 in the cover plate 90, as 0000010.00. The example in the drawings shows what the printed record would be, assuming of course a laterally adjustable paper carriage providing for the printing of added amounts in one column and subtracted amounts in the other and the balance or total in still another column. With the wheels so registering 0000010.00, an operation of the machine under the subtracting adjustment and with total or subtotal key depressed would obviously result in printing the overdraft of 10.00.

Continuing with the example, the restoration of the machine to an adding condition and operation without the use of amount keys would change the registration, as seen through the addition sight opening 91, to 9999990.00, but with the addition of 300.00 this would be changed to a registration of 0000290.00. Upon conversion of the machine to subtracting state and its operation with keys depressed for subtraction of 30.00, this registration would become 0000259.99; and then with the restoration to an adding state and operation with keys depressed to add 180.00, the total would become 0000440.00. Then upon again changing the machine to a subtracting condition and operating with keys depressed for the subtraction of 25.00, the registration would become 0000414.99. Restoration of the machine to adding condition and operation with keys depressed for the addition of 400.00 would bring the total up to 0000815.00. Changing again to subtracting condition and operating with keys depressed for subtraction of 50.00 would leave the registration 0000764.99, and then with the restoration to adding condition and an operation without depression of keys, the correct total 0000765.00 would appear. Obviously an operation of the machine then practised with total or subtotal key depressed and with the adding condition maintained, would result in printing this total.

I claim:

1. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators, and means for changing the timing of direct engagement between either set of wheels and the actuators for totaling purposes.

2. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöpera-

tive relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, and means for changing the timing of direct engagement between either set of wheels and the actuators for totaling purposes.

3. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators, means for changing the timing of direct engagement between either set of wheels and the actuators for totaling purposes, and means for preventing setting of said last mentioned means immediately following shift of the sets of wheels.

4. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, means for changing the timing of direct engagement between either set of wheels and the actuators for totaling purposes, and means for preventing setting of said last mentioned means until after an operation of the prime mover has been had.

5. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means tending to impart a unit of movement to the lowest order wheel of a set, tripping means set as an incident to shifting the wheels to bring that set into direct coöperative relation with the actuators, means for changing the timing of direct engagement between either set of wheels and the actuators for totaling purposes, and means for disabling the tripping means in operation of the prime mover.

6. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together and shiftable to put either set in direct coöperative relation to the racks, both sets having parts to trip said pawls; a double-acting pawl-tripping device shiftable with said sets of pinions to positions for acting upon the pawl of the lowest order rack; means for engaging and disengaging the racks and either set of pinions for adding in the one case and subtracting in the other; and means for changing the timing of engagement of either set for totaling purposes.

7. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together and shiftable to put either set in direct coöperative relation to the racks, both sets having parts to trip said pawls; a double-acting pawl-tripping device shiftable with said sets of pinions to positions for acting upon the pawl of the lowest order rack; means for engaging and disengaging the racks and either set of pinions for adding in the one case and subtracting in the other; means for changing the timing of engagement of either set for totaling purposes; a prime mover; and means operated thereby to set the said double-acting tripping device in a neutral position.

8. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together and shiftable to put either set in direct coöperative relation to the racks, both sets having parts to trip said pawls; a double-acting pawl-tripping device shiftable with said sets of pinions to positions for acting upon the pawl of the lowest order rack; means for engaging and disengaging the racks and either set of pinions for adding in the one case and substracting in the other; means for changing the timing of engagement of either set for totaling purposes; means for locking said totaling means as an

incident to shifting of pinions; a prime mover; and means operated by the latter for unlocking the totaling means.

9. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a frame carrying the cradle and movable to engage pinions with and disengage them from the racks; means carried by the said frame and settable by the said cradle for tripping off the pawl of the lowest order rack; and means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes.

10. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a frame carrying the cradle and movable to engage pinions with and disengage them from the racks; a double-acting pawl-tripping device carried by said frame and settable by said cradle to trip off the pawl of the lowest order rack; and means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes.

11. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a frame carrying the cradle and movable to engage pinions with and disengage them from the racks; a double-acting pawl-tripping device carried by said frame and settable by said cradle to trip off the pawl of the lowest order rack; means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes; means for locking said totaling provisions as an incident to shifting the cradle; a prime mover; and means operated thereby for unlocking the totaling provisions.

12. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a swinging frame in which said cradle is mounted to rock; a tappet-piece concentric with the cradle and frictionally connected thereto, said tappet adapted under two different adjustments to trip off the pawl of the lowest order rack; and means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes.

13. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a swinging frame in which said cradle is mounted to rock; a tappet-piece concentric with the cradle and frictionally connected thereto, said tappet adapted under two different adjustments to trip off the pawl of the lowest order rack; means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes; a prime mover; and means operated by the same to move the said tappet-piece to a neutral position from either of its acting positions.

14. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a swinging frame in which said cradle is mounted to rock; a

tappet-piece concentric with the cradle and frictionally connected thereto, said tappet adapted under two different adjustments to trip off the pawl of the lowest order rack; means for operating the frame to engage one set of pinions with and disengage them from the racks for adding and to engage the other set of pinions with and disengage them from the racks for subtracting, with provisions for changing the order of engagement in either case for totaling purposes; a prime mover; and a vibratory member actuated thereby and adapted to move the said tappet-piece to a neutral position from either of its acting positions.

15. In a machine of the character described, the combination of a reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a swinging frame in which said cradle is mounted to rock; a tappet-piece concentric with the cradle and frictionally connected thereto and having fingers to act, under different adjustments of the tappet-piece, upon different portions of the pawl of the lowest order rack to displace said pawl and release the rack; a prime mover; and means operated thereby to move said tappet-piece from either of its acting positions to a position in which neither of its fingers will affect the said pawl.

16. In a machine of the character described, the combination of reciprocable type carrying members; racks mounted thereon with lost motion; springs tending to take up the lost motion; pawls restraining the springs; two sets of pinions geared together; a cradle holding said pinions and shiftable to put either set in direct coöperative relation to the racks; a swinging frame in which said cradle is mounted to rock; a tappet-piece concentric with the cradle and frictionally connected thereto and having fingers to act, under different adjustments of the tappet-piece, upon different portions of the pawl of the lowest order rack to displace said pawl and release the rack, said fingers carrying studs; a prime mover; and a lever operated thereby and having fingers to act upon said studs respectively, substantially as and for the purpose described.

17. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, a total key and connections for changing the timing of direct engagement between either set of wheels and the actuators; a bail for locking out said key, manipulative means for shifting the two sets of wheels, and a member operated by said means and acting to set said bail to locking position.

18. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, a total key and connections for changing the timing of direct engagement between either set of wheels and the actuators; a bail for locking out said key, a hand lever and connections for shifting the two sets of wheels; and an arm operated by said hand lever and acting to set said bail to locking position.

19. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, a total key and connections for changing the timing of direct engagement between either set of wheels and the actuators; a spring-retracted bail for locking out said key, manipulative means for shifting the two sets of wheels, a member operated by said means and acting to set said bail to locking posi-

tion, a latch to hold it in such position, and means operated by the prime mover for tripping the latch.

20. In a machine of the character described, the combination of type carriers, actuators, two sets of wheels intermeshed and shiftable to provide for direct engagement of either set with the actuators, a prime mover and connections for engaging and disengaging actuators and wheels and for reciprocating the actuators, manipulative means for measuring excursions of actuators with either set of wheels in direct coöperative relation thereto, transfer mechanism arranged to coöperate directly with either set of wheels, means for imparting a unit of movement to the lowest order wheel of a set as a result of shifting the wheels to bring that set into direct coöperative relation with the actuators and subsequent engagement of wheels and actuators, a total key and connections for changing the timing of direct engagement between either set of wheels and the actuators; a bail for locking out said key, a hand lever and connections for shifting the two sets of wheels; and an arm operated by said hand lever and acting to disengage the wheels from the actuators and to set the said bail to locking position.

FRANK C. RINSCHE.

Witnesses:
ROYAL STEWART MIELERT,
WARREN L. HOAGLAND, Jr.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."