C. W. GOOCH.

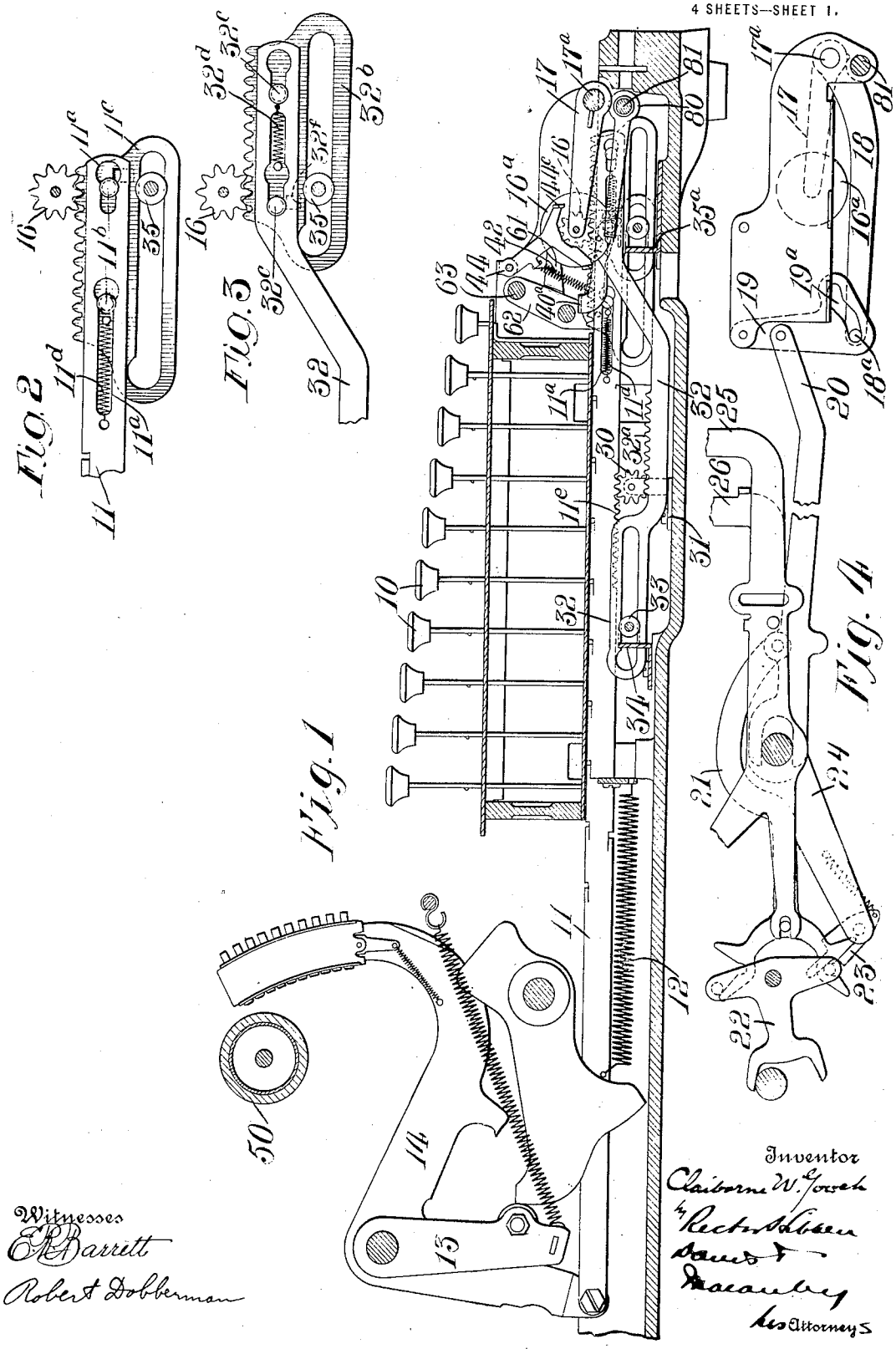
ADDING AND SUBTRACTING MACHINE.

APPLICATION FILED MAR. 3, 1915.

1,327,318.

Patented Jan. 6, 1920.

4 SHEETS—SHEET 1.



Witnesses
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4 SHEETS—SHEET 2.

Fig. 5

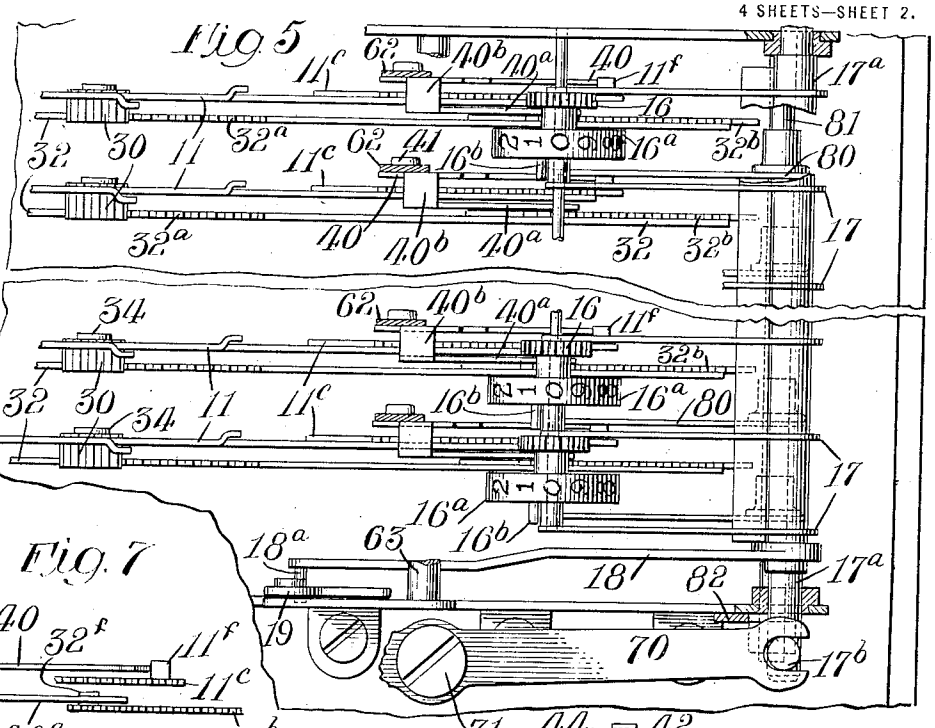


Fig. 7

Fig. 6

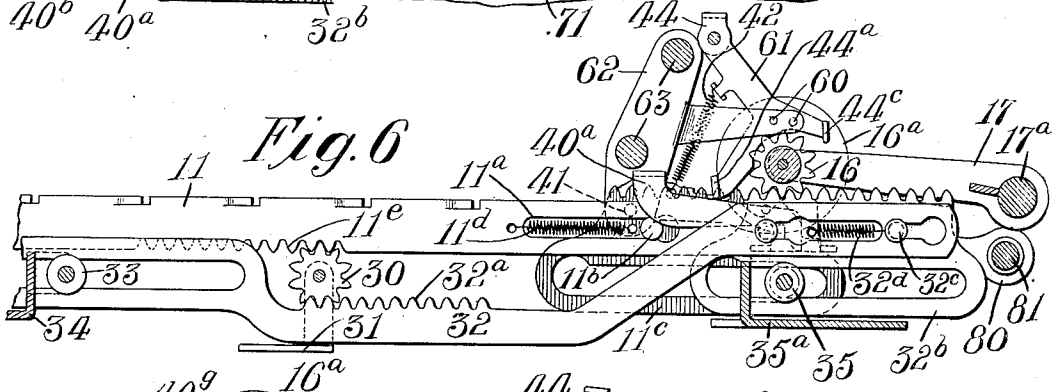


Fig. 8

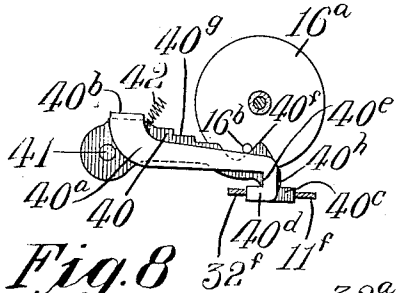
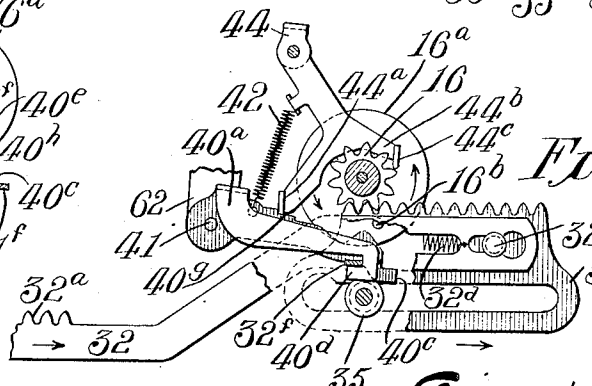


Fig. 9



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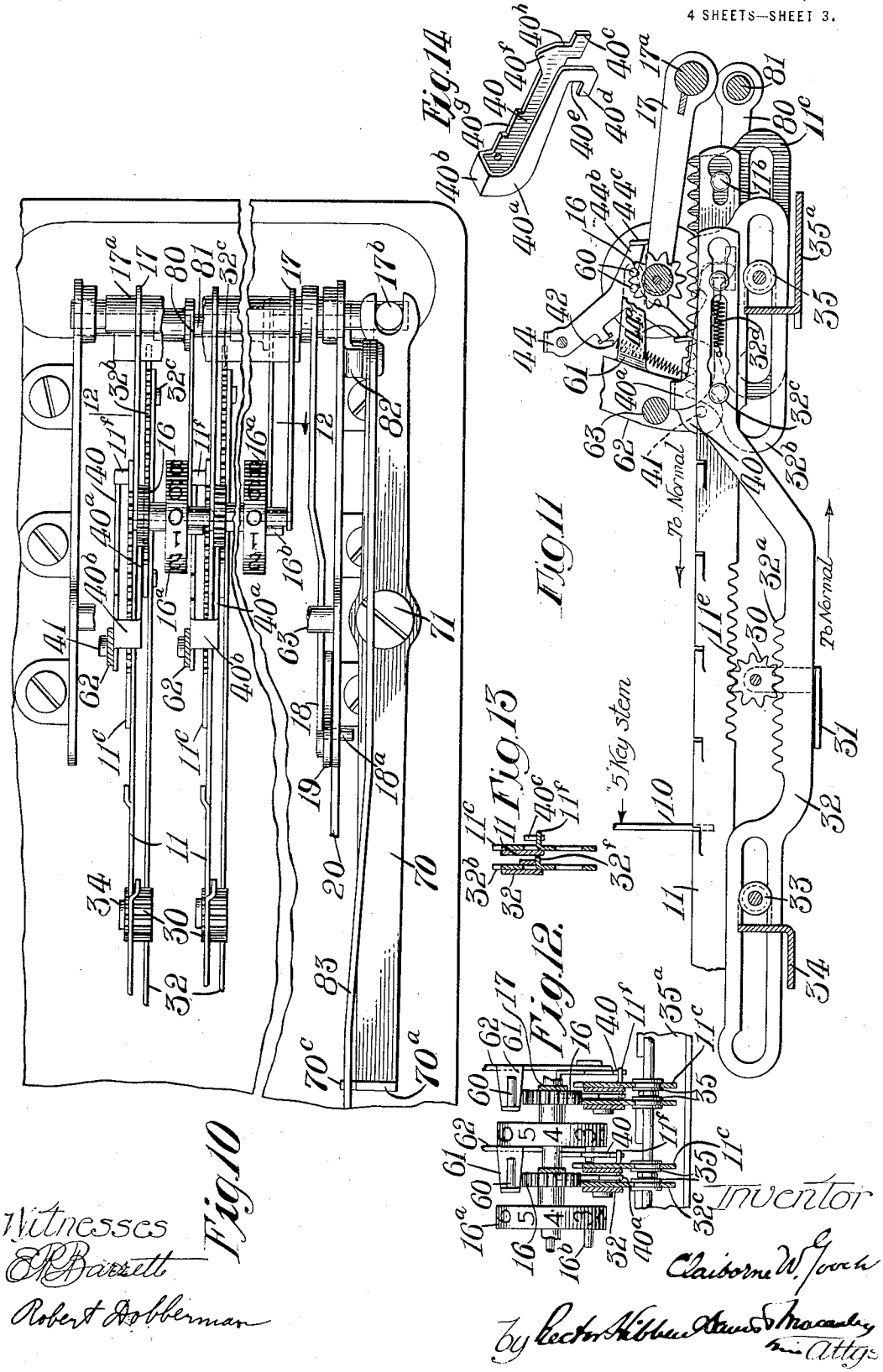
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4 SHEETS—SHEET 4.

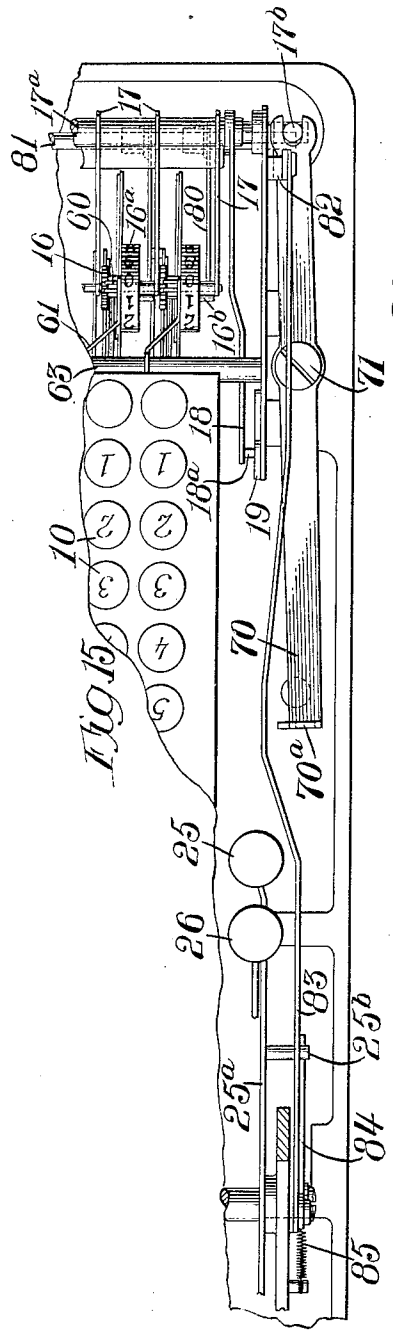


Fig. 15

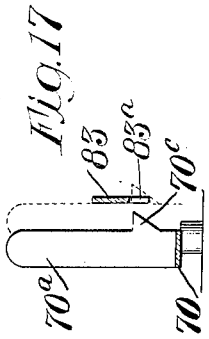


Fig. 17

Fig. 16

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UNITED STATES PATENT OFFICE.

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ADDING AND SUBTRACTING MACHINE.

1,327,318. Specification of Letters Patent. Patented Jan. 6, 1920.

Application filed March 3, 1915. Serial No. 11,758.

To all whom it may concern:

Be it known that I, CLAIBORNE W. GOOCH, 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 Subtracting Machines, of which the following is a specification.

The object of the present invention is to supply a simplified construction in a registering and recording machine, which construction will provide for the performance of either addition of listed amounts or subtraction of listed amounts, subtraction being effected by reverse turning of register wheels without interposition of an additional set of wheels between the actuating devices and the one set of register wheels, and also without modifying the control or timing of engagement and disengagement between the wheels and actuators which provides for the one-way turning of wheels to preserve registrations in the manner shown in certain well-known types of registering and recording machines. Thus, instead of interposing an additional set of wheels or modifying the control or timing devices, I provide an additional set of actuators so connected with the adding actuators as to move reversely thereto, and I arrange for a shift of the register wheels between the two sets of actuators. Not only does such an arrangement do away with the necessity for modifying the control or timing devices and obviate the introduction of additional wheels, but it has the further advantage of permitting application of the same mechanical principle for borrowing in subtraction as for carrying in addition,—in fact substantially duplicating the carrying means for borrowing purposes, while employing transfer tripping devices which are common to the carrying and the borrowing means.

Not only does my invention supply a mechanically simple adding and subtracting construction but one which lends itself to modern shop practice in the matter of economical manufacture and assemblage of parts. This is emphasized by the particular example of mechanical embodiment of my invention which is afforded by the accompanying drawings for they illustrate a well-known commercial registering and listing machine converted into an adding and listing and subtracting machine and it will be noted that the new parts are of like character to standard parts of that commercial machine, being manufacturable and subject to assemblage according to the same approved shop practices.

In the accompanying drawings, Figure 1 represents a vertical section from front to rear of the complete mechanism except that elements of the commercial machine not at all needed for purposes of a complete disclosure in the present invention are omitted; Figs. 2 and 3 are similar detail elevations of transfer means, the former having to do with carrying and the latter with borrowing; Fig. 4 is a partial left side sectional elevation of the machine illustrative of the control or timing system; Fig. 5 is a partial sectionalized plan view of the machine; Fig. 6 corresponds with the right-hand portion of Fig. 1 but is on a larger scale and on a somewhat different section line; Fig. 7 is a detail plan view of certain parts appearing principally in dotted lines in Fig. 6; Fig. 8 shows these same parts in sectionalized side elevation; Fig. 9 is a view on the order of Fig. 6 but omitting the adding devices and illustrating the condition at the end of a subtracting operation when borrowing has occurred; Fig. 10 is a view similar to Fig. 5 but illustrating the register wheels shifted for subtraction; Fig. 11 is a view similar to Fig. 6 but showing the condition in the middle of an operation when a value key has been depressed; Fig. 12 is a section taken substantially on the line 12—12 of Fig. 10; Fig. 13 is a similar section of some of the same parts, the section line being further to the rear of the machine; Fig. 14 is a perspective view of one of the double-acting transfer pawls; Fig. 15 is a partial top plan view of the machine; Fig. 16 is a partial left-side elevation of the machine broken out to illustrate a zero stop action; Fig. 17 is a detail sectional view taken on line 17—17 of Fig. 16.

I have chosen for purposes of the present disclosure of my invention the machine now quite extensively known upon the market as the "Burroughs visible," which in the main is a redesign of a machine formerly known upon the market as the "Pike" and particulars of which are disclosed in a number of prior patents *e. g.* No. 763,692 issued June

28, 1904 and No. 955,789 issued January 19, 1910. In view of the familiar character of this machine it will not be necessary here to detail its construction and mode of operation throughout and I shall only refer briefly to a few of its parts in order that the relation thereto of the new parts supplied by me may be thoroughly understood.

Numeral 10 designates amount keys arranged in the customary way to regulate the extent of movement of reciprocating bars 11, these bars being driven in a forward direction by springs 12 when released as a result of depression of keys and operation of the machine which involves the swinging forward of a bail or restoring frame 13 whose familiar function is to retract the bars by operating upon depending arms of type carriers 14 to which depending arms the bars are respectively coupled. At their forward ends these bars 11 are longitudinally slotted as shown at 11^a, Fig. 2, to receive studs 11^b of rack plates 11^c which are connected by springs 11^d to the bars.

Register pinions 16 together with numeral wheels 16^a are journaled in alinement upon the cross rod of a bail or swinging frame 17 which is secured to a rock shaft 17^a at the front of the machine. An arm 18 secured to this same rock shaft has a stud 18^a, Fig 4, which occupies the cam slot 19^a of an oscillatory arm or plate 19 whose function is the familiar one of raising and lowering the frame 17 to disengage and reëngage the register pinions with their actuating racks. The oscillating of this arm or plate is accomplished in a familiar manner through the medium of a pitman 20 to which an irregular-shaped thrust link 21 is coupled, said link having a forked rear end with flaring jaws and stud seats for coöperation with a rocker plate 22 and its studs which are operated upon in a familiar manner by a wiper pawl 23 carried upon an oscillating arm 24. The racks and register pinions are normally in mesh but by reason of the control or timing connections above specified the pinions are lifted out of mesh at the outset of an operation of the machine for registering an amount and remain out of mesh during the first half of the operation, then being reëngaged with the racks at the beginning of the last half cycle of operation of the machine. The control is modified according to the familiar practice for the purposes of totals or sub-totals, the machine being equipped with the customary total and sub-total keys 25 and 26. The present invention is not, however, essentially concerned with totaling or sub-totaling operations so there would seem to be no occasion for going into any detail in this regard.

The above-specified slot and pin and spring mounting of the racks 11^c upon the bars 11 is for transfer purposes according to familiar practice though modification is called for in this connection in the carrying out of my present invention.

Passing now to the novel equipment of my present invention, it is first to be noted that the reciprocating bars 11 are formed at an intermediate point in their under edges with rack teeth 11^e which mesh with small gear wheels or pinions 30 supported by brackets 31 on the base of the machine and also meshing with similar rack teeth 32^a in the upper edges of reciprocating bars 32 of which there is one to mate with each of the bars 11. Obviously these bars 32 deriving motion from the bars 11 through the medium of said small gear wheels or pinions will be always moved in the reverse direction to that in which the bars 11 move though their extent of movement will be the same. These bars 32 are longitudinally slotted at their rear ends to embrace guiding rollers 33 and they also preferably work in slots of a guiding plate 34. They are spaced laterally from the bars 11 as shown in Figs. 5 and 10 and the pinions 30 are of appropriate width to mesh with the rack teeth of both sets of bars. At their front ends these bars 32 carry rack plates 32^d similar in character to the before-mentioned rack plates 11^c and similarly related to their bars 32, the latter being slotted and the rack plates having studs 32^c which engage said slots and the rack plates and bars being connected by springs 32^d.

The rack teeth of the plates 11^c and 32^b are in horizontal alinement but spaced apart laterally as illustrated in Figs. 5 and 10, so that the register pinion 16 may be shifted axially out of engagement with the racks 11^c and into engagement with the racks 32^b, and vice versa. Obviously, when the pinions are in alinement with the racks 11^c they will be turned in one direction upon operation of the machine to register an amount, and when said pinions are alined with the racks 32^b they will be turned in the opposite direction in such an operation. Under the former conditions the operation will be an adding one, and under the latter conditions the operation will be a subtracting one. The bars 32 of course move forwardly during the last half cycle of operation of the machine, to turn the register wheels backwardly, whereas the bars 11 move rearwardly to turn said wheels in a forward direction, and, correspondingly the relation between the rack plates 32^b and their bars 32 is the reverse of that between the rack plates 11^c and their bars 11, in that the springs 32^d tend to shift the rack plates 32^b forwardly on the bars 32 as contrasted with the tendency of the springs 11^d to shift the rack plates 11^c rearwardly on the bars 11. I find it convenient, however, to guide both the bars 11 with their rack plates

11^a and the bars 32 with their rack plates 32^b by rollers 35 on one and the same cross rod in the base of the machine, both sets of rack plates being co-extensive vertically and being somewhat widened in their lower portions for sufficiently-extended slotting to embrace said rollers. A slotted guide plate 35^a is also supplied for these rack plates.

The members of the two sets of rack plates being thus arranged side by side in pairs, I am enabled to employ a transfer tripping device or transfer pawl (as such an element is commonly termed), which will serve for both members of a pair of these racks, with respect to their being normally held back or restrained in opposition to their respective springs 11^d and 32^d. The transfer pawl is of yoke form comprising an arm 40 which controls the rack 11^c and an arm 40^a which controls the rack 32^b, these arms being spaced apart and connected by a bridge piece 40^b as shown in Figs 7 and 14. Proceeding with the description of one of these pawls as representative of all of them, it is pivoted upon a frame stud 41 and normally upheld by a spring 42. The arm 40 has a forwardly-projecting abrupt end portion 40^c which normally engages a laterally-projecting portion or foot 11^f of the rack 11^c to restrain that rack against rearward movement. The arm 40^a has a similar rearwardly-projecting portion 40^d which normally engages a similar laterally-projecting portion or foot 32^f of the rack 32^b to obstruct forward movement of the latter. The arm 40 has a vertical shoulder 40^h for limiting movement of the rack plate 11^c when released by depression of the transfer pawl, and similarly, though of course facing the other way, the arm 40^a has a shoulder 40^e to limit forward movement of the rack plate 32^b. The transfer pawl must be tripped under either direction of rotation of the associated numeral wheel. Consequently the arm 40, which is the one directly acted upon by the wheel, is formed with an upwardly-projecting nose 40^f taking the form of an inverted V. The wheel carries a pin or stud 16^b adapted to ride over this nose under either direction of rotation and being sufficiently elongated to maintain engagement under either lateral position of the wheel.

It will be understood that in this machine, as in the machines of said prior patents, the slot and pin mounting of racks on actuator bars, besides providing for transfer movements of racks, also provides for movement of the bars without movement of the racks and corresponding movement of the type carriers to bring the zero types to the printing line or printing position opposite the platen 50, and that such movement involves collapsing of the transfer spring. Therefore, in orders where no amount keys have been depressed as well as in orders where keys have been depressed there is no immediate effect, upon tripping or displacement of transfer pawls, to impart carrying impulses as derived from power stored in the transfer springs. Consequently it is customary to automatically latch the transfer pawls upon their displacement by the transfer pins or studs on the numeral wheels. Such provision is made in the present instance though modified somewhat as to the manner of restoring the latches to release the pawls and permit them to return to normal. A description of one of these pawl latches will suffice, it of course being understood that there is one for each of the pawls. It is in the form of an angular arm 44 hung from a frame cross rod and having a laterally-turned end portion 44^a overlying the arm 40 of the transfer pawl. Normally this portion of the latch engages a low forward section of the upper edge of said pawl arm as shown in Fig. 11, serving then simply as a stop to limit the upward movement of the pawl. The same spring 42 which lifts the pawl serves also to swing rearwardly the latch which, however, is normally obstructed as to rearward swinging by engagement of its said laterally-turned portion 44^a against a vertical shoulder of the pawl arm 40. There is a raised edge 40^g extending rearward from this vertical shoulder to another similar shoulder of the arm 40, and when the latter is lowered by the transfer pin or stud on the wheel, the laterally-turned portion or foot of the latch springs over this raised edge and against the second vertical shoulder to hold the pawl down as illustrated in Fig. 9. This figure of the drawings illustrates a borrowing action in which the forcing down of the pawl has taken the rearwardly-directed abutment end 40^d below the abutment ear 32^f of the subtraction rack 32^b and the pawl is held down by its latch while the rack moves a step beyond normal during the last part of the restoring movement of the actuator bar.

At the beginning of the next operation of the machine the latch is retracted and the pawl is thereby released so that when the rack is thereupon restored to normal by its actuator bar the abutment end 40^d of the pawl will move up in front of the abutment ear 32^f of the rack. For the purpose of retracting the latch at this preliminary stage in the operation of the machine, I provide it with a forwardly-projecting branch 44^b having a laterally-turned end portion 44^c which overlies one of the members of the register frame 17 (Fig. 1). It will be recalled that this register frame lifts at the outset of an operation of the machine. Its said member acts against the laterally-turned portion 44^c of the latch and swings

the latter upward and forward so as to take its other laterally-projecting portion 44^a from over the raised edge 40^g of the pawl arm 40 and thus permit the latter to spring upward, as illustrated in Fig. 11.

It will of course be understood that the same effects are had, though in the reverse direction, as to release of an adding rack 11^c in forward rotation of a lower order wheel, and restoration of that rack in the next operation of the machine and reëngagement of the forwardly-projecting abutment portion 40^c of the pawl arm 40 with the abutment ear 11^f of said adding rack.

While tripping of a transfer pawl by rotation of the lower order wheel in either direction involves release of both the adding and the subtracting rack of the higher order, this is of course only effective for transfer purposes as to the particular one of those racks which is in alinement with the higher order pinion, and the transfer movement of the other rack is an idle one. Both racks are simultaneously restored in the first part of the next operation of the machine.

For the purpose of certainly preserving alinement of registrations and keeping the register pinions at all times in correct relation to the racks, I provide two locking and alinement pins or studs 60 for each pinion so arranged, Fig. 11, that as the pinion disengages from a rack in the lifting of the frame 17, one of its teeth will enter between these pins. I mount these pins in forwardly-projecting arms 61 of frame pieces 62, which appear in the form of vertically-arranged plates mounted on cross rods or shafts 63. Downwardly-extending portions of these plates support the pivot studs for the transfer pawls.

For the purposes of the lateral shift of the register wheels and pinions the rock shaft 17^a of the frame 17 is mounted to slide in its bearings and has a projecting left-hand end portion equipped with a stud 17^b. This stud is embraced by the bifurcated end of a horizontally-arranged lever 70 pivoted on a screw-stud 71, fastened in the base of the machine. The rear end of this lever has an upturned handle portion 70^a projecting at the left of the keyboard in a convenient position for manipulation. When this handle is swung to the left as shown in Fig. 15 the register wheels are in their right-hand position with the pinions over the adding racks 11^c as shown in Fig. 5. When this handle is thrown to the right the wheels are shifted to the left and the pinions take up positions over the subtraction racks 32^b as shown in Fig. 12. It will be noted that the stud 18^a is long enough to preserve engagement with the cam slot 19^a of plate 19 when the register frame is shifted to the right taking with it the arm 18. Likewise the locking pins 60 are elongated so as to perform their function under both adding and subtraction conditions. As the register pinions are fully in mesh with one set of racks when a lateral shift occurs and are to move into similar engagement with the other set of racks, the side edges of the pinion teeth may be chamfered to secure easy action, or the side edges of the rack teeth may be so treated or this may be practised as to both the rack teeth and the pinion teeth.

Referring to the matter of taking totals or sub-totals, it is evident that with double-acting transfer pawls of the character described, stopping of wheels at zero positions cannot be done by the pawls as in the familiar adding and listing machines of the Pike and Burroughs type. Therefore, separate zero stops are provided in the form of a series of arms 80, Figs. 10 and 16, secured to a rock shaft 81 journaled in depending portions of side frame pieces of the machine, said arms normally occupying positions below the paths of movement of the transfer pins or studs 16^b on the register wheels. A crank arm 82 fastened to said rock shaft is connected to a link 83 which extends rearward and is coupled to a bell-crank lever 84. The forwardly-extending arm of this bell-crank lever runs under a stud 25^b on the total key lever 25^a. A spring 85 applied to said bell crank normally holds the link 83 rearward and the zero stop arms 80 consequently depressed as shown in full lines, Fig. 16. Upon depression of either the total key 25 or the sub-total 26 the total key lever 25^a is lowered and the bell crank 84 rocked and the stop arms therefore raised into line with the wheel studs or pins 16^b as indicated by dotted lines in Fig. 16.

It is intended that a totaling or sub-totaling operation shall only be practised when the machine is in adding position, the wheels in backward rotation being stopped at zero by an encounter of their studs against the ends of the stop arms 80. It is preferable to definitely preclude a totaling or sub-totaling operation of the machine when in subtracting condition. Therefore, I provide a lug 70^c on the handle 70^a of the shift lever 70, (Fig. 17) which lug when that handle is in subtracting position stands in front of a lug 83^a on the link 83 and thereby locks out both total and sub-total key.

I claim:

1. In a machine of the class described the combination with racks and rack-carriers having slot and pin and spring connections; of additional racks and rack-carriers also having slot and pin and spring connections; means for moving the additional rack-carriers concurrently with and in the reverse direction to the movement of the first-mentioned rack-carriers; register pinions; means for establishing coöperative relationship between the same and either set of

racks; and double acting transfer pawls normally restraining the springs of the rack and carrier connections aforesaid, and adapted to be tripped by the pinions under rotation in either direction.

2. In a machine of the class described the combination of two sets of reciprocating bars having racks arranged in pairs side by side and also having oppositely facing racks, gear wheels connecting the latter, actuating and amount determining means directly related to one set of reciprocating bars, and register wheels gearable with either set of the first-mentioned racks.

3. The combination of reciprocating bars, actuating and amount determining means applied thereto, racks movably mounted on said bars, a second set of bars, gears connecting them with the first set, racks movably mounted on the second set of bars, register wheels gearable with either set of racks, means normally preventing relative movement between the racks and their bars, tripping devices for permitting such movement upon completion of turning of wheels in either direction, and springs through which the movement is effected.

4. The combination of reciprocating bars, actuating and amount determining means applied thereto, racks movably mounted on said bars, a second set of bars, gears connecting them with the first set, racks movably mounted on the second set of bars, register wheels gearable with either set of racks, double-acting pawls normally obstructing movement of the racks relative to their bars, means for displacing said pawls upon completion of turning of wheels in either direction, and springs through which the racks may then be moved.

5. The combination of reciprocating bars, actuating and amount determining means applied thereto, racks movably mounted on said bars, springs connecting the racks and bars, a second set of bars, gears connecting them with the first set, racks movably mounted on the second set of bars, springs connecting these racks to their bars, register wheels gearable with either set of racks, double-acting pawls one for each pair of racks and normally opposing the springs of the latter thereby preventing movement of one rack relative to its bar in one direction and the other rack relative to its bar in the opposite direction, and means on the wheels for tripping said pawls.

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