July 2, 1946. C. M. FRIDEN ET AL 2,403,069

CALCULATING MACHINE

Filed June 2, 1941 7 Sheets-Sheet 1

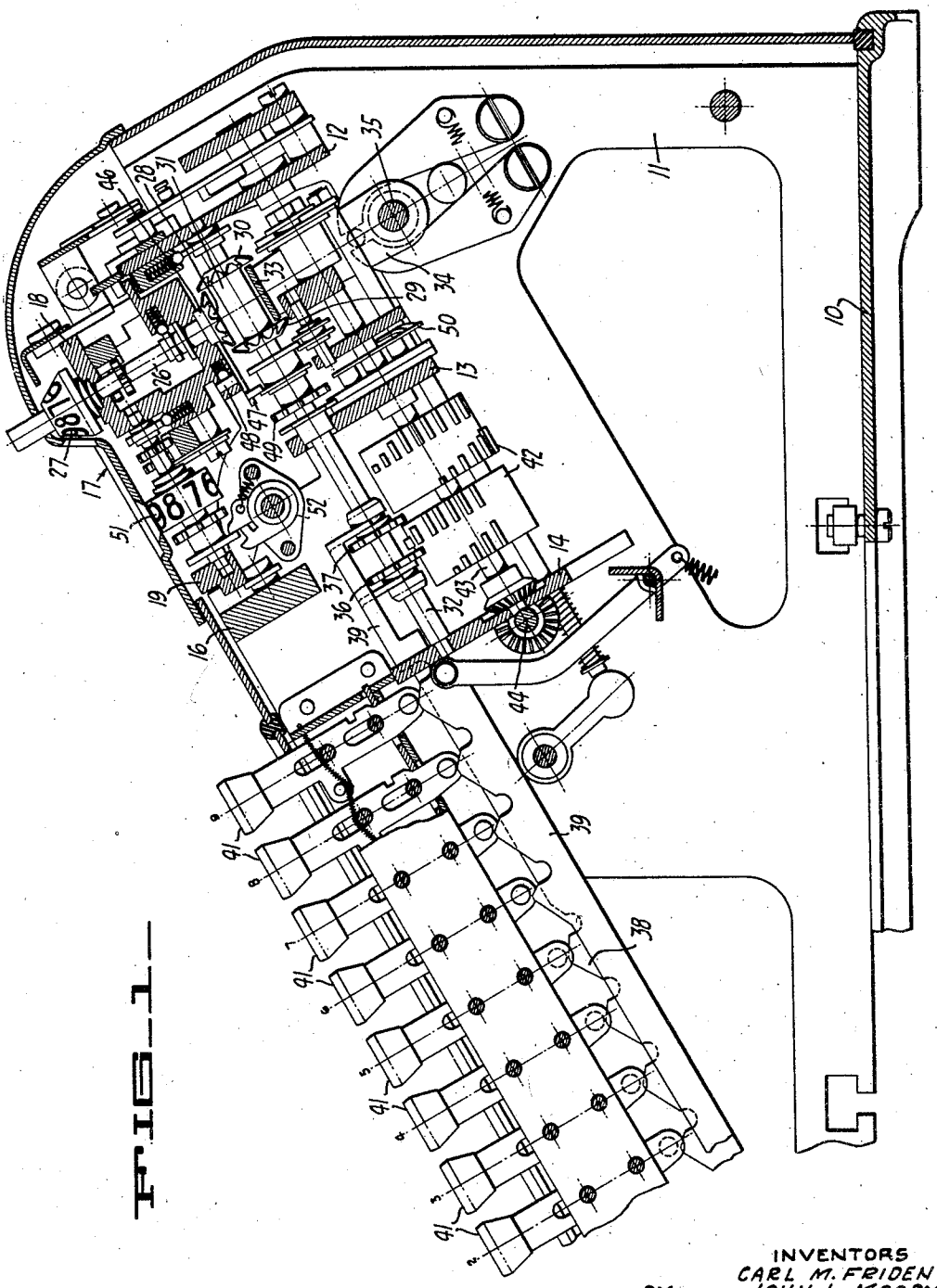


FIG. 1

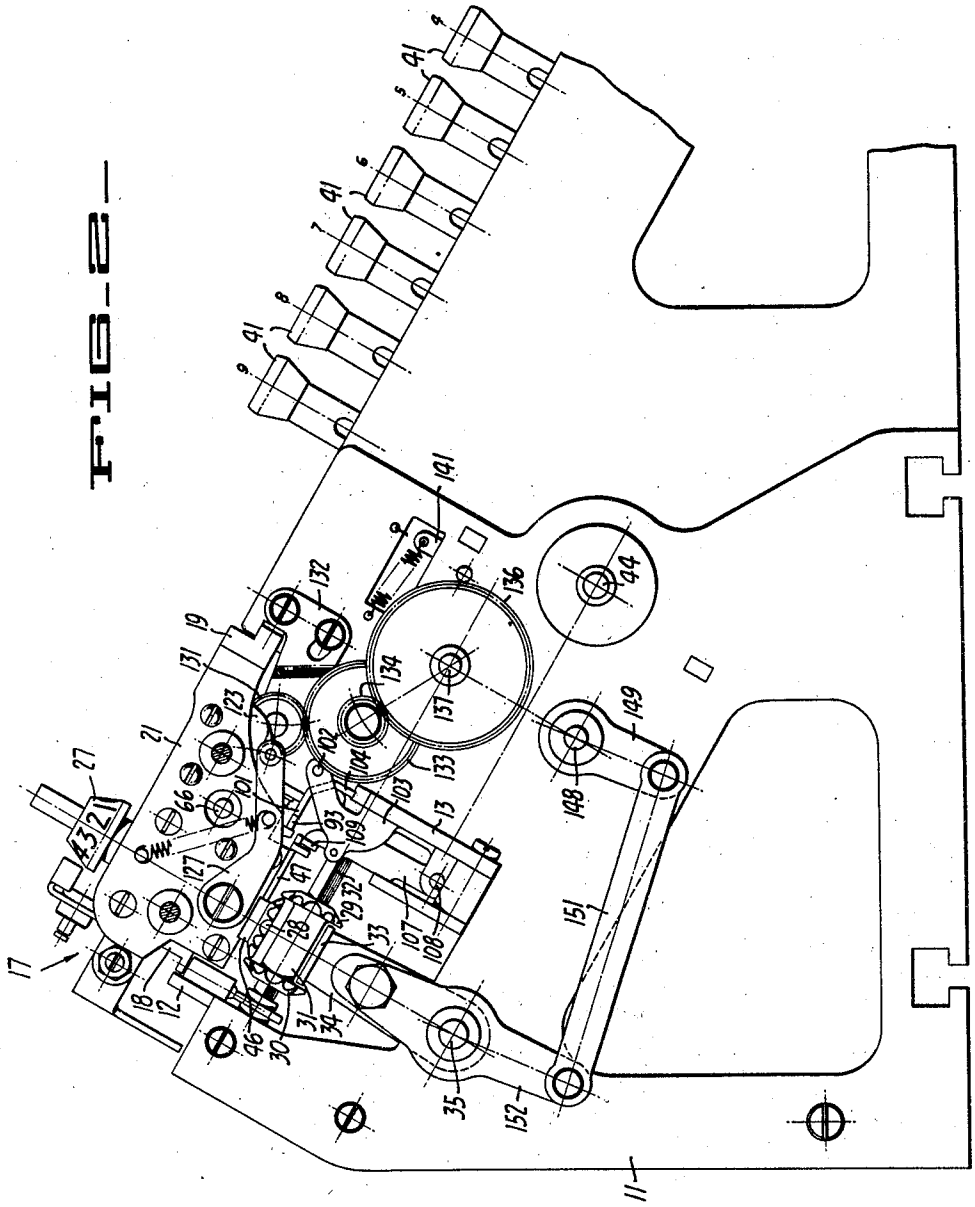
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CALCULATING MACHINE

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FIG 2



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CALCULATING MACHINE

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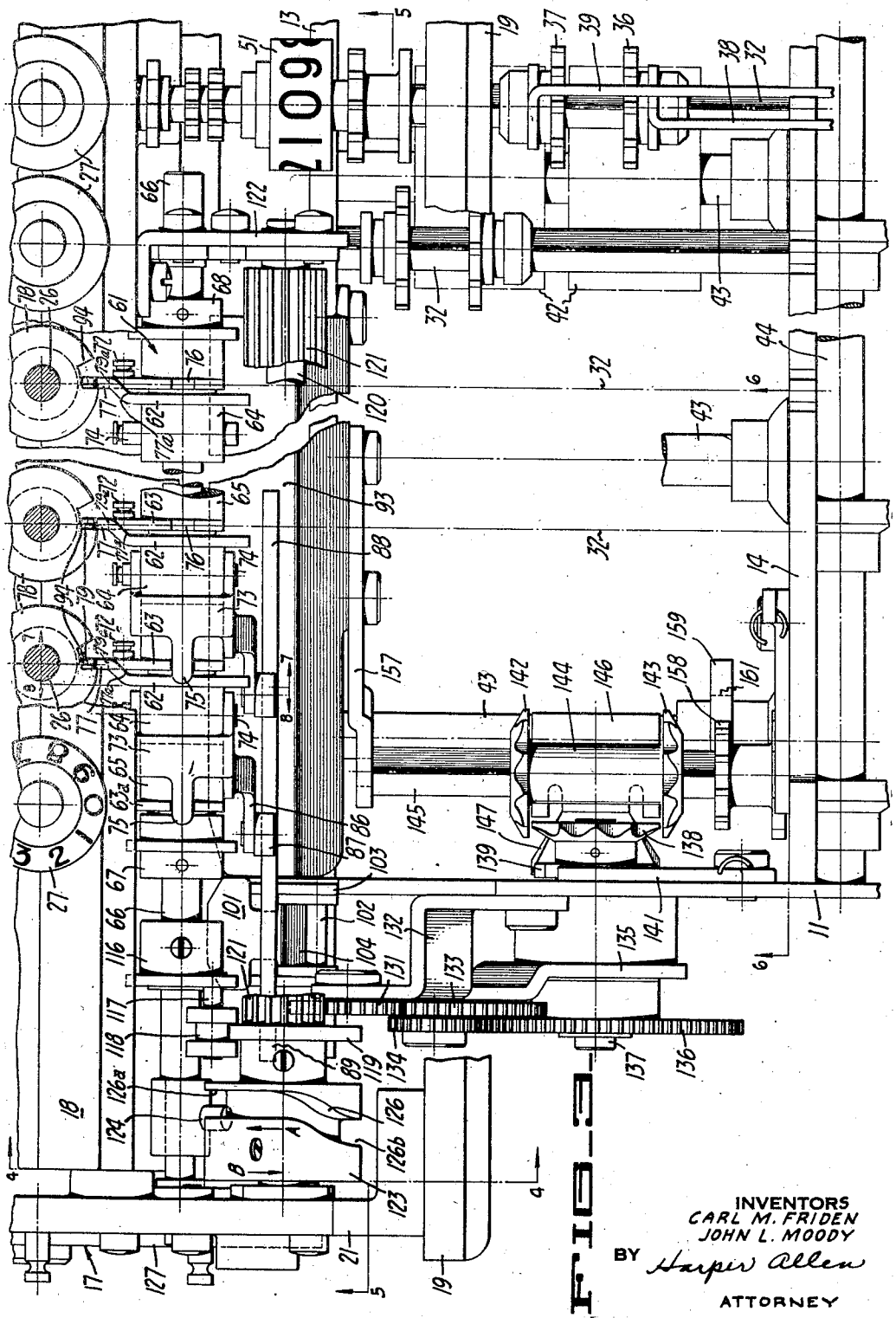


FIG. 3

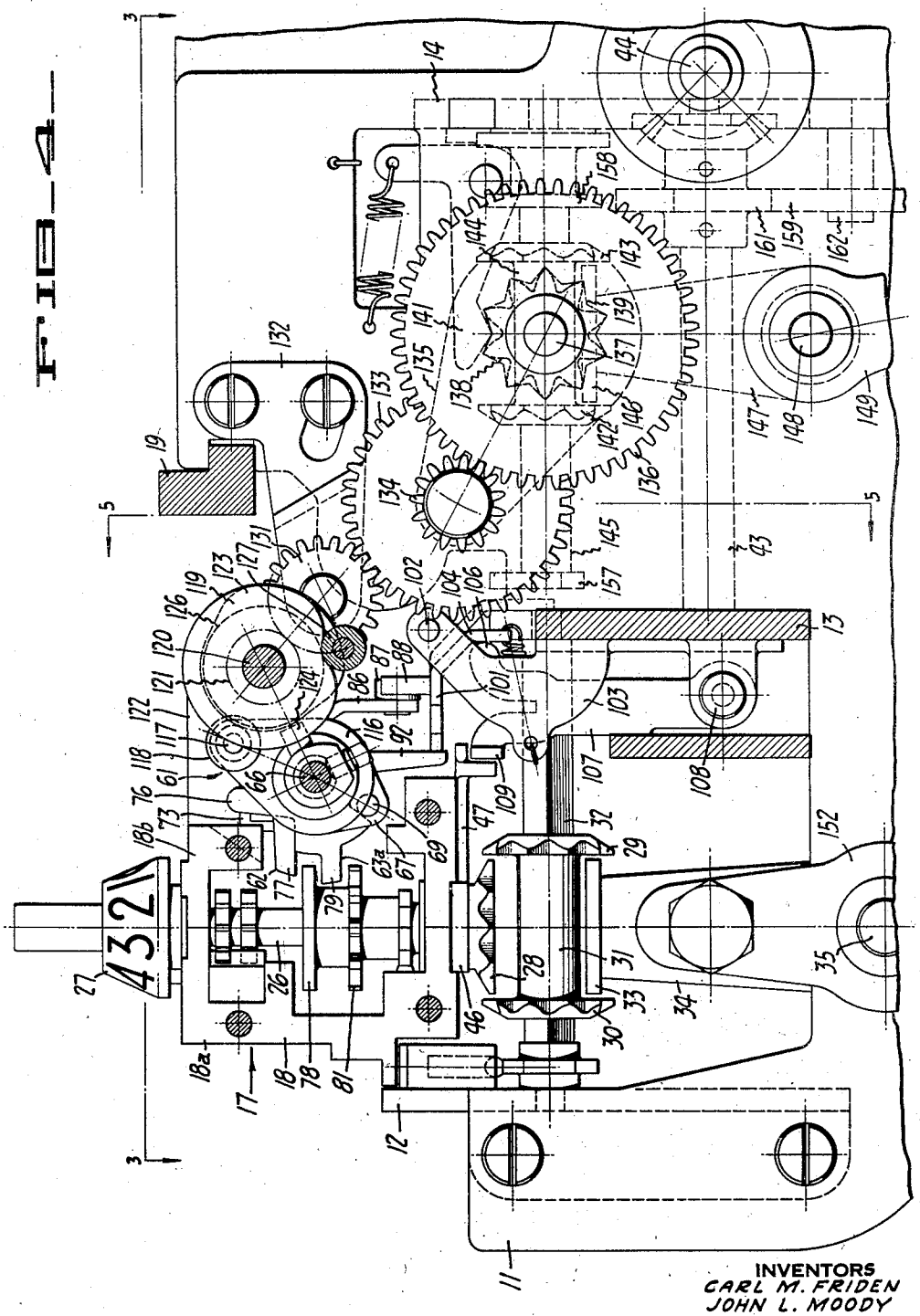
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CALCULATING MACHINE

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FIG. 4



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CALCULATING MACHINE

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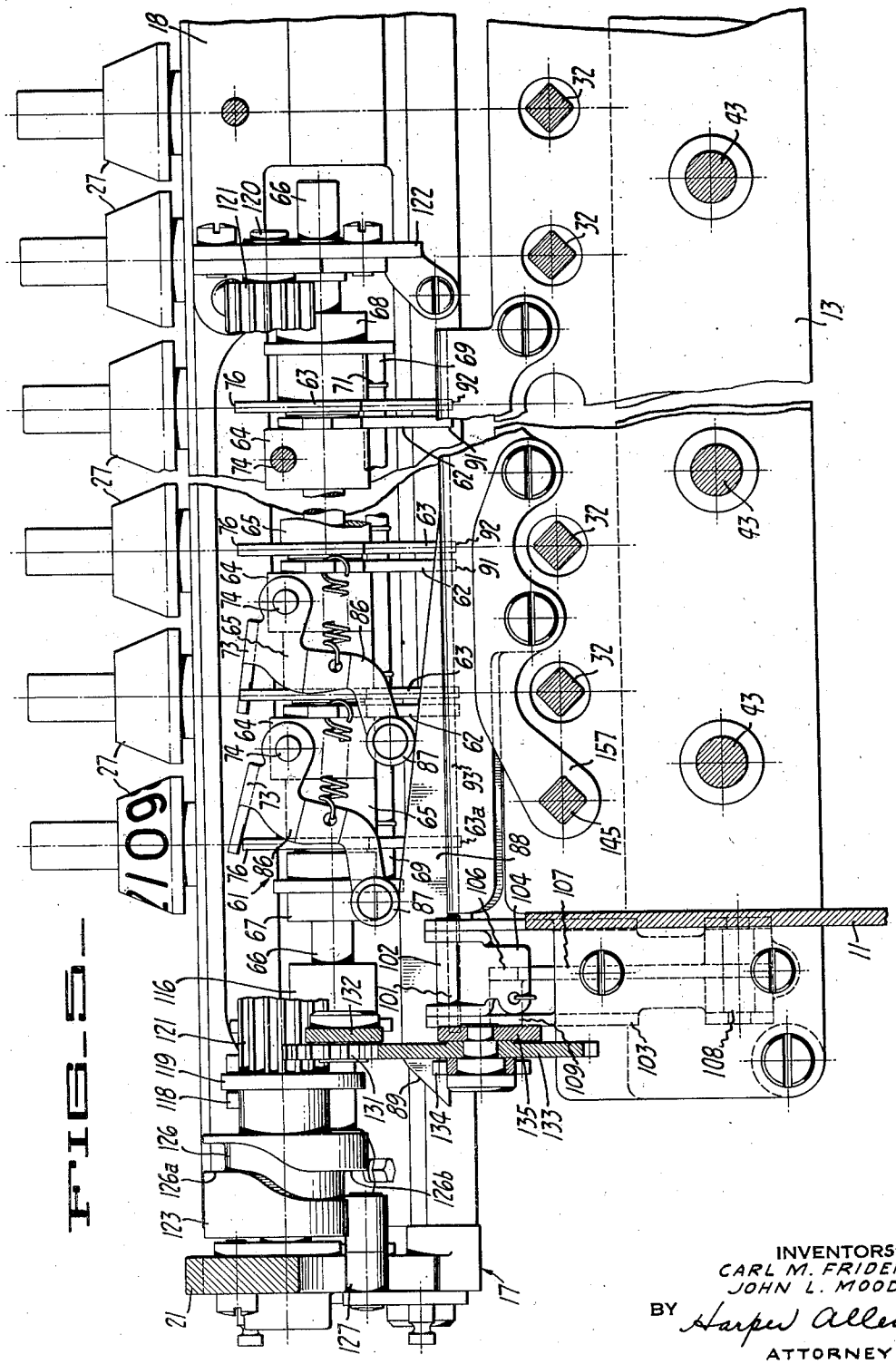


FIG. 5

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CALCULATING MACHINE

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FIG-7-

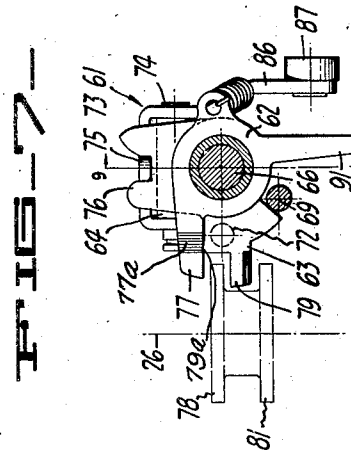


FIG-8-

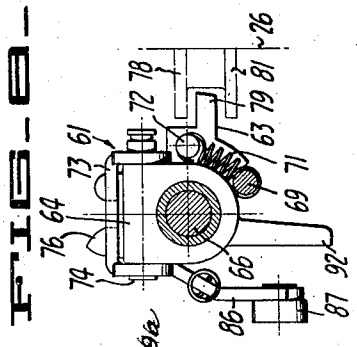


FIG-9-

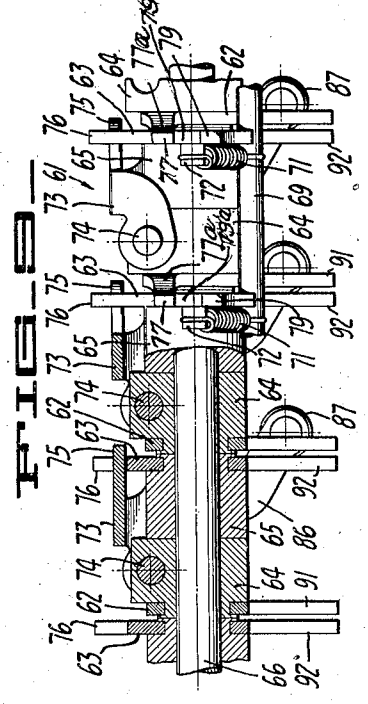
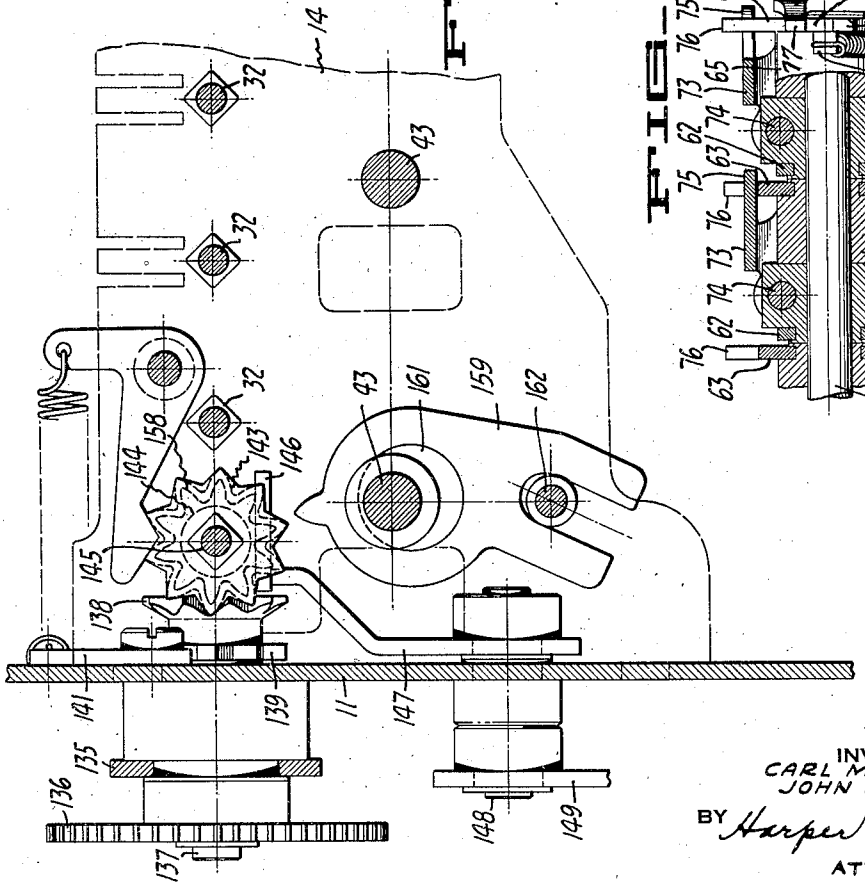


FIG-6-



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CALCULATING MACHINE

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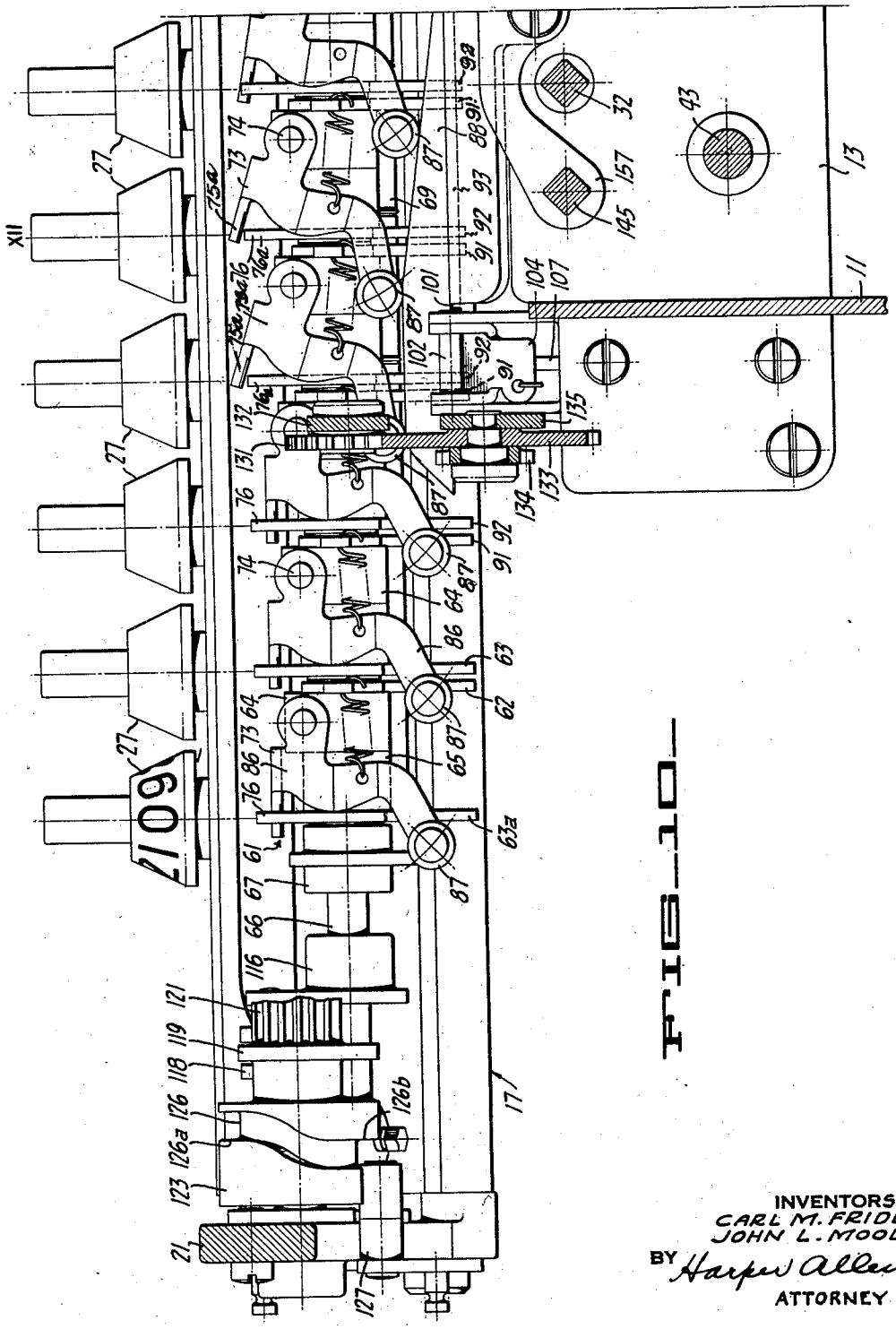


FIG. 10.

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Patented July 2, 1946 2,403,069

UNITED STATES PATENT OFFICE

2,403,069

CALCULATING MACHINE

Carl M. Friden, Pleasanton, and John L. Moody, Oakland, Calif., assignors to Friden Calculating Machine Co., Inc., a corporation of California

Application June 2, 1941, Serial No. 396,306

16 Claims. (Cl. 235—133)

1

This invention relates to calculating machines and is concerned more particularly with the provision of a full tens transfer mechanism for the shiftable register of such machines.

It is a general object of the invention to provide an improved tens transfer mechanism for calculating machines having shiftable registers whereby transferring operations extend to all register dials.

Another object of the invention is to provide an auxiliary tens transfer mechanism operable with respect to all orders to the left of those normally operated upon by the conventional transfer mechanism of the machine.

Other objects and advantages will be apparent from the following description of a preferred embodiment of the machine as illustrated in the accompanying drawings, in which:

Figure 1 is a cross-sectional elevational view illustrating the relation of the accumulator and revolutions counter to their respective actuating means.

Figure 2 is a left side elevational view of the machine, with some parts shown in section.

Figure 3 is an enlarged plan view illustrating the auxiliary transfer mechanism, the view being taken as indicated by the line 3—3 in Figure 4.

Figure 4 is a sectional elevation taken as indicated by the line 4—4 in Figure 3.

Figure 5 is a transverse sectional view taken as indicated by the line 5—5 in Figure 4.

Figure 6 is a transverse sectional view taken as indicated by the line 6—6 in Figure 3.

Figure 7 is a detail section of the auxiliary transfer mechanism taken as indicated by the line 7—7 in Figure 3.

Figure 8 is a detail section of the auxiliary transfer mechanism taken as indicated by the line 8—8 in Figure 3.

Figure 9 is a rear elevational view of the auxiliary transfer mechanism, with left-hand portion of the view illustrating a vertical longitudinal section thereof as indicated by line 9—9 in Figure 7.

Figure 10 is a transverse sectional view similar to Figure 5 but with the carriage positioned so that certain orders of the outboard transfer mechanism are active.

Referring to the drawings, the invention is illustrated as embodied in a calculating machine of the Thomas type, for example of the character shown in the patents to Carl M. Friden Nos. 2,229,889 and 2,229,890, issued January 28, 1941.

Referring to Figures 1 to 3, the machine includes a frame including a base 10, respective

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similar side plates of which the left side plate 11 only is shown, and various cross frame members including cross brackets 12, 13, 14 and 16.

The machine also includes a transversely shiftable register carriage 17 which is suitably mounted for endwise shifting movement on cross brackets 12 and 16. The carriage 17 includes a main frame portion 18 made up of similar opposite sections 18a and 18b and a transverse bar 19 spaced therefrom and connected thereto by respective end plates 21.

The sections 18a and 18b (Figures 1 and 3) of the carriage frame mount a series of numeral wheel shafts 26, each of which carries numeral wheel or dial 27 at its upper end and a numeral wheel gear 28 at its lower end. The number wheel gear 28 is adapted to be meshed in the usual fashion with either of plus-minus gears 29 or 30 carried at the ends of a spool 31 which is slidably mounted on a square shaft 32. The shifted position of the series of plus-minus gears 29 and 30 is controlled by a strap 33 of the usual construction which is carried by one or more arms 34 from a rock shaft 35 which is adjusted to determine the plus-minus condition of registrations in the accumulator.

The square shaft 32 is provided with respective ten-tooth gears 36 and 37 which are controlled by respective slides 38 and 39 from the numeral keys 41 of the same order in the usual fashion. The gears 36 and 37 are shiftable to a selected position to be operated by an associated actuator cylinder 42 mounted on an actuating shaft 43, which is driven in the usual fashion from a transverse drive shaft 44 as fully described in said patents.

It will be understood that to select numbers for entry in the accumulator 27, the gears 36 and 37 are adjusted with respect to the associated actuating cylinder 42 to receive one to nine increments of movement to be transmitted through the operative gear 29 or 30 to the numeral wheel gear 28 and thus to the numeral wheel aligned therewith.

A conventional form of transfer mechanism is provided in the inboard orders of the calculating machine, that is those which are adapted to receive a drive directly from the actuating shafts 43. For this purpose each numeral wheel shaft 26 is provided with a single toothed cam 46 (Figure 1) which operates through a transfer lever 47 which is pivoted at 48 on the carriage frame to adjust the associated transfer gear 49 of next higher order to active position for engagement by the transfer actuator 50 associated therewith.

This construction is conventional and fully disclosed in said patent referred to above, except that in the twelfth order the shaft 32 does not extend forwardly of the frame plate 13 for a purpose that will later become apparent.

The register carriage 17 may also serve to mount a suitable form of revolutions counter having numeral wheels 51 which are adapted for operation by the associated counter actuator mechanism 52 in a conventional manner. Any desired type of counter may be employed.

As previously explained, the invention contemplates the provision of an auxiliary or outboard transfer mechanism for providing a full transferring operation throughout the accumulator, such mechanism being brought into play with respect to the numeral wheels which are outboard, that is to the left of the orders of the regular transfer mechanism. This outboard transfer mechanism is normally latched to become active only in the event of a transfer occurring in the highest order controlled by the regular transfer mechanism of the machine. Also the mechanism is capable of being disabled order-by-order as the orders are shifted inboard so that the extra or outboard transfer mechanism is only active with respect to those orders to the left of the regular or inboard transfer mechanism. This transfer mechanism is preferably of the simultaneous type and can be operated either positively or negatively.

Referring to Figures 3 and 10, the outboard transfer mechanism comprises an actuator assembly indicated generally at 61 which is mounted for endwise reciprocation and for a rotary oscillation and is driven in a manner hereinafter referred to. The actuator assembly 61 (Figures 3, 5, and 7 to 10) comprises a series of similar units made up of a transfer sensing element 62 and a transfer actuating element 63. Sensing element 62 of each unit is adapted to determine whether a lower order numeral wheel is in position to trip a transfer, and if this be the case the actuating element of this unit becomes effective with respect to the next higher order numeral wheel. Element 62 is provided with a hub 64 and element 63 is provided with a hub 65. The series of hubs 64 and 65 are in endwise abutting relation and free for pivoting movement on a shaft 66 having retaining collars 67, 68 secured thereon at the ends of the series of units. Collars 67 and 68 are connected by a rod 69. The rod 69 is connected by spring 71 to a stud 72 carried by each of the actuating elements 63 so that the actuating elements are yieldably urged to follow rod 69 in a clockwise direction as viewed in Figure 8.

A releasable connection is provided between the sensing element and the actuating element of each unit. This releasable connection is formed by a toothed bail 73 (Figures 3 and 7 to 10) pivoted at 74 on the associated hub 64 and having a tooth 75 engaging a forked extension 76 of the associated actuating element 63. In each unit of the actuator assembly, the sensing element 62 is provided with a tooth 77 for cooperation with a notched disc 78 of a numeral wheel while the associated actuating element 63 is provided with an actuating tooth 79 for association with a ten-tooth gear 81 of the next higher order numeral wheel.

The highest order transfer element is provided only with an actuating element 63a adjacent the retaining collar 67. In a nine order outboard mechanism, only the nine highest numeral wheels are provided with a notched disc 78 and ten-tooth wheel 81. The actuating tooth 79 of a lower order underlies the sensing tooth 77 of the next higher order and as shown in Figs. 3, 7 and 9 the bent portion 77a of each lever 77 engages shoulder 79a on the members 79 disposed therebelow; when one sensing member is restrained, all higher units are also restrained.

Means are provided to render the units of the auxiliary transfer assembly ineffective when they are in an inboard position, that is, when the numeral wheels associated therewith are in position to be actuated by the regular transfer mechanism.

In order to break the connection between two adjacent members 62 and 63 of a unit, the bail 73 is provided with a depending arm 86 having a roller 87 adapted to engage a fixed rail 88 mounted on the frame of the machine. Rail 88 has an inclined cam end 89 upon which the rollers 87 ride as they pass from outboard to inboard condition. The sensing and actuating elements 62 and 63 are provided with respective depending fingers 91 and 92 which, as they pass inboard, move along the edge of a fixed rail 93 so as to prevent movement of such inboard elements under the urgency of springs 71 upon clockwise movement of the transfer assembly toward active position as viewed in Figure 8. All orders are shown as being inboard in Figures 3, 4, and 5, the carriage being positioned in its right-end position. In Figure 10, the four highest orders are shown in outboard position. The outboard orders, however, if unlatched by the regular transfer mechanism are free to rock in such direction under the urgency of their springs 71 as the rod 69 rocks with the shaft 66 as later described. Thus, if a numeral wheel, for example in positive registration, is standing at zero, the notch 94 of its disc 78 will be positioned as shown in Figure 3, so that the associated sensing tooth 77 can pass therethrough and let the actuating tooth 79 of the same unit engage the next higher order ten-tooth gear to transfer the increment upon the translatory movement of the auxiliary transfer assembly.

A releasable latch is provided for the outboard orders of the transfer mechanism in the form of a stop member or latch 101 (Figures 3, 4 and 10) pivoted at 102 in a bracket 103 carried by the frame of the machine. Latch 101 has its horizontal latching portion disposed in the plane of rail 93 and lies immediately to the left of the rail as seen in Figure 3 to engage finger 92 of the lowest outboard order. Member 101 has a depending portion 104 for engagement by finger 106 of an arm 107 pivoted at 108 on the frame of the machine. Arm 107 has a second finger provided with an offset end 109 for engagement with the transfer lever 47 operated by the highest order receiving a transfer from the conventional numeral wheel mechanism. With the latch member 101 positioned as shown in Figure 4, the outboard transfer mechanism is inoperative. However, if latch member 101 is rocked counterclockwise from the Figure 4 position to move its horizontal portion below the aligned finger 92 of the lowest outboard order, all outboard orders of the transfer mechanism are also released for a similar counter-clockwise movement as viewed in Figure 4 to operative position. Only the orders to the left of the rail 93 as shown in Figure 10 can be operative.

As stated above, the drive mechanism for the transfer actuator provides for axial reciprocation

and rotary oscillation thereof in timed relation, so that for positive registration the active actuator teeth are dipped to active position during one direction of translatory movement, and during negative registration they are dipped to active position during the opposite direction of translatory movement.

To effect the axial oscillation of the transfer actuator, the shaft 66 has secured thereon a collar 116 (Figures 3, 4 and 10) which carries an eccentrically positioned pin 117 on which a grooved roller 118 is slidably and rotatably mounted. The groove of the roller 118 is engaged by cam 119 having its hub secured on a shaft 120 of a long pinion 121. Pinion 121 and shaft 120 are journaled in end plate 21 and in bracket 122 carried by the frame of the carriage. As seen in Figure 4, the cam 119 is in its neutral position and is seen to be symmetrical with respect to such position with the cam rise located substantially diametrically opposite from the roller 118. Thus upon turning of the cam 119 in either direction, roller 118, pin 117, collar 116, and shaft 66 will be oscillated first counter-clockwise as viewed in Figure 4, and then clockwise back to the position shown in Figure 4. The high portion of cam 119 is of sufficient extent to maintain the actuator in engagement with the associated gears during their active stroke.

To control the axial reciprocation of the transfer assembly, the shaft 120 also carries a grooved cam drum 123 (Figures 3, 4 and 10) engaged by a pin 124 secured on the shaft 66. Drum 123 is provided with a cam groove 126 which is adapted to provide an axial reciprocation of the shaft 66 for each revolution of the cam drum 123. The cam groove has a straight portion 126*a* separated from a second axially displaced straight portion 126*b* by similar inclined portions. Pin 124 is normally midway of one of the inclined portions. The position of the pin 124 with respect to the cam groove 126 being such that in the direction of rotation A of the cam drum 123, the first part of the axial reciprocation of the shaft 66, i. e., to the right, occurs before its rotary oscillation to move the actuator teeth to active position. This action occurs while pin 124 is traveling along straight portion 126*a* of the cam groove. After the teeth are moved to active position in all orders to which transfers are determined, the pin 124 moves along the second inclined cam groove portion whereby the transfer assembly is moved to the left for its full extent of travel to effect entry of any transferred units. Subsequently the actuator teeth are rocked back to inactive position as the roller 118 descends the high portion of cam 119 and thereafter the assembly is moved axially back to its central full-cycle position. Centralizer 127 (Figure 4) engages a recess in cam drum 123 to position it in full cycle position. In the other direction of rotation B of the cam drum, a reverse cycle of movements takes place. As shown in Figure 3, the notched discs 78 are positioned for zero registration so rotation in direction A will effect a negative transfer. If the notch 94 of a disc were positioned one increment for one-tenth revolution clockwise from the position shown in Figure 3, the numeral wheel would be standing at 9 and the direction B of rotation would cause a positive transfer.

The drive is transmitted to the pinion 121 through a gear 131 (Figures 3, 4 and 10) suitably journaled in a bracket 132 secured on side plate 11 and meshing with a large gear 133 of a double gear pair including a small gear 134 journaled on bracket 135. Gear 134 meshes with a large gear 136 carried by a shaft 137 suitably journaled on the side plate 11. Shaft 137 carries a ten-tooth bevel gear 138 adjacent a centralizer cam 139 operatively engaged by centralizer arm 141. Gear 138 is adapted for engagement with either of gears 142 or 143 of a plus-minus gear arrangement including a spool 144 slidably and non-rotatably mounted on shaft 145. Spool 144 is engaged by the upper end 146 of an arm 147 secured on shaft 148. Shaft 148 (Figure 2) carries a depending arm 149 connected by link 151 with an arm 152 depending from shaft 35. Thus, the engagement of gears 142, 143 to control the direction of drive of the pinion 121 is controlled from the setting of the plus-minus gears for the accumulator.

The shaft 145 is journaled in a bracket 157 and in cross frame bracket 14 and carries a ten-tooth gear 158 (Figures 3 and 6) which is adapted for operation by a pawl 159 which engages about an eccentric cam 161 secured on one of the actuating shafts 43. The arrangement is such that for each rotation of shaft 43, gear 158 receives one-tenth rotation and through the gearing 136, 134, 133, and 131 drives pinion 121 for one rotation.

The operation of the auxiliary transfer assembly will be described, for example with reference to a so-called "ten bank" machine which has ten active orders in which digitation entries can be made and usually some extra transfer orders which are operated in time with the actuating means, for example two extra orders, so that the conventional transfer mechanism will take care of transferring into the twelfth order of the accumulator or register. If all of the numeral wheels of the register are standing at zero and a subtractive entry is made, a transitional carry or transfer will be determined partially by virtue of the usual transfer mechanism and partially by virtue of the outboard transfer assembly.

At this time, all of the inboard transfer units of the auxiliary transfer assembly including that of the numeral wheel in the twelfth order position will be held disabled by the rail 93. At the same time the rail 88 engages with the roller 87 of the unit whose sensing element is disposed in the twelfth ordinal position, and whose actuating element is disposed in the thirteenth ordinal position and disconnects the inboard and outboard units by disengaging the tooth 75*a* (Fig. 10) of the bail 73*a* from the forked extension 76*a*. However, all transfer units of the assembly to the left of the twelfth order position (i. e., the outboard orders) will be enabled as shown in Figure 10. Thus upon movement of the aligned transfer lever by the twelfth order numeral wheel, latch 101 is disabled by moving below the aligned finger 92 of the thirteenth effective order as viewed in Figure 10, and the active outboard transfer units are free to rock counter-clockwise as viewed in Figures 4 and 7.

The auxiliary transfer mechanism is effective to operate on only those orders of the carriage standing to the left of the orders in position to be operated by the main transfer mechanism of the machine (Fig. 10).

The elements 62 and 63 (Fig. 3), disposed in the zone of operation of the conventional transfer mechanism, are restrained from rocking (to sense or actuate) by the action of rail 93 (Fig. 5) on depending elements 91 and 92. However, cam 88 (Fig. 10) is so disposed that it raises roller 87 and thereby disengages the toothed connec-

tion between the sensing and actuating elements in the ordinal position at the junction of the inboard and outboard orders so that the transfer lever actuated by the dial shaft in the highest ordinal position to be operated by the conventional transfer mechanism (twelfth ordinal position) is effective to cause the actuating element in the lowest outboard order (thirteenth ordinal position) to become operative.

The add-substract gate 33 (Fig. 2) governs the direction of rotation of shaft 120 by controlling, through the linkage 152, 151, 149, and 147 (Figs. 2 and 4), the setting of gears 142 and 143 with respect to gear 138 (Fig. 4). Gears 142 and 143, which are rotated by the action of tooth member 159 (Fig. 6), actuated by shaft 43, cycle pinion 121 through gears 138, 136, 134, 133 and 131, one revolution per revolution of the machine, commencing at about 25° before the full cycle position, and terminating at the full cycle position, in a direction of rotation determined by the setting of the add-subtract gate 33.

In an additive operation, if the numeral wheel in the twelfth ordinal position passes through the 9–0 position, indicating a transfer into an outboard order, the transfer lever 47 (Fig. 4) of the twelfth order numeral wheel is displaced forwardly, rocking the gate 101, thereby no longer restraining depending member 92 of actuating element 63 in the thirteenth ordinal position from rocking. The timing is such that when, due to rotation in the direction B (Fig. 3), cam 123 has moved shaft 66 to the leftmost position, cam 119 becomes effective to rock shaft 66 in a counter-clockwise direction (Fig. 7) so that the actuating element 79 in the thirteenth ordinal position, which has been unlatched from its sensing element by the cam 88 in that position, is now free to rock into engagement with the associated gear 81 under the urgency of its spring 71. During this phase of operation, cam 123 (Fig. 3) becomes effective to move shaft 66 to the right thereby driving the dial shaft in the thirteenth ordinal position to register one number higher. If at the time cam 119 causes shaft 66 to rock, the dials in additional outboard orders, successively from the right to the left starting with the thirteenth ordinal position, stand at 9, then each associated sensing element will enter the notch in its disc thereby allowing the connected actuating element to mesh with its associated gear 81, as any sensing element 77 outboard of cam 88 is free to rock if the actuating element 79 associated with the next lower order rocks, withdrawing its shoulder 79a from beneath element 77. In this manner, when cam 123 causes shaft 66 to be displaced to the right, all orders wherein associated actuating elements are operative will be driven to register the additional count, effecting a complete carry-over.

In the event of a carry-over in a subtractive operation, the action is similar, only reversed. In this case, due to rotation in the direction A (Fig. 3), shaft 66 is first displaced to the rightmost position, where it is rocked so that the sensing elements may enter the notches in discs of numeral wheels standing at 0, whereupon shaft 66 is then displaced to the left effecting the required subtraction in the associated dials.

We claim:

1. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a tens transfer assembly for said numeral wheels mounted in said carriage, said assembly including a series of ordinal transfer units mounted for axial reciprocation and for rotary oscillation as a whole, each unit including an element for sensing the condition of a numeral wheel to control a transferring operation and an actuating element for cooperation with the next higher order numeral wheel when a transferring operation is determined, each transfer unit including a releasable coupling between the sensing element and the actuating element thereof.

2. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a tens transfer assembly for said numeral wheels, including a series of ordinal transfer units mounted for axial reciprocation and for rotary oscillation as a whole, each unit including an element for sensing the condition of a numeral wheel to control a transferring operation and an actuating element for cooperation with the next higher order numeral wheel when a transferring operation is determined, each transfer unit also including a releasable coupling between the sensing element and the actuating element thereof, and reversible means for driving said assembly in both its axial reciprocation and its rotary oscillation.

3. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a tens transfer assembly in said carriage for said numeral wheels, including a series of ordinal transfer units mounted for axial reciprocation and for rotary oscillation as a whole, each unit including an element for sensing the condition of a numeral wheel to control a transferring operation and an actuating element for cooperation with the next higher order numeral wheel when a transferring operation is determined, each transfer unit also including a releasable coupling between the sensing element and the actuating element thereof, reversible means in said carriage for driving said assembly in both its axial reciprocation and its rotary oscillation, and drive mechanism on said frame including means for effecting a driving relation to said drive means in said carriage in any ordinally shifted position of said carriage.

4. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a tens transfer assembly for said numeral wheels, including a series of ordinal transfer units mounted for axial reciprocation and for rotary oscillation as a whole, each unit including an element for sensing the condition of a numeral wheel to control a transferring operation and an actuating element for cooperation with the next higher order numeral wheel when a transferring operation is determined, means individual to each of said units for urging said elements yieldably to active position, said transfer units having an interlocking relation from the lowest to the highest order thereof, and means for latching the lowest effective order of said units against movement, said latching means being movable to inactive position in response to the determination of a transfer into the lowest effective order of said transfer unit.

5. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, a series of numeral wheels in said carriage, actuating means on said frame

for said numeral wheels, and transfer mechanism associated with said actuating means and said numeral wheels and driven in time with said actuating means; a transfer assembly in said carriage for cooperation with numeral wheels of higher order than those aligned with said transfer mechanism, said transfer assembly including a series of units, each unit of which includes a sensing member and an actuating member releasably coupled together for movement to active position, and means responsive to positioning of a transfer unit in overlapping relation with the highest order of said transfer mechanism for releasing said coupling.

6. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, a series of numeral wheels in said carriage, actuating means on said frame for said numeral wheels, and transfer mechanism associated with said actuating means and said numeral wheels and driven in time with said actuating means; a transfer assembly in said carriage for cooperation with numeral wheels of higher order than those aligned with said transfer mechanism, said transfer assembly including a series of units, each unit of which includes a sensing member and an actuating member releasably coupled together for movement to active position, means responsive to positioning of a transfer unit in overlapping relation with the highest order of said transfer mechanism for releasing said coupling, and means for preventing operative movement of any of said elements positioned in a lower position than the first effective or outboard order of said units.

7. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a transfer assembly in said carriage including a shaft, a series of transfer units on said shaft, each transfer unit including a sensing element and an actuating element journalled on said shaft in side-by-side relationship, spring means yieldably urging said units to follow rocking movement on said shaft in one direction, said shaft having a positive connection for causing return of said units in the other direction, the actuator element of each unit having an interlocking relation with the sensing element of the next higher unit whereby blocking of movement of a lower order unit to active position will also block all higher order units from such movement, each of said numeral wheels having a ten tooth gear for cooperation with the aligned actuator element and a notched disc for cooperation with the aligned sensing element, a releasable blocking element for preventing movement of all effective units to active position, and means for moving said blocking member to ineffective position.

8. In a calculating machine having a frame, a carriage mounted for endwise shifting movement on said frame, and a series of numeral wheels in said carriage; a transfer assembly in said carriage including a shaft, a series of transfer units on said shaft, each transfer unit including a sensing element and an actuating element journalled on said shaft in side-by-side relationship, spring means yieldably urging said units to follow rocking movement of said shaft in one direction, said shaft having a positive connection for causing return of said units in the other direction, the actuator element of each unit having an interlocking relation with the sensing element of the next higher unit whereby blocking of

movement of a lower order unit to active position will also block all higher order units from such movement, each of said numeral wheels having a ten tooth gear for cooperation with the aligned actuator element and a notched disc for cooperation with the aligned sensing element, a releasable blocking element for preventing movement of all effective units to active position, means for moving said blocking member to ineffective position, and means for rendering all of said units in a lower order position than said blocking means ineffective.

9. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, a source of power, means for operating said main transfer mechanism from said source of power, an auxiliary transfer mechanism for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, means for operating said auxiliary transfer mechanism from said source of power, said auxiliary transfer mechanism including a series of individual transfer units in said carriage, each of said units having an element for actuating a numeral wheel and an element for sensing the transfer condition of the next lower order numeral wheel to control operation of the actuating element, means to interlock said auxiliary transfer units for conjoint action upon said numeral wheels, and means on said frame operative upon said interlocking means to disconnect in any position of the carriage the auxiliary transfer units in ordinal alignment with said main transfer mechanism from the auxiliary transfer units in orders higher than the highest order of said main transfer mechanism.

10. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, a source of power, means for operating said main transfer mechanism from said source of power, an auxiliary transfer mechanism for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, means for operating said auxiliary transfer mechanism from said source of power, said auxiliary transfer mechanism including a series of individual transfer units in said carriage, each of said units having an element for actuating a numeral wheel and an element for sensing the transfer condition of the next lower order numeral wheel to control operation of the actuating element, means to interlock said auxiliary transfer units for conjoint action upon said numeral wheels, means on said frame operative upon said interlocking means to disconnect in any position of the carriage the auxiliary transfer units in ordinal alignment with said main transfer mechanism from the auxiliary transfer units in orders higher than the highest order of said main transfer mechanism, and means on said frame to prevent operation by said operating means of auxiliary transfer units in ordinal alignment with said main transfer mechanism.

11. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means

for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, actuating means for said auxiliary transfer mechanism mounted in said carriage including a rotatable member, and means for transmitting rotation from said drive means to said member in any position of said carriage.

12. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, rotary actuating means for said auxiliary transfer mechanism mounted in said carriage, means for transmitting drive from said drive means to said auxiliary transfer actuating means in any position of said carriage, and a reversing gear included in said drive transmitting means adjustable to cause additive or subtractive operation of said auxiliary transfer mechanism.

13. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, actuating means for said auxiliary transfer mechanism mounted in said carriage, an elongated pinion in said carriage for driving said auxiliary transfer mechanism actuating means, and means on said frame for transmitting drive from said drive means to said pinion in any position of said carriage.

14. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, actuating means for said auxiliary transfer mechanism mounted in said carriage, a gear means in said carriage for driving said auxiliary transfer mechanism actuating means, and means on said frame for transmitting drive from said drive means to said gear means in any position of said carriage.

15. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, said auxiliary transfer mechanism including a series of elements for controlling the transfer and for effecting the transfer, means for imparting a substantially rectangular path of movement to said elements to move said elements into operative position, to move said elements to effect the transfer, and to withdraw said elements to inoperative position, said movement imparting means including cam means, means on said carriage for rotating said cam means, and means on said frame for transmitting drive from said drive means to said rotating means in any position of said carriage.

16. In a calculating machine having a frame, a carriage ordinally shiftable on said frame, a series of numeral wheels in said carriage, means for actuating said numeral wheels, drive means for said actuating means, said actuating means including a main transfer mechanism ordinally arranged in said frame adapted to cooperate with numeral wheels in ordinal alignment therewith, an auxiliary transfer mechanism in said carriage for cooperation with numeral wheels disposed in higher orders than the highest order of said main transfer mechanism, said auxiliary transfer mechanism including a series of elements for controlling the transfer and for effecting the transfer, means for imparting a substantially rectangular path of movement to said elements to move said elements into operative position, to move said elements to effect the transfer, and to withdraw said elements to inoperative position, said movement imparting means including a cam for moving said elements into and out of operative position, and a reversible cam for causing reciprocation of said elements in one direction or the other to effect additive or subtractive actuation of said numeral wheels, means on said carriage for rotating said cams, and means on said frame for transmitting drive from said drive means to said rotating means in any position of said carriage.

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