

N. WHITE.
ADDING MACHINE.

APPLICATION FILED MAR. 30, 1912.

Patented Dec. 10, 1912.

7 SHEETS—SHEET 1.

1,046,521.

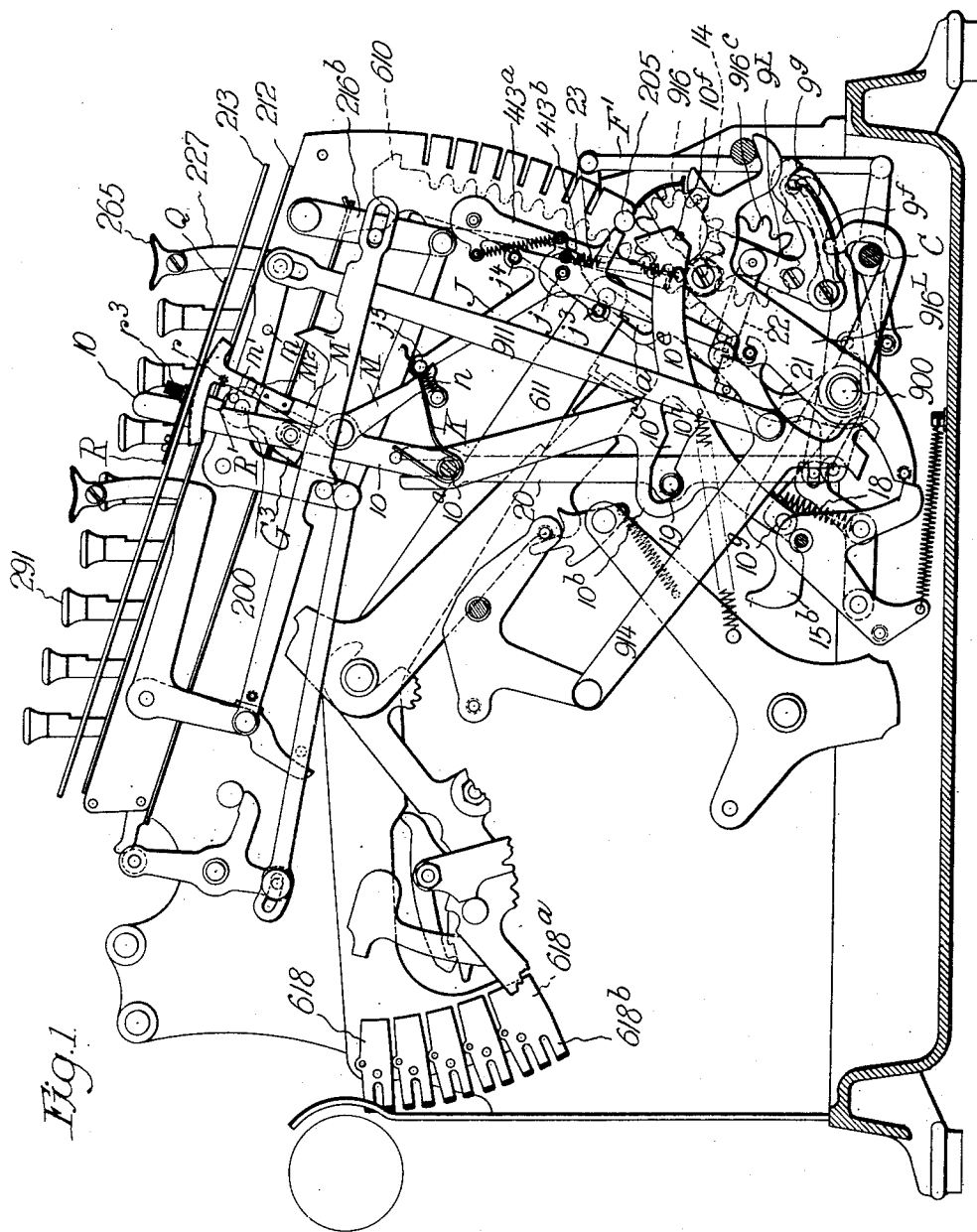


Fig. 1

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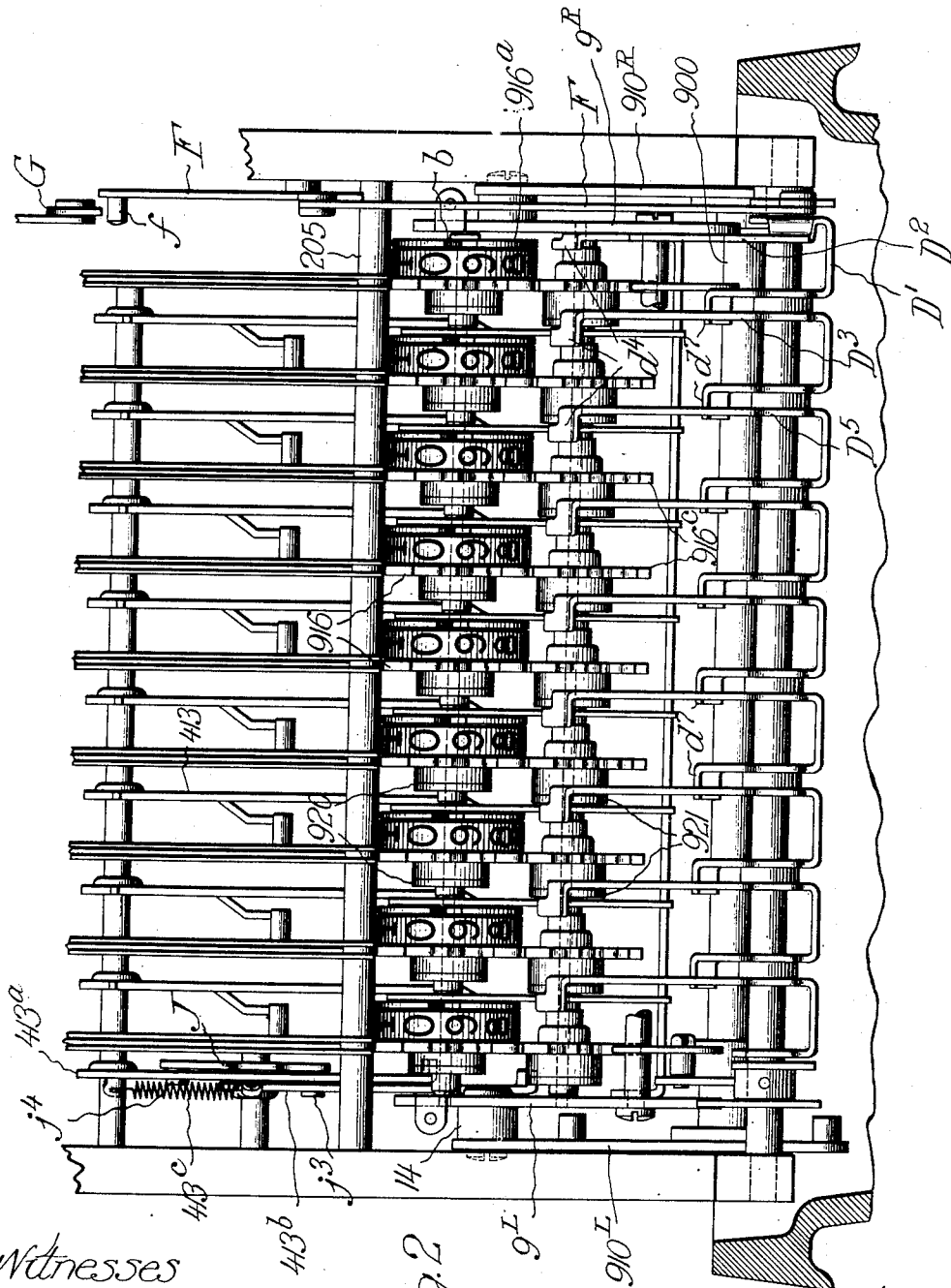
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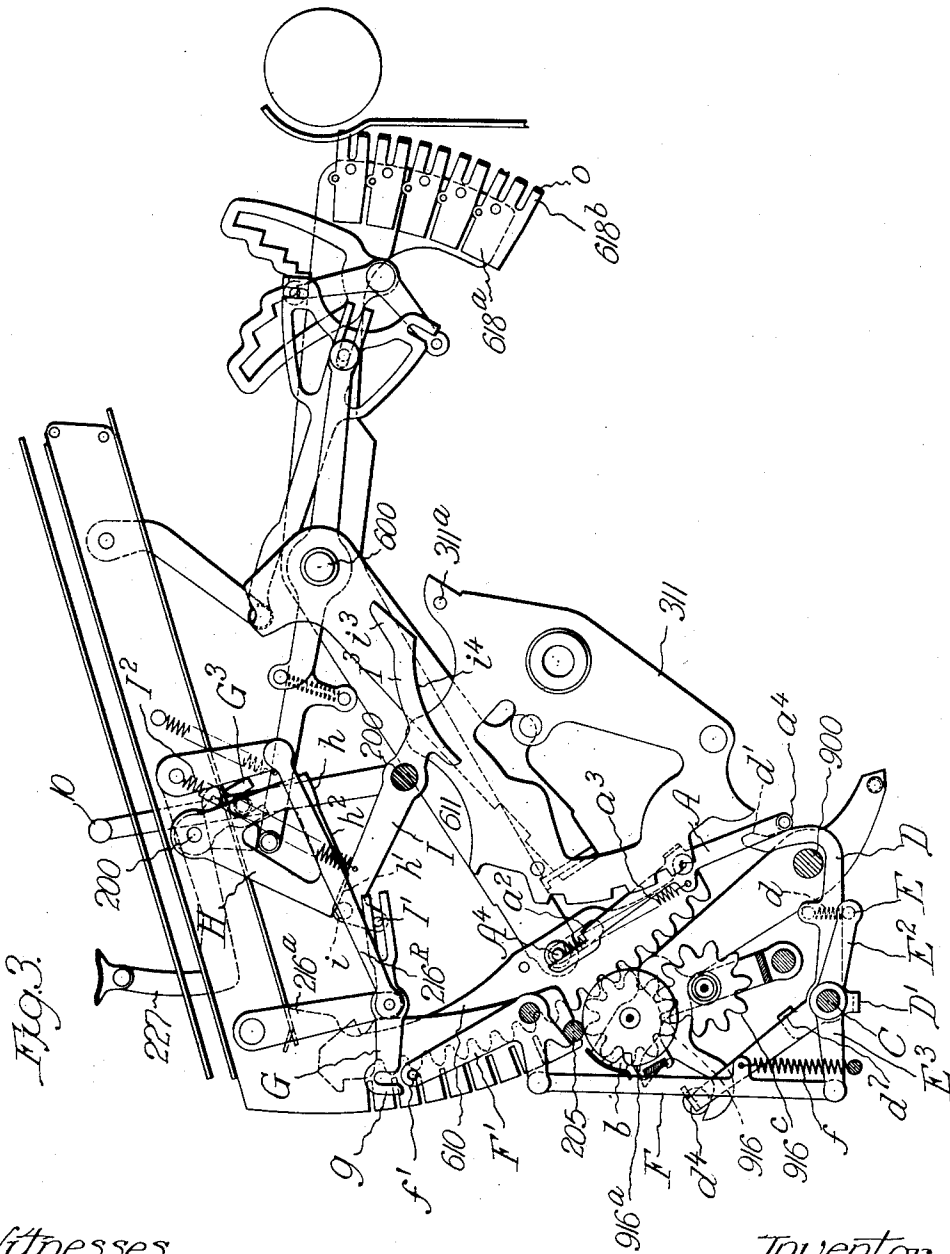
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Fig. 2

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 7 SHEETS—SHEET 3.



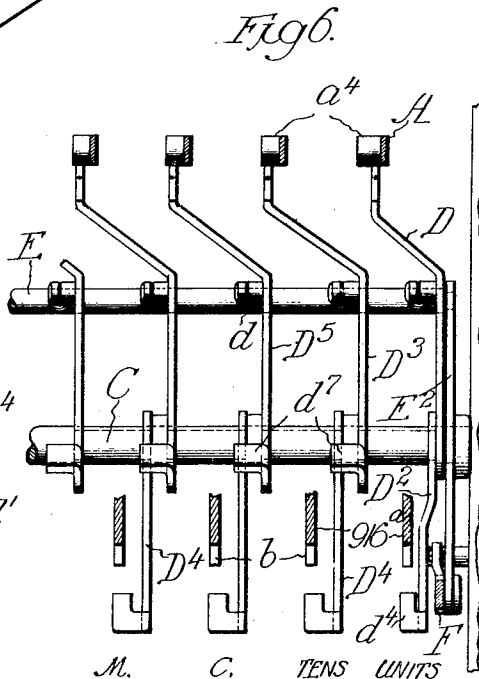
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7 SHEETS--SHEET 5.

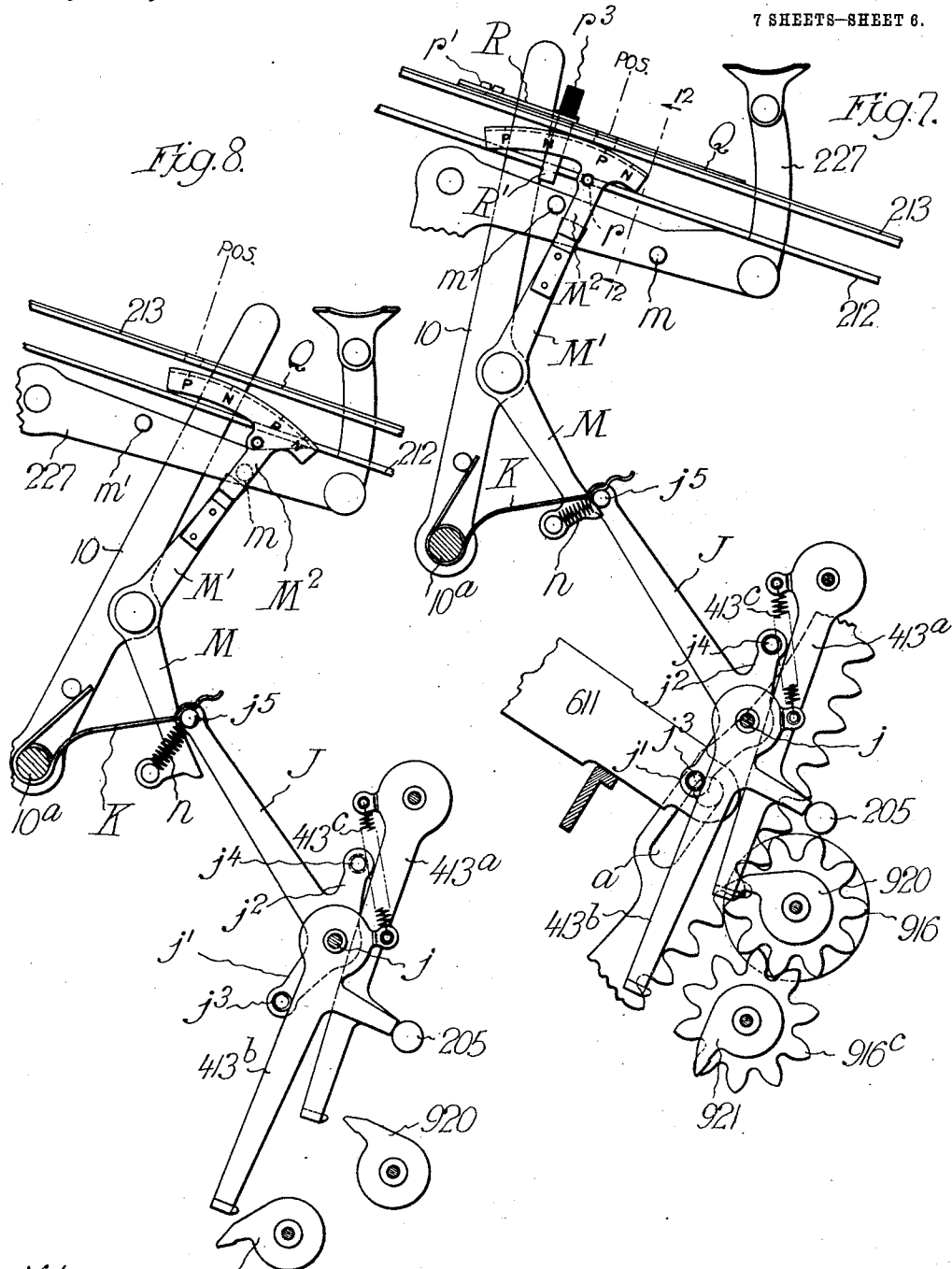


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7 SHEETS-SHEET 6.



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7 SHEETS—SHEET 7.

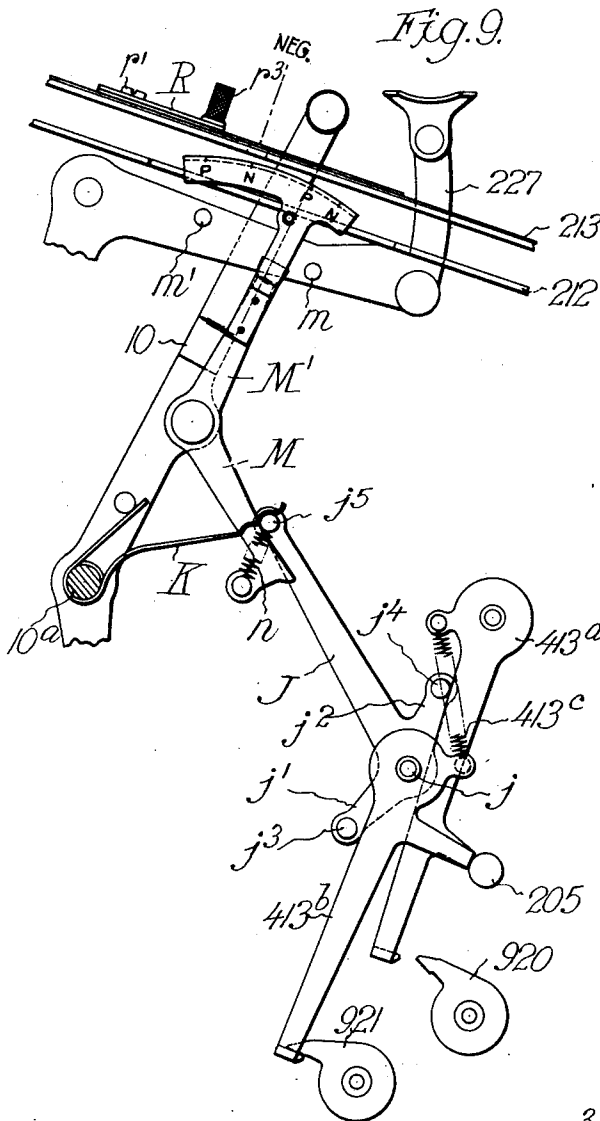


Fig. 10.

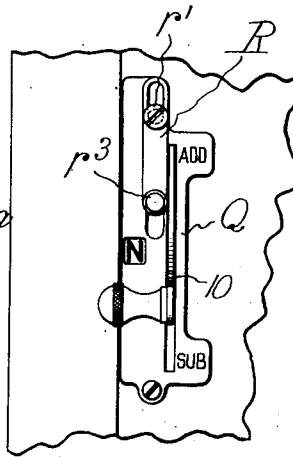
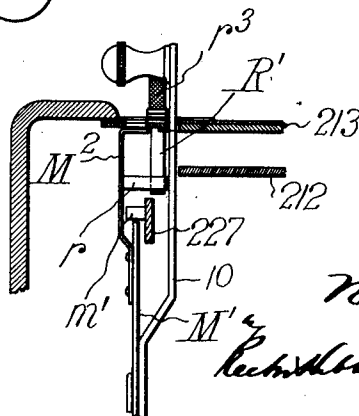


Fig. 11.



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UNITED STATES PATENT OFFICE.

NELSON WHITE, OF PORTLAND, OREGON, ASSIGNOR TO BURROUGHS ADDING MACHINE COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

ADDING-MACHINE.

1,046,521.

Specification of Letters Patent.

Patented Dec. 10, 1912.

Application filed March 30, 1912. Serial No. 687,372.

To all whom it may concern:

Be it known that I, NELSON WHITE, a citizen of the United States, residing at Portland, in the county of Multnomah and State of Oregon, have invented certain new and useful Improvements in Adding-Machines, of which the following is a specification.

The present invention relates more particularly to adding machines equipped with means for accomplishing subtraction by direct process as distinguished from the common method consisting in addition of complementary amounts.

The main object of the present invention is to provide an improved way of taking what is known as a negative total. Where an adding machine is used for subtraction purposes it is highly desirable to be able to print the true amount by which a minuend has been exceeded. For example where machines are used in banks it is a distinct advantage to be able to readily ascertain the amount by which a depositor may have overdrawn his account. The problem of procuring this so-called negative total is not unfamiliar. The chief difficulty experienced in this regard where adding machines have been equipped for performing subtraction by direct process, has been that a totaling operation performed under the subtraction adjustment, shows a negative total which is a unit short. I am familiar with a machine which has been made the subject of a separate application and contains an equipment for making up this shortage preliminary to the performance of a totaling operation. Thus in that machine there is provided a special key which when operated causes the subtraction wheel in the lowest order to advance a step thereby adding to the negative total the necessary unit so that upon performing a totaling operation in the customary way, with the subtraction wheels in direct operative relation to the customary racks, the correct negative total will be printed. My present invention does away with the necessity for any special preliminary operation in order to supply the additional unit. The present machine is automatic in this regard being so equipped that if the minuend is exceeded in subtraction controlling devices will come into play for causing one or more type carriers to partake of extra movement in a totaling operation. The units

type carrier will always partake of such movement in a negative totaling operation, and others will if the extra movement in the units order calls for a transfer.

In the drawings which form part of this specification and illustrate a preferred form of embodiment of the invention, Figure 1 illustrates in left side elevation a machine of the well known Burroughs type equipped with mechanism for carrying out the present invention, the inclosing casing being omitted as well as the left frame piece, and certain pivot studs and cross rods and shafts being shown in section; Fig. 2 is a front elevation of the accumulating or registering section of the machine; Fig. 3 is a right side elevation of the same character as the left side elevation of Fig. 1; Figs. 4 and 5 are right side elevations similar to Fig. 3 but not including as much of the machine and being on a larger scale and further differing in showing changed conditions both as compared with Fig. 3 and as compared with each other; Fig. 6 is a horizontal section taken on line 6—6 of Fig. 4; Figs. 7, 8 and 9 are similar left side elevations illustrating varying conditions having to do with control of the total key in conjunction with the setting of the registering mechanism for a plus or minus result; Fig. 10 is a top plan view of part of the keyboard and Fig. 11 is a vertical cross section on line 11—11 of Fig. 10.

The numeral 291 designates the customary amount keys and 610 the segmental racks whose excursions are measured by stops of the familiar character set by depression of said keys.

The numeral 611 designates levers of the usual kind which at their forward ends have slot, pin and spring connections with the racks respectively and at their rear ends carry type plates 618. In the present instance the lowermost type plate specially designated 618^a has an additional type 618^b for the printing of a cipher in instances where the extra movement in a negative totaling operation carries a type carrier a step beyond the 9 position. A corresponding variation from the ordinary construction is to be found in elongation of the rack slots the same being twice the usual length though normally relative movement between racks and type carriers is the same as usual, to wit a single step for transfer purposes and for moving the regular cipher type to the

printing line. The means for permitting further relative movement between type carriers and racks will be hereinafter pointed out. Pinions designated 916 coöperate with the racks 610 for purposes of addition and positive totaling, the same as in the well known Burroughs machine but in the present instance there is another set of pinions 916^c which are constantly in mesh with the pinions 916, and the two sets of pinions are carried in a cradle which pivots in a rocking frame of the character of the usual rocking frame for meshing and unmeshing pinions and racks.

The numeral 910^L designates the left side piece of the main rocking frame secured to the usual rock shaft 900, and the numeral 9^L designates the left side piece of the cradle. By setting the latter in one position or the other the upper pinions 916 or the lower pinions 916^c may be caused to assume direct coöperative relation with the racks. Under one adjustment the upper set of pinions will add and yield totals the same as in the ordinary construction of Burroughs adding machine. In the other adjustment the lower pinions 916^c will similarly coöperate with the racks but the pinions 916 will then be turned oppositely to what they were before and in this way direct subtraction is accomplished. In all banks or orders except the highest the transfer mechanism of the familiar type is common to the two sets of wheels by reason of the transfer pawls 413 having downward extensions with feet to coöperate with cams on the pinions 916^c the same as the customary cams on the pinions 916 coöperate with the regular feet of the pawls. Of course in the one case the transfer action will be for carrying in addition and in the other case the same transfer action will be for borrowing in subtraction.

The cradle is set in one position or the other through the medium of a lever 10 which protrudes through the keyboard plates 212-213 being pivoted upon a frame stud 10^a and having at its lower end a rearwardly extending branch 10^b with a cam slot 10^c for effecting the rocking of the cradle. A vertical bar 20 is slidably engaged with the said frame stud 10^a and carries a roller stud 19 in said cam slot. Said bar at its lower end is coupled to a bell crank lever 21 which is connected by a link 22 with the cradle as shown in Fig. 1. A lever 15 loose on the rock shaft 900 locks the cradle in its two positions by reason of engagement with notches 9^r and 9^s in a segmental forward extension of the left side piece 9^L of the cradle. Said arm extends rearwardly of the shaft 900 and has a double acting cam portion 15^b which coöperates with a stud 10^s on the rear branch 10^b of the lever 10. When the latter is

thrown one way the stud acts against the front side of the cam to shift the arm and unlock the cradle, the stud then passing to the rear edge of the cam so that the spring 18 applied to the arm may cause the latter to again lock the cradle. When the lever 10 is thrown the other way its stud acts upon the rear edge of the cam with a like effect. A forwardly extending branch 10^a of the lever 10 has a double acting cam portion 10^c to coöperate with a roller 14 on the cradle pivot. This is for the purpose of disconnecting pinions from racks preliminary to rocking of the cradle, so as to avoid binding between the pinions and racks. A spring 23 applied to the main rocking frame returns the latter after the cam 10^c has so acted and after the cradle has been rocked through the connections before described. The enlargements at the ends of the cam slot 10^b allow for the movement of these connections during the preliminary shift of the main rocking frame.

The total key 265 is of the usual type and so are the connections controlled by it comprising the pitman 914 branched and notched at its forward end for engagement with studs on the frame piece 916^L above and below the shaft 900.

It will be understood that the two sets of pinions bear complemental relation to each other, the lower pinions at all times registering in effect the complement of whatever the upper pinions may be registering. Owing to the necessary relation of transfer devices, however, the complemental amount will be one unit short of the true complement. Consequently the mere taking of a total with the lower pinions in direct coöperative relation to the racks would not print the correct negative total.

Referring next to Figs. 3 to 6 there is pivoted upon the lower part of each rack 610 a latching lever A which is connected by a spring 3^s to the stud A^t of the associated lever 611, said spring normally engaging the upper portion of the latch with said stud and positioning the shoulder 3^a of the latch under said stud so as to limit relative movement of lever and rack to that which is customary as before explained. In a negative totaling or sub-totaling operation the latch on the units order rack will always be displaced so as to permit extra movement of the units lever for the purpose of raising the negative total in the setting up of the same by the types at the rear of the machine. Whether or not extra movement occurs in other orders will depend upon whether the extra movement in the units order calls for a transfer as where the units wheel 916^c is in effect registering 9, the companion wheel 916 being at zero as illustrated in Fig. 4. The lower arm of each latch lever A carries a roller stud 3^t and that

of the units latch lever coöperates with an arm D which is journaled upon a cross rod C extending between the side frame pieces of the machine. Said arm D and other similar arms presently to be pointed out are normally upheld by the cross rod E of a bail whose side arms E' and E² are secured to the rock shaft C. The latter has a forward extension E³ whereby, through connections hereinafter described, the bail will be lowered in the depression of the total key. The bail rod E is connected by a spring *d* to the arm D and similarly connected to like arms in other orders. The arm D is turned upwardly at its rear end and has a cam extremity *d'* for acting upon the roller *a*⁴ but normally stands above the same and so long as this condition obtains the latch lever A will be unaffected by said cam. When the said arm is drawn downward, however, by the bail rod E the cam acts upon the roller and shifts the latch lever moving its shoulder *a*² out of line with the stud A⁴ as illustrated in Fig. 5 so that in an ensuing totaling operation the units type-carrying lever may move an extra step for setting up a correct negative total. Alongside the arm D there is journaled upon the rock shaft C a yoke D' which at the right hand side, Fig. 6, has an arm D² extending forward and upward and terminating in a laterally turned and rearwardly projecting finger *d*⁴ in the plane of a disk 916^a secured to the units pinion 916 said disk being notched in its periphery as shown at *b* at such location that when the wheel 916 is at zero the notch will be in line with the finger *d*⁴ as shown in Fig. 4. The left hand side of said yoke has an arm D³ similar to the arm D and related to the latch lever of the tens order the same as the arm D is related to the latch lever of the units order. Furthermore, this arm D³ is connected to the bail rod E by a spring *d*. The arm D³ extends forward of the shaft C and has a laterally turned portion *d'* which extends behind an arm D⁴ of another yoke which is substantially a duplicate of the yoke already described, the said arm D⁴ having a finger to coöperate with a notch disk carried by the tens pinion 916 and this second yoke having a cam arm D⁵ to coöperate with the latch lever of the hundreds order. It will be understood that if the units wheel 916 is at zero the associated wheel 916^a will in effect be registering 9 as the complement and hence the addition of an increment of movement to the units type carrier would take the lower zero type 618^b to the printing line and this would call for a transfer to the next order. In such case the finger *d*⁴ of the arm D² enters the notch *b* so that the yoke takes its full movement and the cam arm D³ trips the tens latch lever and consequently the tens

type carrier also partakes of extra movement. If it should happen that the tens wheel 916 was also standing at zero the full retreat of the laterally turned portion or ear *d'* of the yoke D' would permit the tens yoke to also rock fully and unlatch the hundreds type carrier, the finger of this yoke entering the notch of the disk in the tens wheel. The yoke construction is carried out to the highest order so that such a transfer action can take place all the way across if the situation calls for it. It will be understood that though certain wheels 916 may stand at zero there should not be a transfer action but that this should be controlled by the lower order wheels. The ears *d'* serve to block movement of bails notwithstanding their fingers may be alined with zero notches in the disks. For example if the additional increment of movement of the units type carrier was not from nine to zero and therefore the units wheel 916 was not at zero, the finger *d*⁴ would strike against the periphery of the disk 916^a and the bail D' would not rock far enough to trip the tens latch lever.

The connections for operating the bail are of the following description: The arm E³ is connected by a vertical link F with the forwardly extending arm of a bell crank lever F', a spring *f* being applied to said link and normally holding the bail up and the said bell crank lever in contact with a cross rod 205 as illustrated in Fig. 3. The upwardly extending arm of said bell crank has a stud *f'* which is adapted to be engaged by a hook *g* on the forward end of a lever G pivoted upon the cross rod of the usual rack releasing bail of the total key system, said bail comprising as usual side pieces 216^a and 216^b though in the present instance radius links 216^a and 216^b are preferably employed to support the bail - at the forward end. Whether the lever G connects with the bell crank F' depends upon the adjustment of the lever 10. If the upper end of the latter is rearward, denoting an adding adjustment, the lever G will be disconnected from said bell crank as illustrated in Fig. 3. If the upper end of the lever 10 is forward the hook *g* will engage the stud *f'* as illustrated in Fig. 5. The controlling connections here comprise a short bifurcated arm G³ secured to the left hand end of a rock shaft 200 as shown in Fig. 1 and embracing a stud 10^b on the lever 10 so that in the shifting of the latter the shaft will be rocked. There is secured to the right hand end of the shaft 200 an abutment plate and cam piece H, Figs. 3, 4 and 5 which has a concentric edge *h* at the rear portion nearer to the shaft than a concentric edge *h'* at the upper portion, and between these concentric portions there is a cam edge *h*². The piece H coöperates with a stud *i* at the bend of an elbow-shaped arm I of a lever pivoted upon a frame stud

200^a. The down-turned end portion of this arm I has a stud I' which engages a bifurcated rear arm of the lever G. When the controlling lever 10 is in the adding position as illustrated in the adding position, Fig. 3, the outer circumferential edge *h'* of the abutment piece H is presented to the stud *i* so that the arm I is held down against the stress of the spring I² tending to raise it. In consequence the lever G is elevated on the forward side of its pivot and its hook *g* disconnected from the stud *f'*. On the other hand when the controlling lever 10 is in the subtracting position as illustrated in Figs. 4 and 5 the inner circumferential edge *h* of the abutment piece H is presented to the stud *i* so that the arm I may take up a more elevated position than before and the lever G will be lowered forward of its pivot and its hook engaged with the stud *f'*. In such case it will be obvious that depression of the total key in drawing upon the bail side piece or link 216^R will move the lever G rearward and rock the bell crank F² and lower the bail rod E as illustrated in Fig. 5 thereby effecting unlatching of one or more of the levers 611 with the result before described.

Inasmuch as one or more of the fingered yoke arms may be in the notches of the disks 916^a when the operation starts with the total key depressed, it is essential that there be a restoration of yokes before the wheels begin to turn. Therefore the lever of which the arm I forms a part has another arm on the other side of its pivot which arm is of crescent shape in large part but at the rear has a cam portion *i*³ to coact with a stud 311^a on the full stroke sector 311. The crescent portion thereof has an under edge *i*⁴ which will be traversed by the stud 311^a under normal conditions (Fig. 3) without effect upon the lever. By normally is here meant a condition with the controlling lever 10 in the adding position. If the controlling lever 10 is in a subtracting position as illustrated in Fig. 4 the cam portion *i*³ of the lever will stand in the path of the stud 311^a and therefore the lever will be rocked very shortly after the full stroke sector 311 moves. It will be understood that this full stroke sector is secured to the handle shaft of the machine and so starts to move immediately the handle is pulled. Of course if the total key is not down the movement of the lever is an idle one and so likewise is the accompanying movement of the lever G. If, however, the total key is depressed as in Fig. 5 the shaft of the lever I—I³ in disconnecting the lever G from the bell crank lever F² results in restoration of the bail rod E and the yokes to which it is connected so that the fingers *d*⁴ withdraw from the disks 916^a and the wheels 916 will be free to turn forward as the wheels 916^c are

turned backward when the downward movement of the racks begins. The upper sides of the notches *b*, however, are preferably made oblique so that the turning of the wheels may start before the fingers are completely withdrawn. This speedy restoration of the parts does not disturb the intended effect in adding increments of movement to type carriers, notwithstanding it involves freeing the latch levers A from the restraining influence of the cam arms. By the time this release and restoration occurs the studs A⁴ of any type carrying levers that have been unlatched will have passed down below the shoulders *a*² so that even though the release of latches occurs before the type carriers have partaken of the full extent of movement that movement will be gone through with and the type properly set up. Of course when the type carrying levers are swung upward in the usual manner by the restoring frame or bail 613 said studs A⁴ will be carried past the shoulders *a*² and the latch levers will then spring back to their normal position.

It will be obvious that a totaling operation with the upper pinions 916 in mesh with the racks should only occur when the total is a positive one and vice versa that a totaling operation should only occur with the lower pinions 916 in mesh with the racks when the total is a negative one. When the total becomes negative the highest order wheel 916 necessarily turns backward past the zero position and the highest order wheel 916^c correspondingly advances in the opposite direction so that its transfer cam 921 takes effect, and then if in continued operations the total again becomes positive this means that this cam 921 goes back past the zero position and the cam 920 of the highest order wheel 916 advances through its effective arc of movement. The operability of the totaling system is therefore put under control of these two transfer cams. This calls for some modification of the transfer mechanism in the highest order as compared with that in lower orders. As before pointed out the transfer pawl 413 in the lower orders simply has the downward extension with the additional foot for cooperation with the lower wheel. In the highest order separate transfer pawls are employed for the two wheels. The numeral 413^a designates the pivoted transfer pawl for the upper wheel suspended from the same cross rod that the other transfer pawls 413 journal upon and having a foot of the usual kind with which the cam 920 cooperates. On a frame stud *j* located at a point below the said journal rod there is pivoted a transfer pawl 413^b having a foot with which the cam 921 cooperates. The two transfer pawls are connected by a spring 413^c which swings both of them

toward their respective transfer cams the movement being limited by abutment of legs on the two pawls with the cross rod 205. Of course these are not strictly speaking transfer pawls because they have no function to perform as such since there is no higher wheel to which a transfer is made. They do perform the same functions as the one-piece pawls in the matter of stopping backward rotation of wheels. Then they perform the additional function of compelling proper use of the total key in the matter of positive and negative totals. There is pivoted upon the stud j an arm J having at its forward end oppositely extending branches j' and j'' with laterally projecting studs j^3 and j^4 to coact respectively with the rear edges of the pawls 413^b and 413^a. There is lost motion to provide for shifting of the arm J in one direction by one pawl and in the opposite direction by the other pawl. The positive total adjustment is illustrated in Figs. 7 and 8 wherein it will be observed that the stud j^3 is in contact with the rear edge of the pawl 413^b whereas the stud j^4 is spaced from the rear edge of the pawl 413^a. Fig. 9 represents the minus or negative total condition wherein the stud j^4 is in contact with the rear edge of the pawl 413^a and the stud j^3 is spaced from the pawl 413^b. The rear end of the arm J carries the stud j^5 which engages the projecting end of a spring K wound around the stud 10^a said projecting end having notches in which the stud j^5 seats for the purpose of insuring its stability under the two different adjustments. The stud j^5 engages the front edge of the downwardly extending arm M of a locking lever pivoted to the controlling lever 10 and having an upwardly extending arm M' whose end edge is adapted to cooperate with studs m and m' projecting from the total key bell crank lever 227 and spaced apart lengthwise the substantially horizontal arm of this bell crank lever. The lower arm M of the locking lever and the arm J are connected by a spring n which is applied at one end to the stud j^5 and at the other to a stud on the arm M. It will be obvious that the angular position of the locking lever with relation to the controlling lever 10 depends upon the position of the arm J. The relation of these parts and the relation between the arm M' and the studs m and m' are such that if the total is positive or more strictly speaking if the total has not gone into negative, and the handle 10 is in the adding position as illustrated in Fig. 7, the rear stud m' is just back of the end of the arm M' so that the total key may be depressed, whereas if under such conditions the controlling lever is moved to the subtracting position as in Fig. 8 the end of the arm M' will be carried under the stud m locking out the total lever. If

now the total goes into negative the swinging back of the pawl 413^b by the cam 921 rocks the arm J which through the medium of the spring n swings the locking lever so that the end of its upper arm M' retreats to the position shown in Fig. 9 thus passing from under the stud m so that the total key can then be depressed for the taking of a negative total. Now if the controlling lever 10 is moved to the adding position the end of the arm M' will take up a position directly below the stud m' preventing the depression of the total key. However, if the total becomes position thereafter the arm J will be rocked rearward and the locking lever shifted to the position shown in Fig. 7 so that the total key is free for the taking of a positive total. It will be understood of course that under either adjustment there is sufficient lost motion between the stud j^3 or the stud j^4 and the associated pawl to permit movement of the latter in another passing of the transfer cam.

Inasmuch as occasion will arise for clearing the upper wheels while a negative total condition obtains, I have provided a slide piece R, Fig. 10, which is fitted upon an index plate Q the latter secured to the upper keyboard plate and slotted for the passage of a finger R' therethrough, Fig. 7, to cooperate with a stud r in a plate M² fastened to the arm M'. The slide piece R is slotted to embrace a guiding screw r' and has a finger piece r'' by which to manipulate it. It will be obvious that under a negative total condition but with the lever 10 rearward forward movement of the slide piece R will shift the arm M' so as to free the total key.

It is desirable to provide a visual indicator from which the operator can readily see whether a negative or positive total condition obtains. To this end the plate M² which is secured to the arm M' has a segmental upper portion with a flange to work under the keyboard plate 213 which flange is inscribed to denote the condition of the machine as by the letters "N" and "P." The keyboard plate is open under the indexing plate Q and the latter made with an aperture through which the indicating letter may show. Inasmuch as the positive indication should show under both adjustments of the lever 10 if the condition is a positive one within the machine, and similarly the negative indication should show in both positions of the lever, the flange of the plate M² is inscribed at two places with the letter "P" and at two places with the letter "N" as denoted in Figs. 7, 8 and 9. The letters here appear on the side of the plate merely to show their location on the flange with relation to the end of the arm M'.

I claim:

1. In a machine of the character described, 130

the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; means for reversing the order of engagement and disengagement between either set of wheels and the racks for zero setting purposes; and means for automatically as an incident to a totaling operation adding an increment of movement to one or more type carriers beyond that permitted by zero setting of one set of wheels, whereby to raise by a unit the complemental amount registered by that set, such automatic means being under the control of the highest order wheel of said set.

2. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; means for reversing the order of engagement and disengagement between either set of wheels and the racks for zero setting purposes; and means for automatically as an incident to a totaling operation adding an increment of movement to one or more type carriers beyond that permitted by zero setting of one set of wheels, whereby to raise by a unit the complemental amount registered by that set by a unit, such automatic means being under the control of the highest order wheel of said set; and means also under control of said wheel for enabling and disabling the means for reversing the order of engagement and disengagement of wheels and racks to prevent operation of said means when the

wheels containing the complement of the true total,—whether a plus or minus quantity,—are in mesh with the racks.

3. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction, to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; means for reversing the order of engagement and disengagement between either set of wheels and the racks for zero setting purposes; means for automatically as an incident to a totaling operation adding an increment of movement to the lowest order type-carrier, and transfer devices to carry such movement to a higher order type carrier.

4. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers; the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; means for reversing the order of engagement and disengagement between either set of wheels and the racks for zero-setting purposes; latches normally restricting relative movement between type carriers and racks; and latch-displacing mechanism under control of said means for reversing the order of engagement and disengagement of racks and wheels, and also under control of the wheels themselves, said mechanism including transfer devices to carry extra movement of racks from lower to higher orders.

5. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable

therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complementary relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key and connections for reversing the order of engagement and disengagement between racks and wheels; latches for normally restricting relative movement between racks and type carriers; latch displacing arms; a bail normally retracting the latter; operative connections between the bail and the total key; notched disks turning with the wheels; arms with portions for entering the notches of said disks, said arms being connected with aforesaid latch-displacing arms respectively, the disk-engaging arm of a lower order being connected to the latch displacing arm of the next higher order and the latter arm in turn controlling the disk-engaging arm of its own order.

6. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complementary relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key and connections for reversing the order of engagement and disengagement between racks and wheels; latches for normally restricting relative movement between racks and type carriers; latch displacing arms; a bail normally retracting the latter and spring-connected thereto; operative connections between the bail and the total key; notched disks turning with the wheels; arms with portions for entering the notches of said disks, said arms being connected with aforesaid latch-displacing arms respectively, the disk-engaging arm of a lower order being connected to

the latch displacing arm of the next higher order and the latter arm in turn controlling the disk-engaging arm of its own order.

7. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complementary relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key and connections for reversing the order of engagement and disengagement between racks and wheels; latches for normally restricting relative movement between racks and type carriers; latch displacing arms; a bail normally retracting the latter; operative connections between the bail and the total key including a coupling controlled by the means for determining which set of wheels shall cooperate directly with the racks; notched disks turning with the wheels; arms with portions for entering the notches of said disks, said arms being connected with aforesaid latch-displacing arms respectively, the disk-engaging arm of a lower order being connected to the latch displacing arm of the next higher order and the latter arm in turn controlling the disk-engaging arm of its own order; a prime mover; and means operated thereby for uncoupling the connections between the total key and the bail.

8. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complementary relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key and connections for reversing the order of engagement and disengagement between racks and

wheels; latches for normally restricting relative movement between racks and type carriers; latch displacing arms; a bail normally retracting the latter; operative connections between the bail and the total key including a coupling and uncoupling member in the form of a lever controlled by the means for determining which set of wheels shall cooperate directly with the racks; notched disks turning with the wheels; arms with portions for entering the notches of said disks, said arms being connected with aforesaid latch-displacing arms respectively, the disk-engaging arm of a lower order being connected to the latch displacing arm of the next higher order and the latter arm in turn controlling the disk-engaging arm of its own order; a prime mover; and means operated thereby for uncoupling the connections between the total key and the bail; said means comprising a lever engaged with the coupling and uncoupling lever and having a cam portion for coaction with the prime mover.

9. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanism of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key and connections for reversing the order of engagement and disengagement between racks and wheels; latches for normally restricting relative movement between racks and type carriers; latch displacing arms; a bail normally retracting the latter; operative connections between the bail and the total key including a coupling and uncoupling lever; notched disks turning with the wheels; arms with portions for entering the notches of said disks, said arms being connected with aforesaid latch-displacing arms respectively, the disk-engaging arm of a lower order being connected to the latch displacing arm of the next higher order and the latter arm in turn controlling the disk-engaging arm of its own order; a prime mover; a lever operatively engaged with the aforesaid coupling and uncoupling lever and having a cam portion coacting therewith; and a differential abutment piece for coacting with said levers to couple or uncouple the afore-

said connections, said abutment piece being controlled by the means for determining which set of wheels shall directly cooperate with the racks.

10. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a shiftable controlling member for determining which set of wheels shall be in direct cooperative relation with the racks; a total key and connections for reversing the order of engagement between wheels and racks; means for automatically as an incident to a totaling operation adding an increment of movement to one or more type carriers beyond that permitted by zero-setting of one set of wheels whereby to raise by a unit the complemental amount registered thereby; a lock for the total key operated by the shiftable controlling member; and means for controlling said lock by the transfer mechanism associated with the pair of highest order wheels.

11. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other and there being independently movable trip pawls for the two wheels of the highest order pair; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a shiftable controlling member for determining which set of wheels shall be in direct cooperative relation with the racks; a total key and connections for reversing the order of engagement between

wheels and racks; means for automatically as an incident to a totaling operation adding an increment of movement to one or more type carriers beyond that permitted by zero-setting of one set of wheels whereby to raise by a unit the complemental amount registered thereby; a lock for the total key operated by the shiftable controlling member; and means for controlling said lock by the aforesaid trip pawls.

12. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other and there being independently movable trip pawls for the two wheels of the highest order pair; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key lever and connections said lever having spaced studs; a lever for determining which set of wheels shall be in direct cooperative relation with the racks; a lock piece pivotally mounted on said latter lever and adapted to engage either stud of the total key lever; and a controlling arm for said lock piece said arm set by the trip pawls in either of two positions according to which of the wheels of the highest order pair passes the zero point.

13. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other and there being independently movable trip pawls for the two wheels of the highest order pair; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the op-

posite direction, to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key lever and connections said lever having spaced studs; a lever for determining which set of wheels shall be in direct cooperative relation with the racks; a lock-piece pivotally mounted on said latter lever and adapted to engage either stud of the total key lever; and a pivoted controlling arm for said lock piece yieldingly connected therewith at one end and branched at the other end and the branches equipped with studs on opposite sides of the pivot for co-action respectively with the two aforesaid trip pawls there being lost motion to provide for shifting of the controlling arm by either pawl.

14. In a machine of the character described, the combination of a series of reciprocable type carriers; racks movable therewith and to a limited extent relatively thereto; two sets of gear wheels intermeshed in pairs and separately engageable with the racks; combined transfer and zero-setting mechanisms of duplex character to provide for both carrying and borrowing through movement of racks relative to type carriers, the two sets of wheels bearing a complemental relation to each other and there being independently movable trip pawls for the two wheels of the highest order pair; means for effecting engagement of either set of wheels with the racks during movement of latter in one direction and disengagement therefrom during their movement in the opposite direction,—to add upon one set of wheels or subtract therefrom according to which set is cooperating directly with the racks; a total key lever and connections said lever having spaced studs; a lever for determining which set of wheels shall be in direct cooperative relation with the racks; a lock piece pivotally mounted on said latter lever and adapted to engage either stud of the total key lever; a pivoted controlling arm for said lock piece yieldingly connected therewith at one end and branched at the other end and the branches equipped with studs on opposite sides of the pivot for co-action respectively with the two aforesaid trip pawls there being lost motion to provide for shifting of the controlling arm by either pawl; and a spring to frictionally hold the arm in its different positions.

NELSON WHITE.

Witnesses:

NORRIS B. GREGG,
CHAS. W. HILL.