Aug. 24, 1943. C. M. F. FRIDEN ET AL 2,327,704

CALCULATING MACHINE

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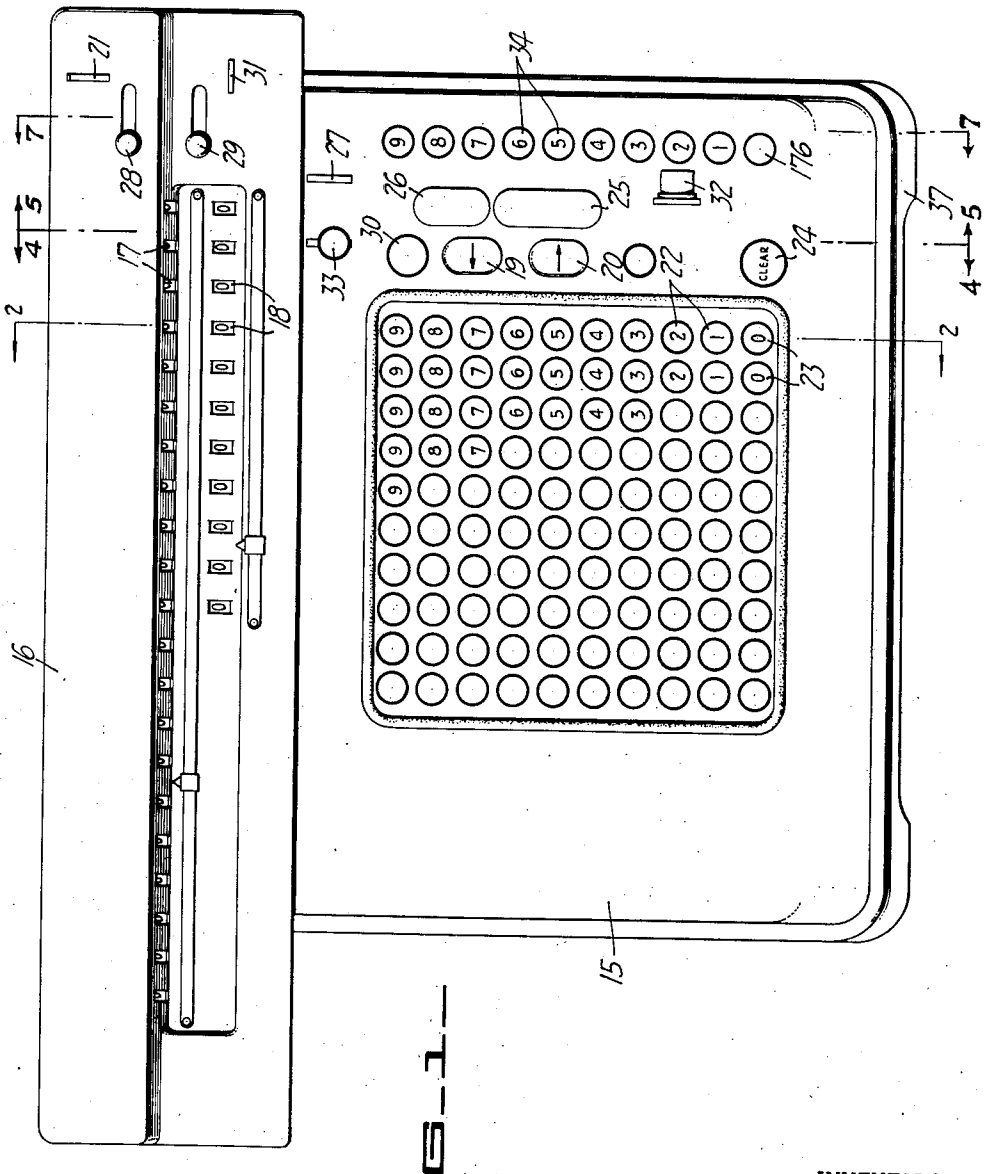


FIG. 1

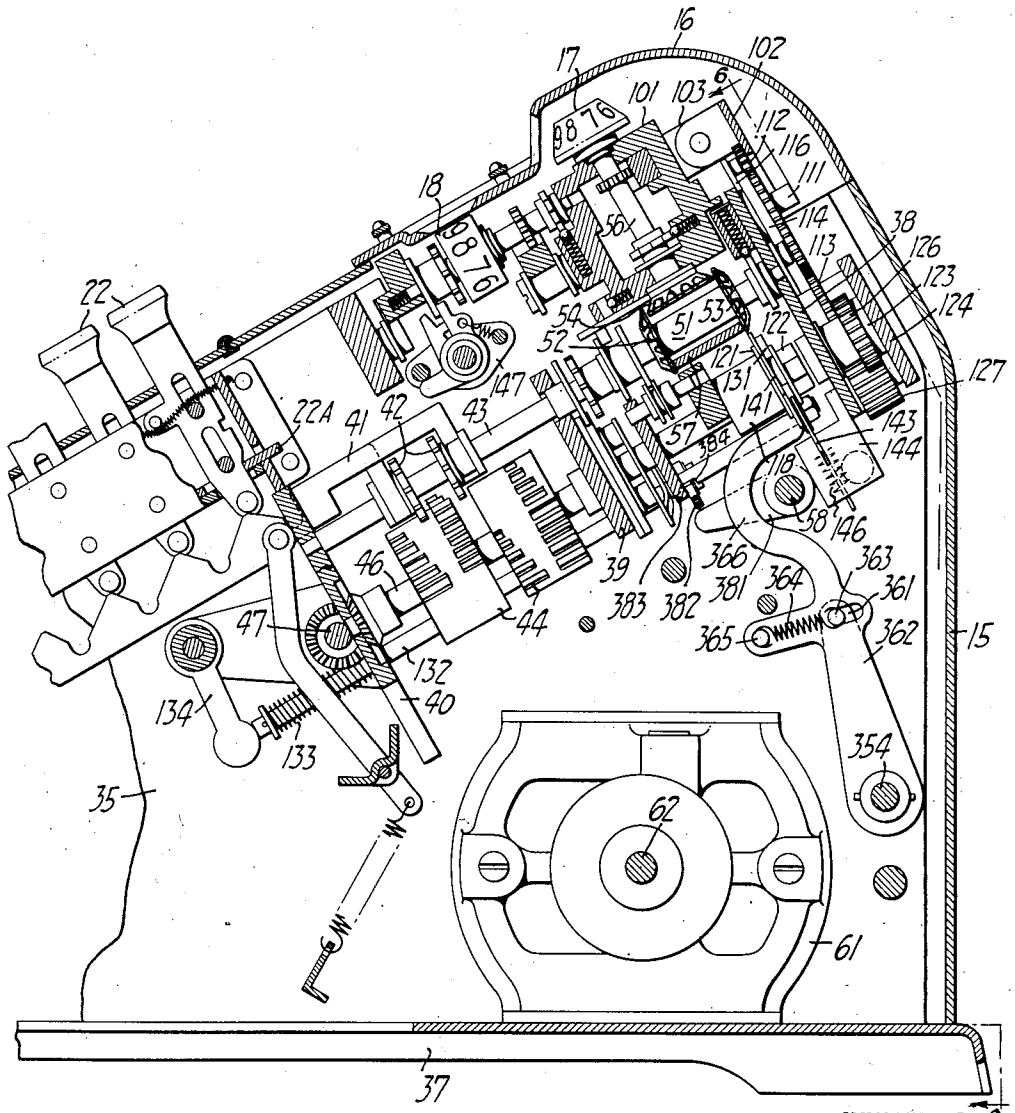
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FIG. 2



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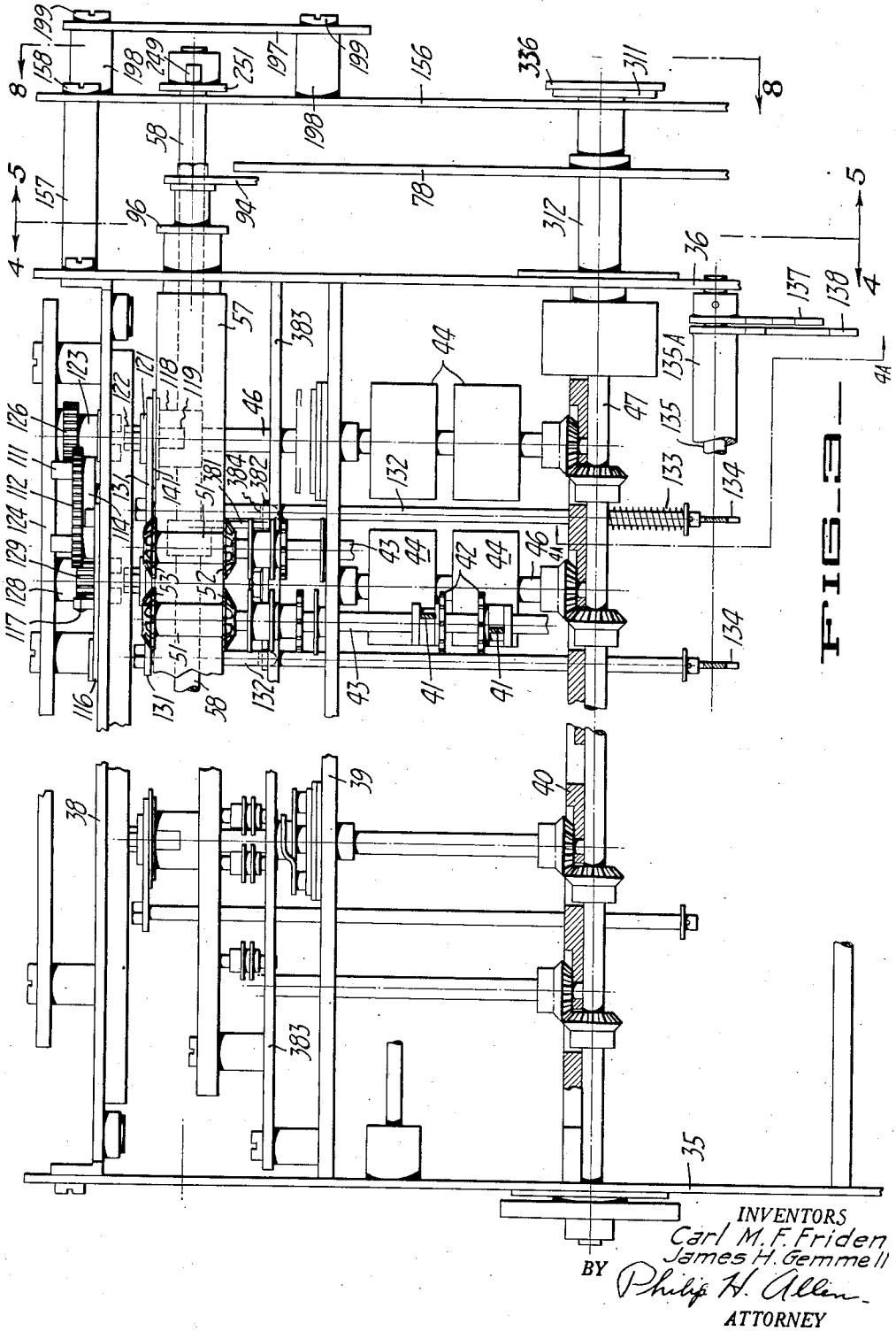


FIG. 3

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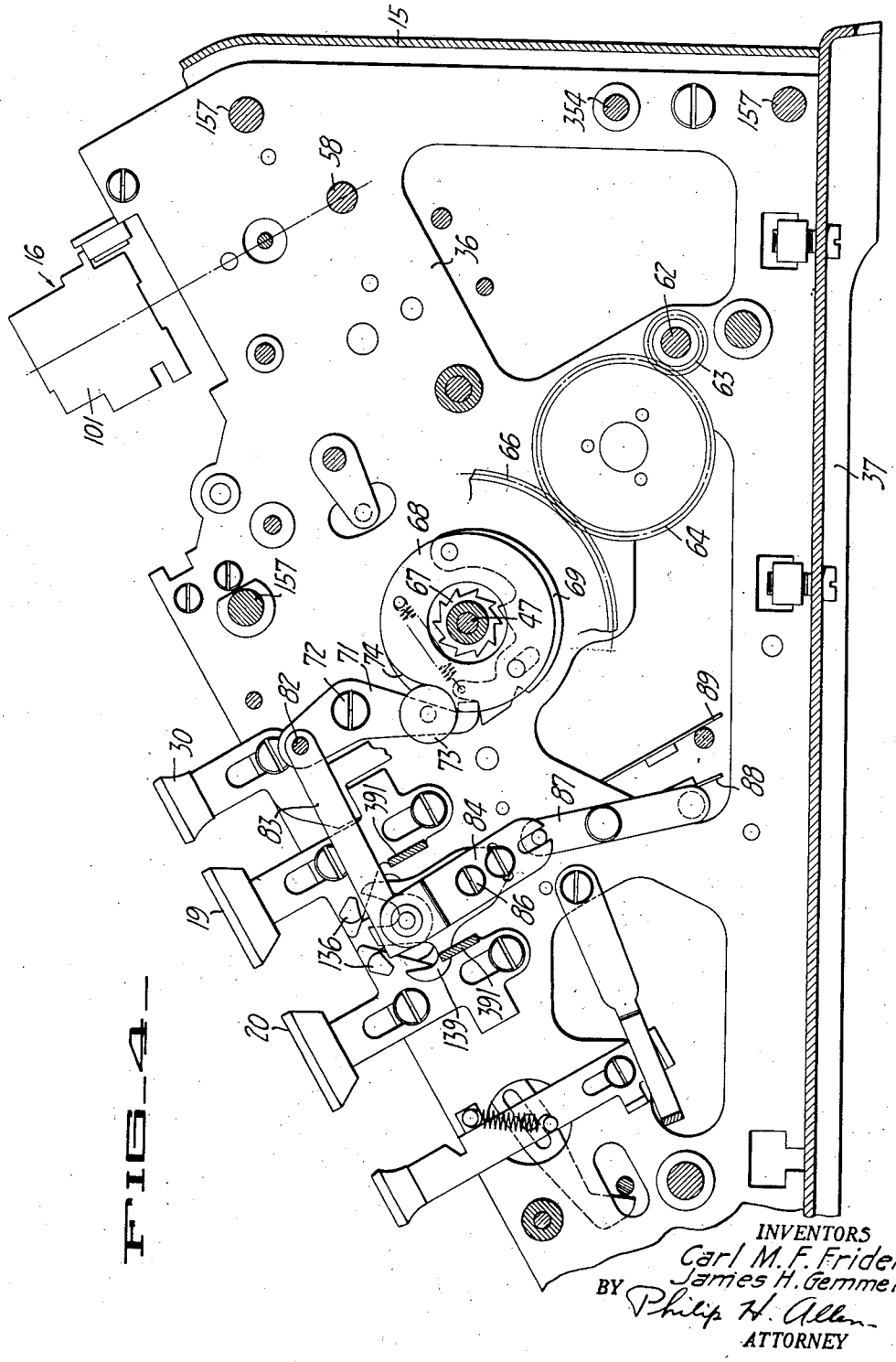


FIG-4-

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CALCULATING MACHINE

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FIG_9A_

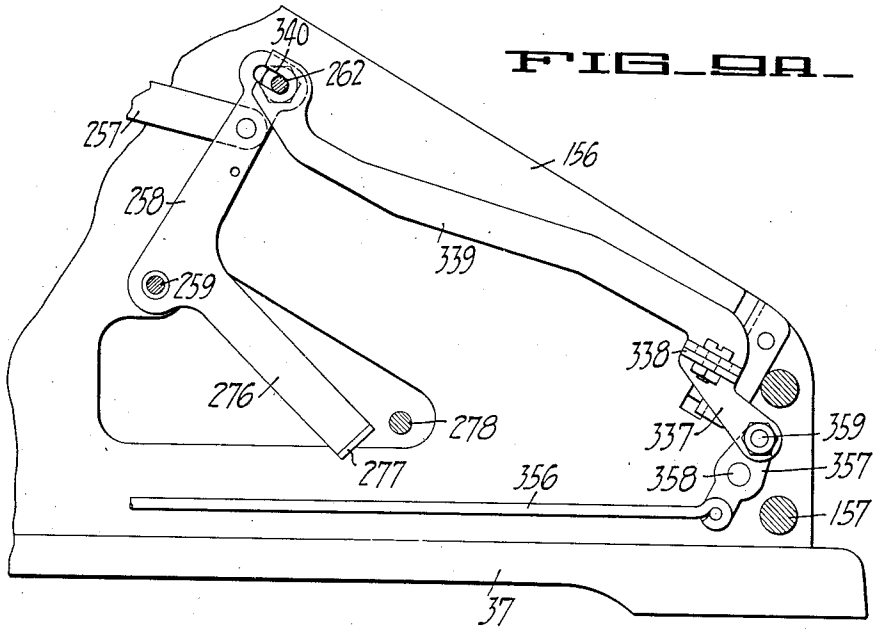
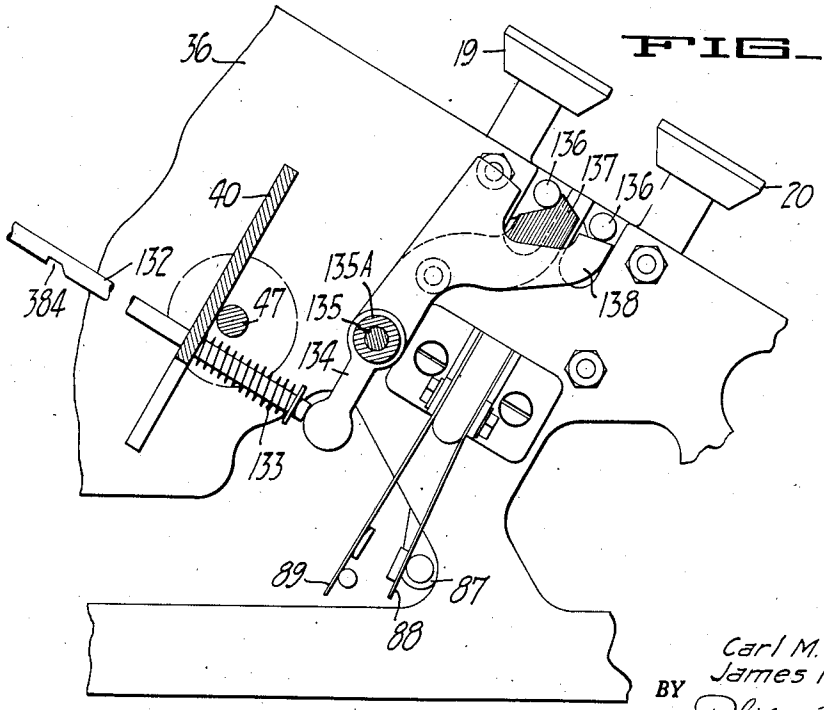


FIG_4A_



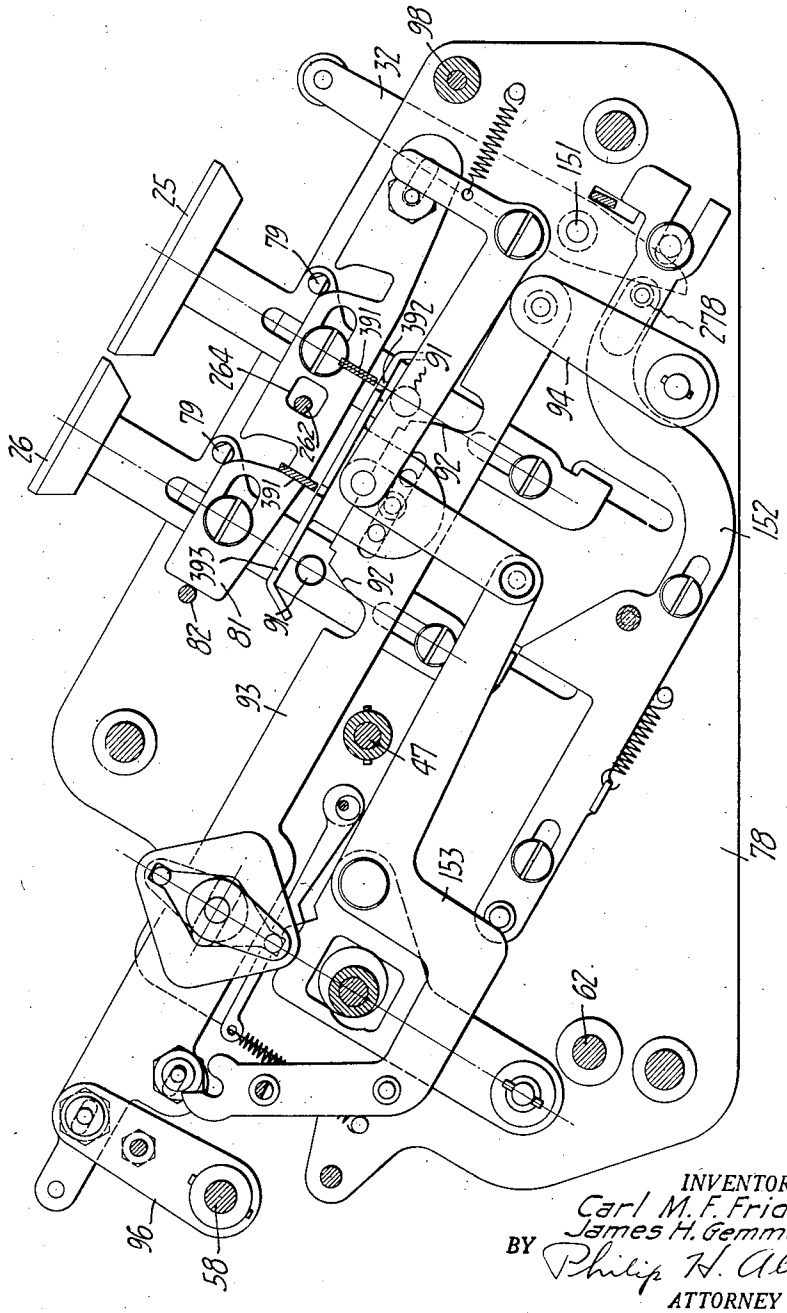
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FIG. 5



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FIG. 6.

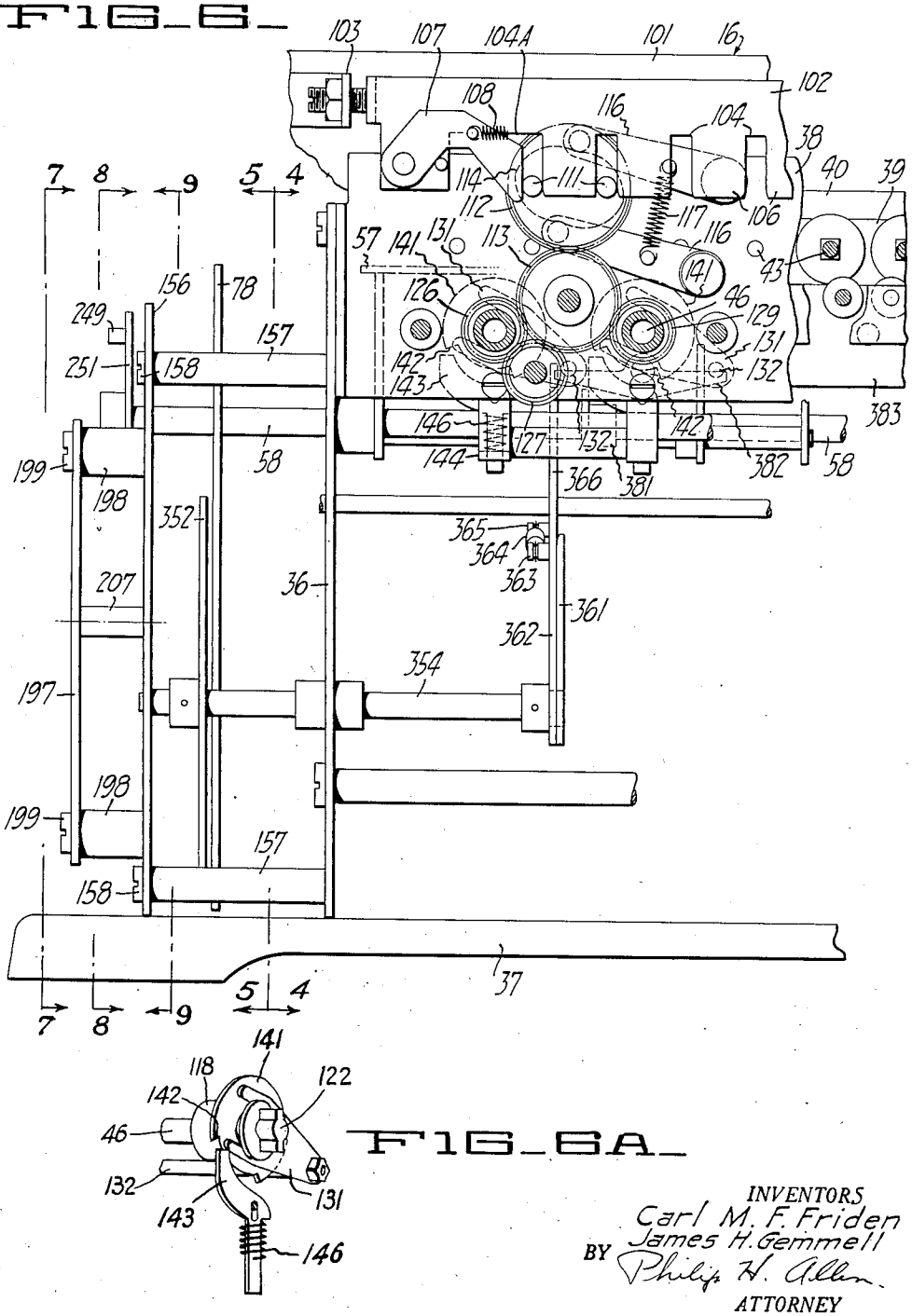


FIG. 6A.

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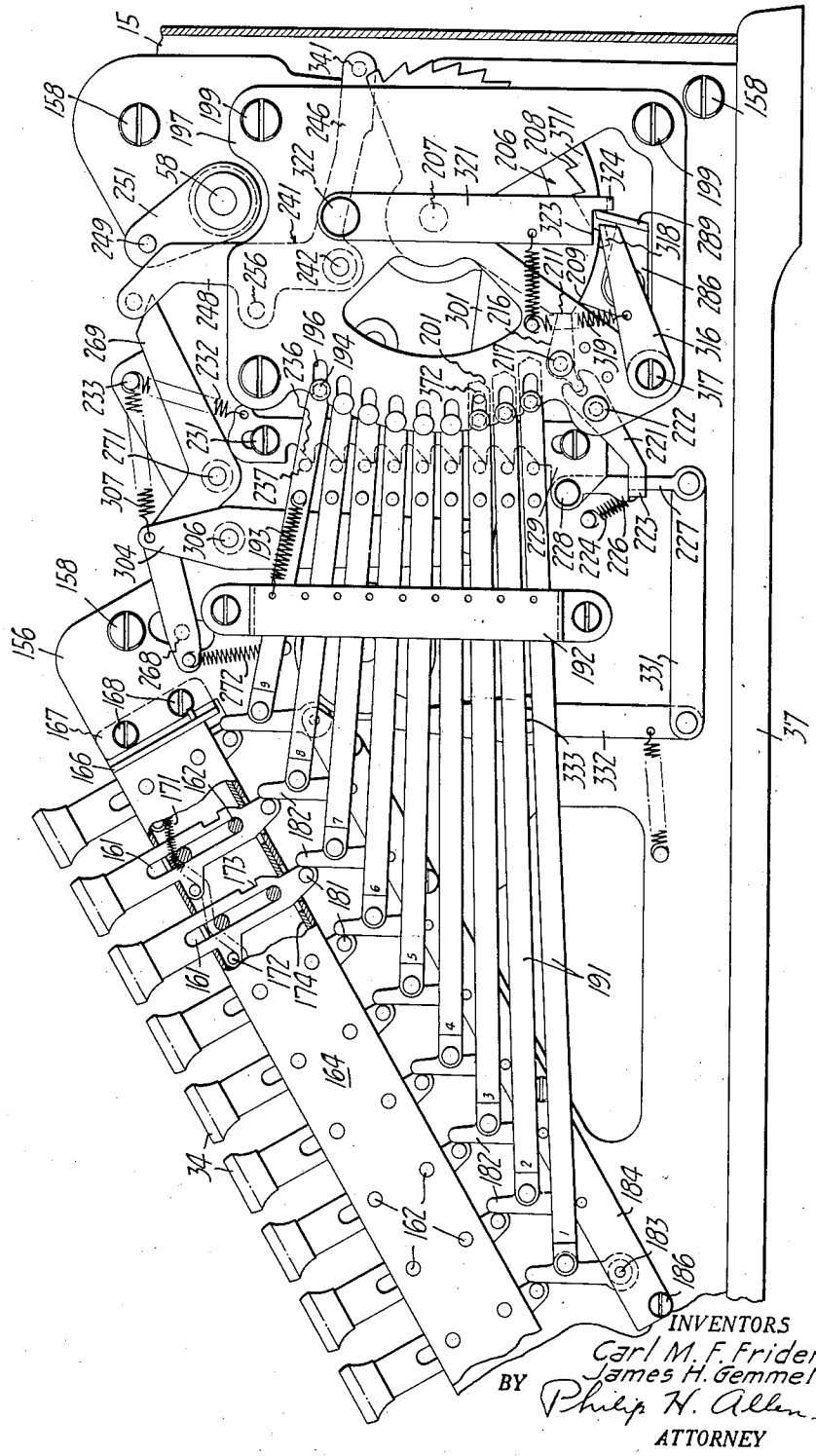


FIG-7-

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CALCULATING MACHINE

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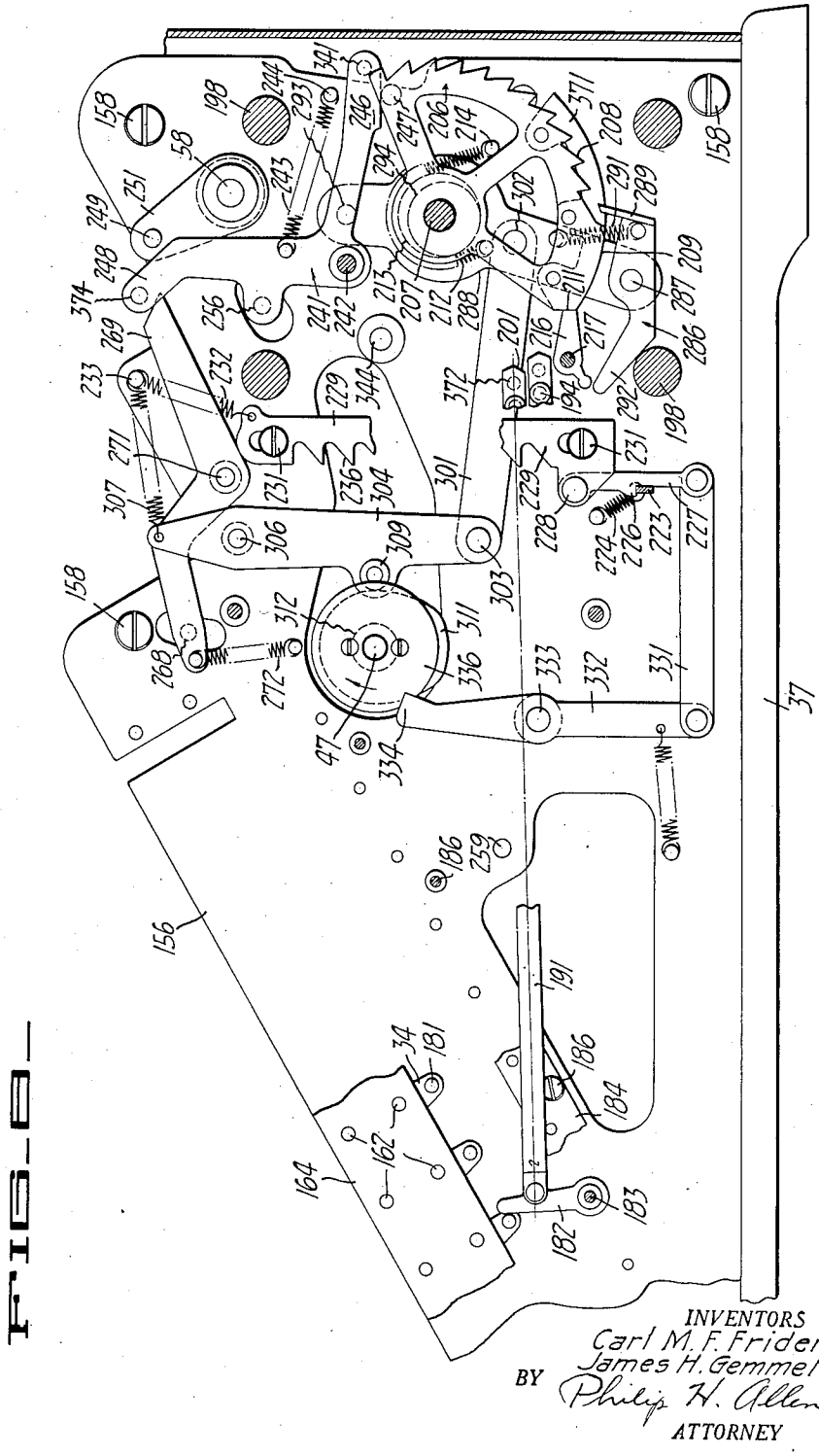


FIG-8-

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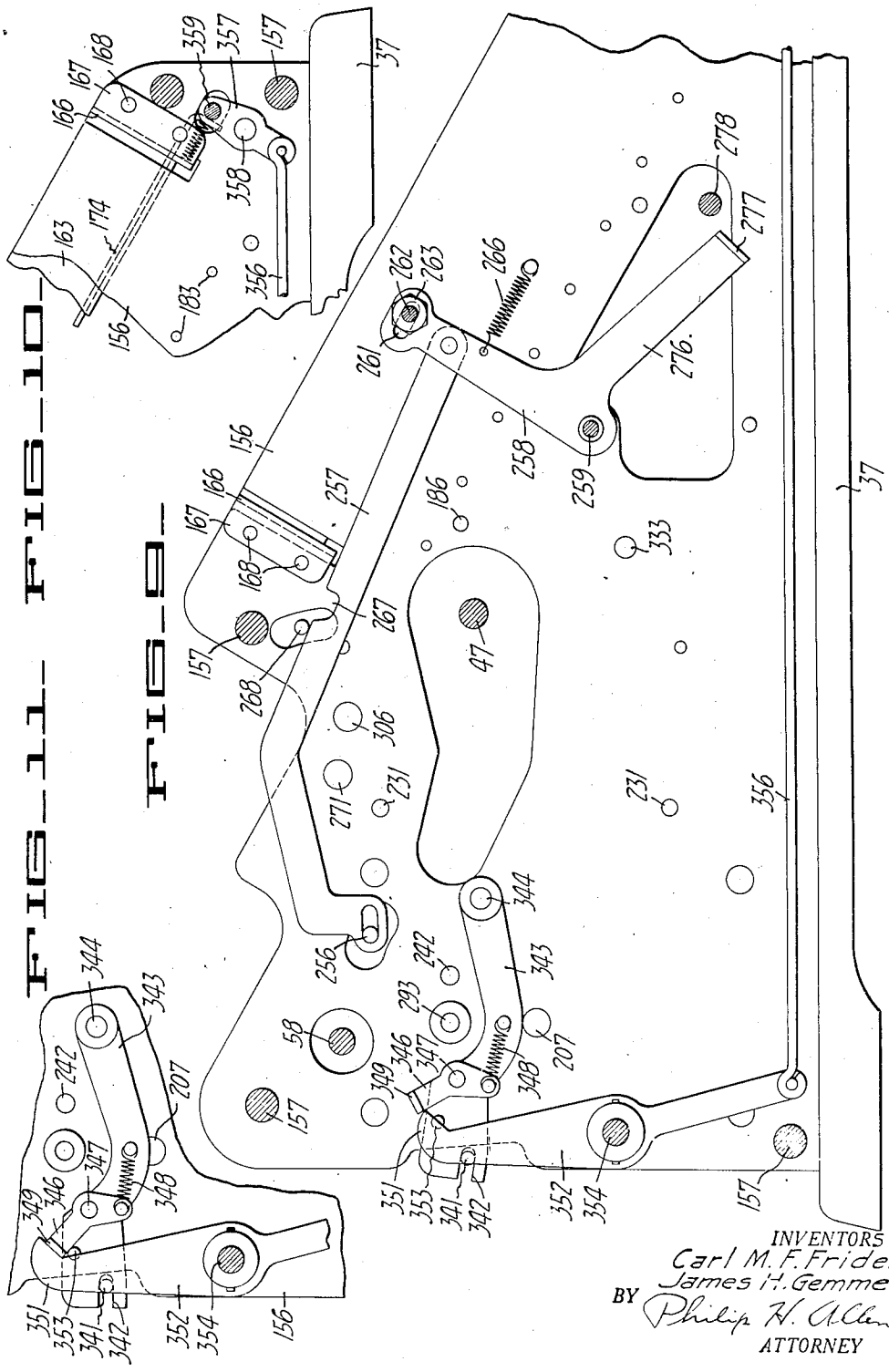
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FIG. 10.

FIG. 11.

FIG. 9.



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FIG. 14

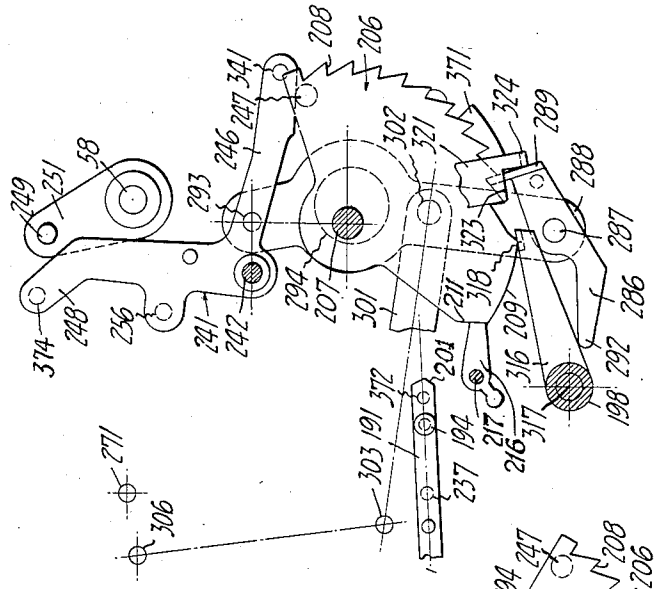


FIG. 13

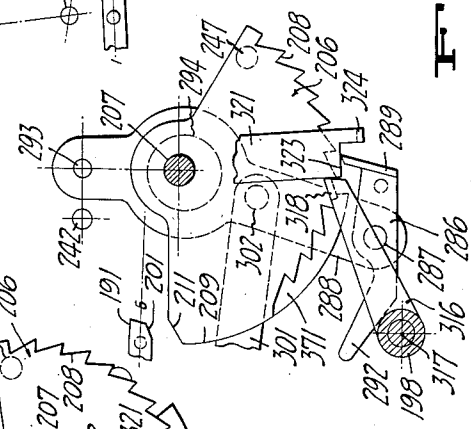
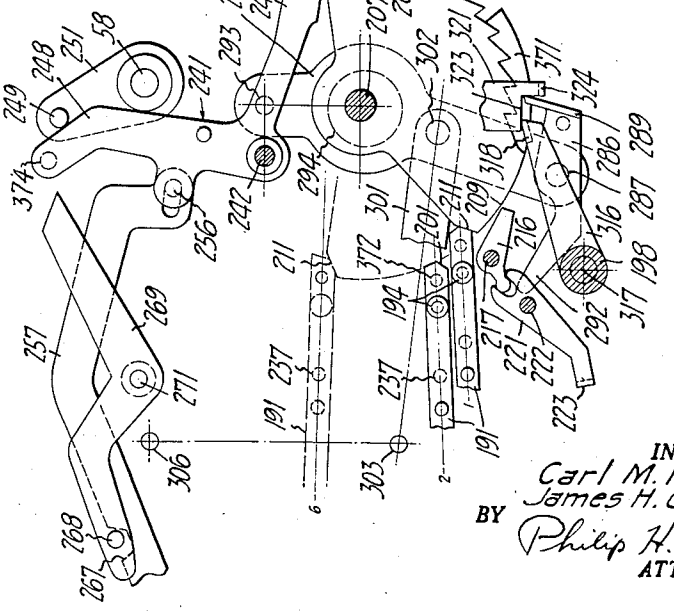


FIG. 12



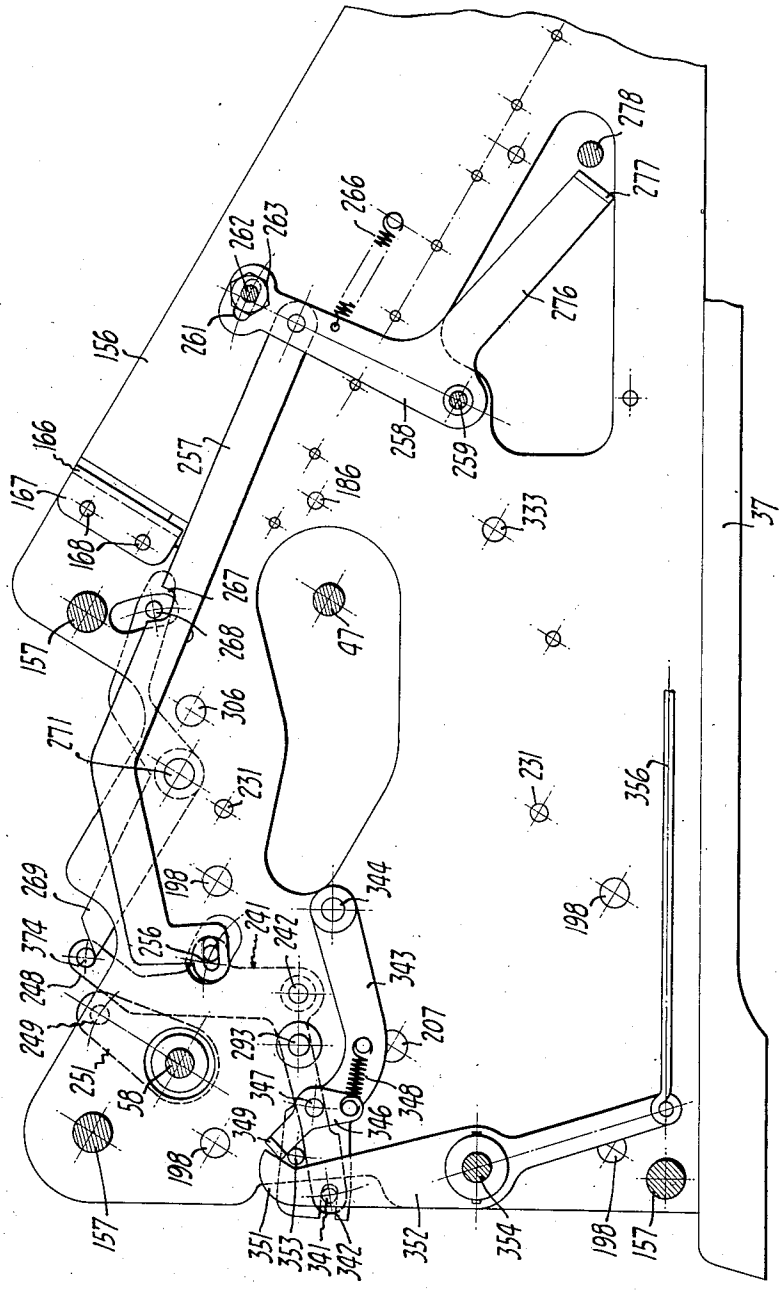
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CALCULATING MACHINE

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FIG. 15



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Patented Aug. 24, 1943

2,327,704

UNITED STATES PATENT OFFICE

2,327,704

CALCULATING MACHINE

Carl M. F. Friden and James H. Gemmell, Oakland, Calif., assignors to Friden Calculating Machine Co., Inc., a corporation of California

Application October 27, 1936, Serial No. 107,806

9 Claims. (Cl. 235—63)

The present invention relates to calculating machines adapted to perform addition, subtraction, multiplication and division, such as disclosed in my co-pending application, Serial No. 724,482, filed May 8, 1934, and more particularly to an improved multiplier and tabulating mechanism therefor.

It is a general object of the invention to provide an improved multiplier mechanism for calculating machines.

Another general object of the invention is to provide an improved tabulating mechanism for predetermining a selected number of carriage shifting operations.

A further object of the invention is to provide calculator control mechanism for predetermining the number of cycles of operation of the calculating machine selectively for a carriage shifting operation or for a digitation operation.

Another object of the invention is to provide improved calculator mechanism of the character referred to which is especially adapted for use in a Thomas type calculating machine.

Another object of the invention is to provide an improved multiplier mechanism which is constructed for assembly as a unit on the calculating machine.

Another object of the invention is to provide an improved calculator mechanism of the character referred to which is of simple construction and reliable operation.

Another object of the invention is to provide an improved calculating machine which performs multiplication and carriage shifting incident thereto by continuous and uninterrupted cyclic operation of the actuating means.

Another object of the invention is to provide a calculating machine having improved means for setting the machine for a predetermined number of cycles of operation.

Another object of the invention is to provide a calculating machine having improved means for ending a multiplication operation and normalizing the various parts of the multiplier mechanism.

Another object of the invention is to provide an improved calculating machine having the multiplier and tabulating mechanism and the parts associated therewith constructed to promote economy in manufacture and assembly.

Other objects of the invention will appear as the description progresses with reference to a preferred embodiment of the invention as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a plan view on a reduced scale of a calculating machine embodying my invention.

Figure 2 is a full size longitudinal vertical section taken in a plane indicated by the line 2—2 in Fig. 1, the front part of the machine being omitted.

Figure 3 is a fragmentary plan view of the machine with various parts, including the carriage, key sections, and drive and control mechanisms omitted.

Figure 4 is a sectional elevation of the right side frame member and various parts mounted thereon with certain of the parts shown in section. The view is taken as indicated by the lines 4—4 of Figs. 1, 3 and 6.

Figure 4A is a fragmentary sectional elevation of the right side frame member and a portion of the shift control mechanism as indicated by the line 4A—4A in Fig. 3.

Figure 5 is a sectional elevation of the left side (as viewed from the front of the machine), of the control plate and various control members mounted thereon with certain shafts and the like shown in section. The view is indicated by the lines 5—5 in Figs. 1, 3 and 6.

Figure 6 is a fragmentary rear sectional elevation of the machine with the cover removed and certain parts omitted, the view being indicated by the line 6—6 in Fig. 2.

Fig. 6A is a perspective view of the full cycle mechanism for controlling the engagement of the carriage shift drive mechanism.

Figure 7 is a right side elevational view of the multiplier and tabulating unit, as indicated by the lines 7—7 in Figs. 1 and 6.

Figure 8 is a sectional elevation of the multiplier and tabulating unit with certain parts of the unit omitted and broken away to clarify the disclosure. The view is indicated by the line 8—8 in Figs. 3 and 6.

Figures 9 and 10 together illustrate a sectional elevation of certain parts of the multiplier unit as viewed from the left, the view being taken as indicated by the line 9—9 in Fig. 6.

Figure 9A (sheet 5) is a view similar to Figs. 9 and 10 illustrating certain parts of the multiplier and tabulating mechanism which are omitted in Figs. 9 and 10 to avoid obscuring other parts therein.

Figure 11 is a fragmentary view of a part of the mechanism shown in Figure 9, but illustrated in a different operative position.

Fig. 12 is a fragmentary view similar to Fig. 8, but showing the parts as positioned after depression of the number one multiplier key, while

in dotted lines the parts are shown as positioned with the number six key depressed. In each instance the parts are shown in the position occupied before the first cycle of movement of the machine resulting from depression of the multiplier key.

Fig. 13 is a fragmentary view similar to Fig. 12, but showing the parts as positioned after one cycle of actuation of the multiplier rack 206 away from the position it occupies after depression of the number six key.

Fig. 14 is a view similar to Figs. 12 and 13 and shows the parts as positioned in the next to the last cycle of any multiplying operation when the multiplier pawl 286 is in active position.

Fig. 15 is an operational view of the shift control mechanism showing the condition of the parts at the beginning of the shift cycle.

The invention is described as embodied in a preferred form and as adapted to a Thomas type calculating machine. Referring to Fig. 1, the machine includes body 15 in which the actuating, selecting, and control mechanisms are mounted and carriage 16 which is mounted for endwise shifting movement transversely of body 15 and which carries numeral wheels 17 and 18 of the accumulator register and revolutions counter, respectively. Carriage 16 can be shifted by power in either direction by manipulation of respective shift keys 19, 20 through mechanism described hereinafter, or manually by manipulation of carriage release lever 21.

Values to be registered in the accumulator are entered into the machine by depression of numeral keys 22 in the various ordinal rows thereof, keys 22 being releasable individually by depression of ordinal clear keys 23 or collectively by depression of clear key 24. Values introduced into the machine are registered additively or subtractively on accumulator numeral wheels 17 by depression of plus key 25 or minus key 26, while the number of registrations or its complement can be entered in counter numeral wheels 18 by proper setting of control lever 27.

Values registered in numeral wheels 17 and 18 can be erased, i. e. the register can be zeroized, by manipulation of respective manually operable resetting handles 28, 29, or by power through depression of return and clear key 30. Depression of key 30 first effects return of carriage 16 to its farthest left position and subsequently effects resetting of accumulator numeral wheels 17 alone, or both numeral wheels 17 and counter numeral wheels 18 as selected by the setting of control lever 31.

The machine is adapted to perform automatic plural order division by means including division starting control lever 32, and division stop lever 33 by means of which a division operation can be terminated at the end of any selected ordinal division. Automatic multiplication can also be performed by depression of selected multiplier keys 34 and the operation of mechanism associated therewith, the same mechanism being adapted to control tabulating of the carriage in either direction by simultaneous depression of one of shift keys 19 or 20, and one of multiplier keys 34. This mechanism and the associated control means form the principal subject matter of the instant invention, and are described later in detail.

With the above general organization of parts in mind, various of the above noted mechanisms will be described in detail insofar as deemed necessary or desirable to an understanding of the present invention, it being understood that the mechanism which is not described fully may be of conventional construction.

Selecting and actuating mechanisms

Within body or casing 15, the frame includes left and right side plates 35, 36 (Fig. 3) which are suitably mounted on base 37 (Fig. 2) and are interconnected by various cross frame members including members 38, 39 and 40 for supporting various mechanisms including the selecting and actuating mechanisms described hereinafter.

The values to be introduced into accumulator numeral wheels 17 are selected by means of a plurality of similar orders of selecting mechanism associated with numeral keys 22, one of such orders being partially illustrated in Fig. 2. Such mechanism will be described briefly, and for a complete description thereof reference is made to my said co-pending application No. 724,482 and to my application Serial No. 35,619, filed August 10, 1935. Each bank or order of keys 22 cooperates with a pair of similar parallel spring-urged value selecting slides 41 mounted for endwise movement by a suitable linkage. Each slide 41 is provided with cam surfaces of varying inclination for cooperation with suitable pins on certain of keys 22 to effect a differential movement of slide 41 on depression of a key 22. Each bank of keys 22 has a latching slide 22A of conventional construction associated therewith to latch any depressed key 22 releasably in depressed position. Each slide 41 is connected at its rear end with a ten-toothed gear 42 slidably and non-rotatably mounted on square shaft 43. Movement of a slide 41 serves to position gear 42 on shaft 43 with respect to the stepped teeth of the associated actuating cylinder 44 in accordance with the value of the depressed numeral key 22. A pair of actuating cylinders 44 (Figs. 2 and 3) for adjacent orders of the machine are mounted on each actuating shaft 46, which is suitably journalled in cross members 39 and 40 and has a bevel gear connection with transverse clutch driven shaft 47. Shaft 47 is operable cyclically in a single direction from clutch controlled driving means as described hereinafter.

As seen in Fig. 3, the pair of square shafts 43 associated with each actuating shaft 46 are positioned above and to either side thereof, while sets of gears 42 on respective square shafts 43 are offset longitudinally for cooperation with the associated axially offset actuating cylinders 44. By the above arrangement and upon each rotation of the actuating means, variable increments of movement can be imparted to each square shaft 43 by the associated actuating cylinder 44 in accordance with the adjusted position of gears 42.

Each square shaft 43 is suitably journalled in cross members 38, 39 and 40, and between members 38 and 39 has associated therewith selectively settable plus-minus gears for driving an aligned numeral wheel 17. The plus-minus gears of each order of the machine include a spool 51 (Figs. 2 and 3) slidably and non-rotatably mounted on shaft 43 and having opposed bevel gears 52, 53 arranged for selective engagement with similar gear 54 on numeral wheel shaft 56. The engagement of gears 52 and 53 with gear 54 is controlled by strap 57 which extends transversely of the machine between each set of plus-minus gears 52, 53 and is mounted for rocking movement with shaft 58, which is suitably journalled in side plates 35, 36. Shaft 58 is controlled in a manner hereinafter de-

scribed to determine positive registration by meshing gears 52 with gears 54, and negative registration by meshing gears 53 with gears 54. In the neutral position shown in Fig. 2 in which gears 52 and 53 are held normally by suitable spring urged centralizing means, carriage shifting can be effected.

During both additive and subtractive registration of values in numeral wheels 17, suitable transfer mechanism is operative to effect the tens transfer as disclosed, for example, in said applications.

Drive and drive control

As stated above, the actuating means is operable cyclically to effect registration in the accumulator of the values set into the machine by depression of the numeral keys. For this purpose a clutch controlled drive is provided for the actuating mechanism which preferably forms the sole drive means for all operating parts of the machine. The source of power of the drive means comprises electric motor 61 (Fig. 2) with drive shaft 62 (Figs. 2 and 4) carrying drive gear 63 which is connected by gear 64 (Fig. 4) with gear 66 journalled on transverse clutch driven shaft 47 and having driving clutch element or ratchet 67 formed on the hub thereof. Driven clutch element 68 is secured on shaft 47 and has pivoted thereon spring-urged clutch pawl 69 having a tooth for engagement with the teeth of ratchet 67 to establish the drive connection. Pawl 69 is urged to operative position but is restrained in the neutral or full cycle position of the parts by clutch control lever 71 pivoted at 72 on side plate 36. Lever 71 carries roller 73, which seats in depression 74 on clutch element 68 in the full cycle position thereof, and in other positions thereof maintains lever 71 in its clutch engaging position for a purpose later referred to.

It is seen, therefore, that one or more cycles of operation of the actuating mechanism can be determined by oscillation of clutch control lever 71. Simultaneously with movement of control lever 71, the circuit for motor 61 is established as described hereinafter.

Plus and minus keys

Means are provided for selectively determining positive or negative registration on the numeral wheels in the form of plus key 25 (Fig. 5) and minus key 26 which are slidably mounted for endwise movement on control plate 78, which is mounted in spaced relation from side frame member 36 (Fig. 3). Depression of either of keys 25, 26 serves to engage the clutch, close the motor circuit, and select the sign character of the registration.

To enable the drive, keys 25 and 26 (Fig. 5) have respective pins 79 in operative relation with suitable cam surfaces on clutch control slide 81 which is suitably mounted for endwise movement on plate 78. To effect control of the clutch by such movement, pin 82 (Figs. 4 and 5) on the upper arm of clutch control lever 71 abuts the rear end of slide 81, so that rearward movement of slide 81 oscillates lever 71 in a clockwise direction as viewed in Fig. 4 to release clutch dog 69 for engagement with drive ratchet 67.

To close the motor circuit, pin 82 (Fig. 4) is connected by link 83 with lever 84 pivoted at 86 on side plate 36 and connected at its lower end with lever 87 also pivoted on plate 36. Lever 87 has a suitable insulated pin in overlapping relation with spring mounted contact 88 normally spaced from similar contact 89. Thus, clockwise movement of clutch control lever 71 serves through link 83 and lever 84 to oscillate lever 87 in a counterclockwise direction, whereby contact 88 is engaged with contact 89 to establish the circuit for the motor. It will be noted that roller 73 in maintaining control lever 71 in clutch engaging position when the actuating means is out of full cycle position also serves to maintain contacts 88 and 89 closed so that the motor circuit can be interrupted only in the full cycle position of the parts.

To determine the sign character of the registration, plus and minus keys 25 and 26 (Fig. 5) have respective rollers 91, disposed in operative relation with opposed cam surfaces 92 on plus-minus slide 93. Slide 93 is mounted for endwise movement at its front end by link 94 and at its rear end by arm 96 on shaft 58. As described above, shaft 58 (Figs. 2, 3 and 6) carries transversely extending strap 57 which controls the engagement or disengagement of gears 52 or 53 with numeral wheel gears 54. Thus, depression of plus key 25 moves slide 93 rearwardly of the machine and rocks shaft 58 and strap 57 to effect meshing of gears 52, 54, determining positive registration on numeral wheels 17 of the value set in the keyboard. Similarly, depression of minus key 26 determines one or more negative registrations of such values by meshing gears 53, 54.

Carriage shift mechanism

Means are provided for shifting the carriage in either direction from one ordinal position to another by power driven means controlled by manually operable keys. The power driven means preferably includes a part of the actuating means for entering values into the accumulator register. Carriage 16 (Figs. 2 and 6) includes frame 101 having shift plate 102 extending along the rear side thereof with its ends pivotally supported by similar brackets 103, only one of which is shown. Plate 102 is provided with vertical slots 104 (Fig. 6) formed between teeth 106, each end slot 104A being formed in part by yieldable pawl 107, only one of which is shown, and which are connected by spring 108. Slots 104 are adapted for engagement by opposite shift pins 111 on shift gear 112 suitably journalled on cross frame member 38. Shift gear 112 can be rotated selectively in either direction thru idler gear 113 to shift the carriage thru any desired number of ordinal spaces by the cooperation of pins 111 and teeth 106, each one half rotation of gear 112 effecting one ordinal spacing of the carriage. Shift gear 112 is centralized by means of cam 114 and centralizing arms 116 having spring 117 connected therebetween.

In order to rotate shift gear 112 selectively in either direction the two right hand actuating shafts 46 (Figs. 3, 6 and 6A) are extended and are provided with similar controllable drive connections with gear 112. Each connection includes a collar 118 fixed on the associated shaft 46 adjacent the end thereof and having opposite slots slidably engaged by corresponding teeth 119 of shiftable collar 121, which is mounted for sliding movement at the end of shaft 46. Collar 121 has smaller teeth 122 in operative relation with corresponding slots in gear sleeve 123. Gear sleeve

123 is suitably journalled in cross member 38 and plate 124 and carries gear 126 meshing with wide idler gear 127 which also meshes with idler gear 113. Similar gear sleeve 128 (Fig. 3) has gear 129 which meshes with idler gear 113, and has a similar controllable drive connection with an actuating shaft 46.

Thus, by selective shifting of collars 121 to establish a drive connection, rotation of actuating shafts 46 determines rotation of shift gear 112 in either direction to effect shifting of carriage 16 in either direction.

Similar mechanisms are provided to control shifting of collars 121. Each mechanism includes a fork 131 (Figs. 3 and 6) at the rear end of rod 132 and engaging a suitable annular groove in the associated collar 121. Rod 132 (Figs. 2 and 3) is slidably mounted in cross members 383 and 40 and is spring-urged to the position shown by spring 133. Rods 132 (Figs. 2, 3 and 4A) have associated therewith respective arms 134 depending from shaft 135 and sleeve 135A journalled thereon, which are oscillated to shift rods 132 by depression of respective shift keys 19 and 20 (Figs. 1 and 4). Keys 19 and 20 carry respective pins 136 (Fig. 4A) overlying the offset upper ends of respective arms 137, 138 carried by shaft 135 and sleeve 135A, respectively. The opposite ends of pins 136 also overlie suitable cam surfaces of cam plate 139 (Fig. 4) secured on lever 86, so that depression of a shift key rocks lever 86, clutch control lever 71, and circuit control lever 87 to thereby engage the clutch and close the motor circuit as described in connection with plus and minus keys 25, 26.

Means are provided for maintaining each shift drive connection engaged for a full cycle of the actuating means, and, as each such means is of identical construction, only one will be described. Each shiftable collar 121 (Figs. 2, 6 and 6A) carries a disc 141 which has cut-away portion 142 in its periphery so positioned that in the full-cycle position of the parts, cut-away portion 142 is registered with full-cycle pawl 143 laterally, but not vertically. Pawl 143 is mounted for vertical sliding movement in bracket 144 secured on cross frame member 38 and is urged to the upper position thereof illustrated, by spring 146 seated in bracket 144. As seen in Fig. 2, disc 141 is positioned to the left of pawl 143, and will, upon shifting of collar 121 to engage teeth 122 with collar 123, be moved to the right of pawl 143. Subsequent rotation of the actuating means moves the unbroken periphery of disc 141 into registry with pawl 143 so that collar 121 is held in active position for a full rotation of disc 141 and the drive connection is maintained for a full cycle of operation of the actuating means. Also, if collar 121 is not shifted to operative position at the beginning of a cycle of actuation, such movement is prevented until the end of the cycle.

Thus, carriage 16 carrying numeral wheels 17, 18 can be shifted selectively in either direction through one or more ordinal positions by depression of keys 19 and 20 to control the cyclic operation of the actuating means.

Revolutions counter

Numeral wheels 18 (Fig. 2) of the revolutions counter register the number of actuations of accumulator numeral wheels 17 in a conventional manner by the operation of counter actuator 147 as disclosed, for example, in said application Serial No. 724,482.

Division mechanism

The division mechanism is only disclosed in part herein as a complete description thereof is not believed necessary to an understanding of this invention. Such mechanism includes division starting control lever 32 (Fig. 5) pivoted at 151 on control plate 78 and operatively associated with division setting slide 152 to effect movement thereof to initiate a division operation. Movement of slide 152 sets division latch lever 153 to enable various parts of the division mechanism, after which the division operation proceeds in a conventional manner to register the quotient in the revolutions counter.

Multiplier and tabulating mechanism

The multiplier and tabulating mechanism is built as a unit for mounting in operative relation with the various associated mechanisms, and for convenience will be described first in connection with its operation as a multiplier unit. The mechanism includes a series of multiplier keys 34 corresponding to multiplier digit values of from "one" to "nine" and each of which effects on depression thereof a number of registrations of the multiplicand corresponding to the value of the depressed key. At the conclusion of any such registration, the carriage is shifted one step to the right, so that the key corresponding to the next higher order multiplier digit can be depressed, until the entire product is registered.

Depression of a multiplier key 34 serves to set the multiplier selection mechanism, to release the multiplier rack to receive such selection, to enable the multiplier rack actuator, and to set various interlocks, all as described hereinafter.

As seen in Figs. 3 and 6, multiplier frame plate 156 is secured on side frame member 36 and in spaced relation therefrom by spacers 157 and bolts 158, the various parts of the unit being mounted on plate 156. Multiplier keys 34 are similar and similarly mounted, the entire key section being assembled as a unit on the multiplier plate. Each key 34 (Fig. 7) has a longitudinal slot 161 which is engaged by spaced studs 162 secured between U-shaped side plates 163, 164, which are notched at the meeting edges thereof to receive keys 34. Plates 163, 164 are secured together by studs 162 and by similar end plates 166 (Figs. 7, 9 and 10) only one of which is seen in Fig. 7. Each plate 166 extends through multiplier plate 156 and has offset flange 167 secured thereto by screws 168. Keys 34 are yieldably held in their upper inactive positions by sinuous coil spring 171 extending over top studs 162 and under pins 172 on keys 34.

Latch means are provided for holding a multiplier key in depressed position, and for this purpose each key 34 (Fig. 7) has latching notch 173 above a suitable cam surface thereon which is operatively engaged with latching slide 174, which is slotted to receive keys 34. Slide 174 (Figs. 7 and 10) is mounted for endwise sliding movement between key section side plates 163, 164 and is spring-urged toward the front of the machine, so that, upon depression of a key 34, slide 174 will engage in notch 173 to maintain such key depressed. As described later, a depressed key 34 is released automatically at the end of the multiplying operation. Multiplier clear key 176 (Fig. 1) of conventional construction may also be depressed to move slide 174 to release any erroneously depressed key 34.

As stated above, depression of a key 34 serves

to set the multiplier selection mechanism, which is preferably in the form of a series of stops for cooperation with the multiplier rack which is released for engagement with a set stop by the depression of a key 34. Each key 34 (Fig. 7) carries pin 181 at its lower end for cooperation with the associated selecting arm 182, which has its lower end pivoted at 183 on strap 184 which is secured on multiplier plate 156 as by screws 186. Each arm 182 is pivotally connected intermediate its ends to one of selecting stop links 191 which extend rearwardly of the machine between multiplier plate 156 and retaining strap 192 suitably secured in spaced relation thereon. Springs 193 are tensioned between strap 192 and links 191 and serve to urge links 191 to the inoperative positions thereof illustrated in Fig. 7, with arms 182 engaging pins 181 on the multiplier keys.

Adjacent their rear ends each link 191 carries a flanged stud 194 which engages in a corresponding guide slot 196 formed in the arcuate forward edge of guide plate 197, which is secured in spaced relation from multiplier plate 156 as by spacers 198 (Figs. 3, 6 and 7) and bolts 199. As seen in Fig. 7, guide slots 196 are equally spaced apart vertically and are of equal depth from the arcuate edge of guide plate 197 so that guide slots 196 and flanged studs 194 serve to position the active ends of the selecting stop links vertically as well as laterally of the machine. As seen in Fig. 8, each link 191 has beveled stop end 201, and ends 201 are positioned in an arc for cooperation, when projected to active position, with the multiplier rack as described hereinafter.

From the above description, it is seen that depression of a multiplier key 34 serves to rock the associated selecting arm 182 and move a selecting link 191 rearwardly of the machine to active position. In such position, the stop end 201 of an active link 191 is positioned differentially from the multiplier rack in accordance with the value of the depressed multiplier key which is normally latched in inactive position and is released by depression of a multiplier key 34 to move into engagement with the set stop 201. Subsequently, the multiplier rack is returned step by step to and past its inactive position for a purpose later described.

Multiplier rack 206 (Figs. 7 and 8) is pivotally mounted on stub shaft 207 secured between multiplier plate 156 and guide plate 197. Rack 206 is formed as an arcuate sector and has ten teeth 208 formed on the periphery thereof, adjacent unbroken arcuate portion 209 which terminates in beveled stop engaging face 211. Rack 206 is urged in a clockwise direction by spring 212 secured thereto at one end and extending around hub 213 thereof to stud 214 on multiplier plate 156, and is held in its inoperative position shown in Figs. 7 and 8 by latch pawl 216 which has the flat end thereof engaged with face 211 of the rack.

Latch pawl 216 is pivoted at 217 on guide plate 197 and is oscillated upon depression of a multiplier key 34 to release rack 206 and permit movement thereof by spring 212 into engagement with the stop 201 which is set by the depressed key 34. For this purpose, latch pawl 216 (Fig. 7) has a rounded end thereof embraced by the forked end of release lever 221 pivoted at 222 on guide plate 197. Offset end 223 of lever 221 is urged upwardly by spring 224 and underlies shoulder 226 (Figs. 7 and 8) formed on link 227 which is pivotally connected at 228 to multiplier rack release slide 229. Slide 229 is mounted for limited vertical sliding movement by studs 231 on multiplier plate 156 and is urged to its upper or inactive position by spring 232 connected to the upper end thereof and to stud 233 on plate 156. Movement of the release slide downwardly from its inactive position serves through link 227, lever 221 and pawl 216 to release the multiplier rack, and to effect such movement, slide 229 is provided with a plurality of similar vertically spaced cam surfaces 236 for cooperation with pins 237 on links 191.

From the above description it is seen that depression of a key 34, through the associated link 191 and pin 237 thereon serves to move slide 229 and link 227 downwardly, thereby rocking lever 221 and pawl 216 to release multiplier rack 206. This condition is illustrated in Fig. 12 where rack 206 is shown in full lines as positioned with the "one" key depressed, and in dotted lines as positioned with the "six" key depressed. After depression of any multiplier key 34, subsequent immediate depression of a key 34 of higher value is ineffective because the rack 206 will engage the lowest value stop 201 which is in active position, while means are provided to prevent such depression of any key 34 of lower value. For this purpose rack 206 carries sector 371 (Figs. 8 and 12) which is aligned with pins 372 on links 191 of a lower value than any set stop link 191 to prevent complete depression of any key 34 of lower value than any such key which has been depressed.

The movement of multiplier rack 206 from its inactive position shown in Fig. 8 serves to release power-operated means for setting the plus-minus gears to "plus" position, for engaging the clutch, for enabling the shift mechanism, for enabling the multiplier key latch release means, and for enabling various interlocks. Preferably, such power operated means comprises a spring-pressed restrained element which is energized at the end of each multiplying operation by restoration of the multiplier rack to inactive position.

Such element comprises bellcrank 241 (Figs. 7 and 8) pivoted on stud 242 which is secured between multiplier plate 156 and guide plate 197. Bellcrank 241 is urged in a clockwise direction by comparatively strong spring 243 connected thereto and to stud 244 on plate 156, but is restrained by the engagement of horizontal arm 246 thereof with roller stud 247 on rack 206. Upon movement of rack 206, bellcrank 241 moves under the influence of spring 243 from the position shown in Fig. 8 to that shown in Fig. 12.

To set the plus-minus gears by movement of bellcrank 241, vertical arm 248 thereof has its upper bent end operatively related with, but slightly spaced from stud 249 of arm 251 which is secured on shaft 58. As heretofore described, rocking of shaft 58 controls the position of the plus-minus gears. As seen in Fig. 8, arm 248 is spaced from stud 249 a sufficient distance to permit movement of shaft 58 and arm 251 in setting the machine for subtraction, and also to permit a slight movement of arm 248. It is also seen that clockwise movement of bellcrank 241 serves through arm 248 thereof and arm 251 to rock shaft 58 so that plus gears 52 (Fig. 2) are meshed with numeral wheel gears 54.

To engage the clutch, vertical arm 248 (Fig. 8) of bellcrank 241 carries pin 256 (Figs. 8 and 9) which extends through multiplier plate 156 and engages in the slotted rear end of link 257 (Fig. 9)

having its forward end pivotally connected to the upright arm of bellcrank 258 pivoted at 259 on plate 156 and urged in a clockwise direction by spring 266. At its upper end, arm 258 has slot 261 in which pin 262 is adjustably clamped by nut 263. Pin 262 (Fig. 5) engages in aperture 264 of clutch control slide 81, the aperture being of a size to permit movement of slide 81 without interference by pin 262, which can be adjusted with respect to slide 81 by virtue of its adjustable mounting on bellcrank 258. As previously described, the clutch is engaged and the motor energized by rearward movement of slide 81, consequently, when link 257 is moved rearwardly upon clockwise movement of bellcrank 241, to effect rearward movement of slide 81 the clutch is engaged and the motor is energized. It will be noted that such movement of link 257 serves to align notch 267 in link 257 with pin 268 (Figs. 8 and 9) carried by latching lever 269 for the clutch engaging or control means. Latching lever 269 is pivoted at 271 on plate 156 and is urged to active position as illustrated in Fig. 12 by spring 272 for a purpose later described in connection with the carriage shift at the end of a multiplying operation.

As previously noted, movement of bellcrank 241 serves to enable various interlocks and it will be understood that movement of clutch control slide 81 serves to block depression of the plus and minus keys. To prevent movement of division control lever 32, lower arm 276 of bellcrank 258 is provided with offset end 277 which is movable into blocking relation with pin 278 (Figs. 5 and 9) on division slide 152 when the multiplier mechanism is active.

Upon engagement of the clutch, a step by step drive means for the multiplier rack becomes active to return the rack to normal or inactive position and one step beyond during the shift cycle of the actuating means, the next to last step being utilized to determine the shift and restore certain parts to normal, and the last or shift cycle step being used to complete the normalizing operation. Also, the latch pawl for the multiplier rack is normalized during the first step of movement.

The multiplier rack actuating means includes actuating pawl 286 (Fig. 8) pivoted at 287 on actuating arm 288 and having offset tooth 289 urged toward rack teeth 208 by spring 291 tensioned between pawl 286 and arm 268. Pawl 286 is maintained inactive or retracted by inclined tail 292 thereof engaging one of spacers 198. Arm 288 is pivoted at 293 on plate 156 and is apertured intermediate its ends at 294 to engage freely over shaft 207. Arm 288 is oscillated at each cycle of operation of the main actuating means by means including link 301 having one end pivotally connected thereto at 302 and having its other end pivotally connected at 303 to cam follower 304. Follower 304 is pivoted at 306 on plate 156 and is urged in a clockwise direction by spring 307 secured thereto and to stud 233 on plate 156, to engage roller 309 thereof with cam 311 (Figs. 3 and 8) secured on enlarged end 312 of transverse clutch driven shaft 47. Thus, upon each cycle of operation of the actuating means, cam 311 (Fig. 8) operates through follower 304, link 301, and actuating arm 288 to oscillate pawl 286 and effect a one step advance of rack 206 in a counterclockwise direction.

A holding pawl is associated with rack 206 to maintain an advanced position thereof, such pawl being maintained disabled until one cycle of movement of rack 206 is completed. Holding pawl 316 (Fig. 7) is pivoted at 317 on plate 197 and has offset tooth 318 extending therethrough into operative relation with teeth 208 of rack 206 under the influence of spring 319 connected between the holding pawl and a stud on plate 197. The holding pawl is normally disabled by engagement with surface 209 of rack 206. After setting of rack 206, the holding pawl is maintained disabled by arm 321 pivoted at 322 on plate 197 and having shoulder 323 at its lower end overlying tooth 318 and lateral extension 324 lying rearwardly of tooth 289 of pawl 286. Upon the first oscillation of actuating pawl 289, latch 321 is moved from above holding pawl 316 by pawl 289 and holding pawl 316 moves to active position as seen in Fig. 13, where the parts are shown after a one step movement of rack 206 from the dotted line position thereof shown in Fig. 12. Upon return of the parts to normal, pawl 316 is moved to inoperative position by engagement with surface 209 of rack 206 and arm 321 moves back to active position under the influence of its spring as shown in Fig. 7.

As stated above, the first step of movement during multiplication also serves to re-enable latching pawl 216 for rack 206. For this purpose, link 227 (Fig. 8) is pivotally connected to link 331, which is also pivotally connected to lever 332 pivoted at 333 on plate 156. At its upper end, lever 332 has nose 334 which in the full cycle position of the actuating means engages a complementary notch in cam disc 336 on cam 311. It will be noted that upon rotation of disc 336 from full cycle position, lever 332 is oscillated and through link 331 rocks link 227 to move shoulder 226 thereof from over offset end 223 of lever 221. Lever 221 is then free, with latch pawl 216, to return to normal position under the influence of spring 224, so that pawl 216 will engage face 211 of rack 206 when rack 206 is restored to its neutral inactive position at the end of the operation.

During the next to last cycle of a multiplying operation, i. e. the last value entering cycle, rack 206 engages bellcrank 241 to normalize certain parts of the mechanism and to condition the parts for a carriage shift, by cocking the shift control mechanism, such control mechanism being effective however only at the end of such next to last cycle. During the next to last step of movement of rack 206, roller stud 247 thereon engages and moves bellcrank 241 from the position shown in Fig. 12 to that shown in Fig. 14, where arm 251 and shaft 58 have moved back to neutral position so that plus gears 52 and numeral wheel gears 54 are disengaged. The disengagement of gears 52 and 54 is not effected, however, until after the value entering operation is completed. Fig. 14 shows the parts during the next to the last cycle of any multiplying operation when pawl 286 is at its extreme active position. Rack 206 is maintained in such position by pawl 216 which becomes active at this time (see Fig. 7). It is to be noted that at this time, bellcrank 241 has moved to a position which would permit movement of link 257 (Fig. 9) and bellcrank 258 to clutch disengaging position, such movement being prevented however by the engagement of pin 268 (Fig. 12) of latch lever 269 in notch 267 of link 257 which maintains the engagement of the clutch during the shift cycle.

To enable the shift, arm 246 of bellcrank 241 carries pin 341 (Figs. 8 and 9) which engages in notch 342 (Fig. 9) at the end of arm 343 pivoted

at 344 on plate 156. Live pawl 346 pivoted at 347 on arm 343 and spring urged in a counterclockwise direction by spring 348, has offset ear 349 which in the inactive position of the part overlies nose 351 of lever 352 and above pin 353 on arm 343. Lever 352 is pinned on shaft 354 which is pivotally mounted in plate 156 and side frame member 36 (Fig. 2). Lever 352 (Fig. 9) has its lower end pivotally connected to rod 356 which extends forwardly of the machine and is connected to lever 357 (Fig. 10) pivoted at 358 on plate 156 and having pin 359 positioned in front of latch slide 174 for multiplier keys 34.

Upon depression of a multiplier key, the parts are positioned as shown in Fig. 11, the release of bellcrank 241 and its subsequent clockwise movement (as viewed in Fig. 12) serving through pin 341 to move arm 343 downwardly from the position shown in Fig. 9 to that shown in Fig. 11. During such downward movement of arm 343, pawl 346 snaps past nose 351 of lever 352 to position ear 349 below nose 351 as shown in Fig. 11. During the next to last step of movement, pin 341 moves arm 343 upwardly from the position shown in Fig. 11 by virtue of the step of movement of bellcrank 241 under control of rack 206 to effect release of the depressed key 34 and also to condition the machine for a one step shift of the carriage. Arm 343 through pin 353 and pawl 346 rocks lever 352, and holds lever 352 in rocked position until release of the parts during the last cycle as later described. This movement serves through link 356, and lever 357 (Fig. 10) to operate latch slide 174 so that the depressed multiplier key is released. The movement of link 356 and lever 357 also operates a safety device to prevent premature disengagement of the clutch at the beginning of the shift cycle. To effect this result, a booster linkage is associated with lever 357 (Fig. 9A) comprising short link 337 pivotally mounted on stud 359 at the upper end of lever 357 and having its free offset end adjustably connected by slot and bolt connection 338 with longer link 339 which extends rearwardly and has slot 340 engaging pin 262. At the beginning of a multiplying operation, pin 262 and link 257 are moved to the left from the position shown in Fig. 9A to initiate the drive. When lever 357 is oscillated just at the end of the next to last cycle of operation, the end of slot 340 is moved into engagement with pin 262 to prevent the possibility of the drive enabling linkage associated therewith returning from active position. It is only necessary that the booster linkage be operative slightly before and during the time the parts are passing through full-cycle position, i. e., while roller 73 (Fig. 4) is passing full-cycle depression 74 of disc 68.

As stated above such movement of arm 352 and shaft 354 also conditions and enables the shift mechanism. For this purpose shaft 354 (Figs. 2 and 6) has shift conditioning arm 361 (Figs. 2 and 6) secured thereon and has a shift initiating arm 362 pivoted thereon. Arm 361 carries pin 363 which extends thru a slot in arm 362 and is connected by spring 364 with pin 365 on arm 362. Arm 362 has upper hooked end 366 positioned forwardly of shift fork 131 and in operative controlling relation therewith. From the above described arrangement, it is seen that rocking of shaft 354 and arm 361 during the next to last cycle of a multiplying operation, tensions spring 364 and thereby places a bias on shift initiating arm 362 whose end 366 is urged against the associated shift fork 131. However, during such next to last cycle of movement, the engagement of teeth 122 of collar 121 with the corresponding slots in gear sleeve 123 to establish a shift drive is prevented by the engagement of disc 141 with full-cycle pawl 143. When the parts including disc 141 reach full cycle position at the end of such next to last cycle of the multiplying operation and cut-away portion 142 of disc 141 is aligned with pawl 143, spring 364 operating through shift initiating arm 362 becomes effective to engage collar 121 with gear sleeve 123 and determine a carriage shift during the last cycle of a multiplying operation. As described above, one rotation of gear sleeve 123 effects a one-half rotation of shift gear 112 to perform the carriage shifting operation.

As noted above, the shift or last cycle of a multiplying operation is utilized to complete normalizing of the machine by restoring all active parts to neutral or inactive position. For this purpose, rack 206 is operated by pawl 286 during the shift cycle to move bellcrank 241 and effect such normalizing, rack 206 and bellcrank 241 being moved away from and immediately returned to the position shown in Figs. 7 and 8. Movement of bellcrank 241 in a counterclockwise direction from the position shown in Fig. 8 serves through pin 341 to lift arm 343 (Figs. 9 and 10) a sufficient amount to move pawl 346 above nose 351 of lever 352 to permit return of lever 352 to inactive position to relieve the bias of spring 364 on the shift control mechanism. At the same time, pawl 346 is re-latched in the position shown in Fig. 9. Thus, the shift control and key release control means including lever 352 and pawl 346 are restored to normal inactive position during the shift cycle.

To effect release of the clutch, upper arm 248 (Fig. 8) of bellcrank 241 carries pin 374, which upon the counterclockwise movement of bellcrank 241 during the shift cycle of the multiplying operation engages the adjacent beveled end of lever 269 effecting clockwise movement thereof to lift pin 268 (Figs. 9 and 12) out of notch 267 of link 257 to permit return of link 257 and bellcrank 258 (Fig. 9) to inactive position under the influence of spring 266. It will be recalled that pin 262 (Figs. 5 and 9) on bellcrank 258 is operatively related with clutch control slide 81 which through pin 82 (Figs. 4 and 5) controls the positioning of clutch control lever 71 (Fig. 4) and also contact controlling lever 87. Thus, return of bellcrank 258 and pin 262 to inactive position determines movement of clutch control lever 71 to clutch disengaging position, as well as separation of contacts 88 and 89 to interrupt the motor circuit. These operations complete the normalizing of the machine after a multiplying operation.

Interlocks

As stated above, various interlocks are provided to prevent misoperation of the machine during a multiplying operation, the interlocking of the division mechanism having been described in connection with bellcrank 258 having offset end 277 on lower arm 276 thereof which is movable into blocking relation with pin 278 of the division mechanism. As seen in Fig. 5, movement of clutch control slide 81 to the left at the initiation of a multiplying operation moves such slide beneath pins 79 of plus and minus keys 25 and 26 to prevent depression thereof. Also rocking movement of lever 139 positions the upper end

thereof into blocking relation with pins 136 on shift keys 19, 20. Locking of shift key 19 also locks carriage return and clear key 30 which overlies an extension of shift key 19. Thus, the various other operating controls are locked against movement upon operation of any of the multiplier keys 34.

Repeated addition

If desired the multiplier mechanism can be controlled to operate in one order without carriage shifting, when, for example, repeated addition of a single item is desired when adding a series of items. This control may be effected by depression of a control key simultaneously with the depression of a multiplier key to disable the shifting function of the last cycle of operation and maintain the plus-minus gears in operative position to determine an additive registration during such last cycle.

Preferably, the plus key is utilized for this control. In this connection it will be noted that if the plus key is depressed at the same time as one of the multiplier keys, pin 79 of the plus key will move into its corresponding cam slot in slide 81 as the slide 81 moves to operative position (to the left in Fig. 5) under the influence of pin 262 as described in the multiplying operation. Also, plus key 25 will be maintained in depressed condition by slide 81 until release thereof at the end of the number of cycles determined by a depressed multiplier key, this number being always one more than the value of the depressed multiplier key because of the extra cycle which is used normally to effect shifting. As the plus key is maintained depressed, plus-minus slide 93 is held in its rearward position by roller stud 91 of the plus key throughout the operation to maintain shaft 58 rocked in a counterclockwise direction as viewed in Fig. 5, or in a clockwise direction as viewed in Fig. 2 to hold plus gears 52 in mesh with numeral wheel gears 54.

The above described positioning of shaft 58 is utilized to disable the shift control of the multiplier mechanism, and for this purpose shaft 58 is provided with arm 381 (Figs. 2 and 3) which underlies an end of interlock lever 382 pivoted intermediate its ends on frame plate 383. The ends of lever 382 register with transverse notches 384 in respective shift control rods 132. If either of the shift rods are moved rearwardly of the machine to enable a shifting operation, the beveled edge of its notch 384 rocks lever 382 to prevent shifting of the other rod 132. Also, if shaft 58 be oscillated to mesh plus gears 52 with the numeral wheel gears, arm 381 moves lever 382 into locking engagement with notch 384 of the shift rod controlled by spring urged shift initiating arm 362 of the multiplier mechanism to prevent its operative movement. Thus, at the time in a normal multiplying operation when the shift would be initiated, the movement of arm 362 under the influence of spring 364 is prevented and the extra cycle of operation is utilized for a registration.

Thus, the plus key, when depressed simultaneously with a multiplier key, controls means for disabling the normal shift operation in the last cycle of the actuating means, and supersedes such operation with a registration. It will be noted that for such repeated addition the operator must always depress a multiplier key of one less value than the number of repeated additions desired to compensate for the use of the extra (shift) cycle as a registration cycle.

Carriage tabulation

It will be recalled that the above description of the multiplier and tabulating mechanism was made with reference to its use in a multiplying operation, and such mechanism will now be described in connection with a tabulating operation. Keys 34 which control the multiplying operation, and which have heretofore been referred to as multiplier keys, also control the tabulating of the carriage, and in connection with this description will be referred to as tabulating keys. To condition the machine for a tabulating operation in either direction, one of the shift keys is depressed simultaneously with a tabulating key having a value of one less than the number of shift cycles desired.

The depression of the shift key serves to disable the control of tabulating or multiplier keys over the plus-minus gears by locking the plus-minus slide against operation, the shift drive, the clutch and motor circuit being enabled by depression of the shift key and being disabled at the end of the determined number of cycles of operation in the usual manner by the multiplier and tabulating control mechanism, that is, by the overstroke of rack 206 and the accompanying movement of bellcrank control lever 241 as previously described in connection with the multiplying operation.

Each shift key carries a laterally projecting ear 391 (Figs. 4 and 5) which in the raised position of the key is spaced slightly above transverse notch 392 in plate 393 carried by plus-minus slide 93. When a shift key is depressed ear 391 moves into notch 392 to block movement of the plus-minus slide, and, consequently, shaft 58 which controls the meshing of the plus-minus gears with the numeral wheel gears. Thus, upon simultaneous depression of a shift key and a tabulating key, pin 249 (Fig. 8) and arm 251 on shaft 58 form a stop for bellcrank control lever 241, so that the enabling function thereof with respect to the plus-minus gears is eliminated. However, control lever 241 has a limited movement before striking pin 249 as seen in Fig. 7. This movement of lever 241 is effective through pin 256 (Fig. 9), link 257, bellcrank 258 and pin 262 (Fig. 5) to prevent movement of slide 81 from its active position. This control through pin 82 of the clutch control lever 71 (Fig. 4) is concurrent with that exerted by depression of the shift key. During the tabulating operation, therefore, the clutch is maintained in engagement and cam plate 139 is maintained in the position to which it was moved by the depressed shift key. The cam slots in plate 139 are such that the normally inoperative or upper edge of the slot will overlie the depressed pin 136 to maintain the depressed position of the shift key.

After the simultaneous depression of the selected shift and tabulating keys, the operation of the rack 206 and associated parts is the same as described above in connection with a multiplying operation, except when shift key 19 is depressed, which determines a shifting or tabulating operation in the direction opposite to that of the automatic one step shift after a multiplying operation. However, the automatic one step shift control is disabled by the depression of shift key 19 because shift rod 132 associated therewith rocks interlock lever 382 to block operation of the other shift rod 132 which is normally operated at the end of a multiplying operation to effect the one step shift.

From the above description, it will be evident that the operation control mechanism of the machine disclosed herein provides for a very flexible choice of operating characteristics, so that multiplication with or without carriage shift and tabulation of the carriage in either direction can be obtained, so well as the usual plus, minus and shift key controlled operations.

While we have shown and described a preferred embodiment of our invention, it is to be understood that the mechanism disclosed is capable of variation and modification without departing from the spirit of our invention. We desire it understood therefore, that the scope of our invention should be limited only by the appended claims.

We, therefore, claim as our invention:

1. In a calculating machine having ordinally shiftable numeral wheels and actuating means therefor; multiplier mechanism for controlling cyclic operation of said actuating means to effect a multiplying operation followed by shifting of said numeral wheels by said cylic operation, said mechanism including manually operable control means for initiating operation thereof, and means including a key for disabling the shift control of said mechanism and for determining registration on said numerals wheels during the cyclic operation of said actuating means normally utilized for shifting of said numeral wheels.

2. In a calculating machine having ordinally shiftable numeral wheels and cyclically operable actuating means therefor, automatic control mechanism for predetermining a selected number of cycles of operation of said actuating means, and selectively operable control means for said mechanism for determining a registration on said numeral wheels or for determining shifting of said numeral wheels by said operation of said actuating means.

3. In a calculating machine, ordinally shiftable numeral wheels, actuating means therefor, means for shifting said numeral wheels including a control key operable to determine shifting of said numeral wheels, multiplier mechanism including manually operable control means for predetermining a selected number of registrations on said numeral means, and means controlled by simultaneous operation of said shift control key and said multiplier control means for disabling the registration control of said multiplier mechanism and for determining shifting of said numeral wheels for a selected number of ordinal spaces under control of said multiplier mechanism.

4. In a calculating machine, ordinally shiftable numeral wheels, actuating means therefor, means for shifting said numeral wheels including control keys selectively operable to determine shifting of said numeral wheels in either direction, multiplier mechanism including a series of multiplier keys for initiating a multiplying operation and for selecting the number of registrations on said numeral wheels in accordance with the value of the depressed multiplier key, and means controlled by simultaneous operation of one of said shift keys and one of said multiplier keys for effecting shifting of said numeral wheels in the direction determined by the selected shift control key and for the number of ordinal spaces determined by the selected multiplier key.

5. In a calculating machine, numeral wheels, actuating means for said numeral wheels, a clutch for effecting cyclic operation of said actuating means from a source of power, a control member operable to control one or more complete cycles of movement of said clutch, means for controlling said control member to effect engagement of said clutch for one or more cycles of operation thereof, and booster means associated with said controlling means and brought into play during the last of said cycles for maintaining said control member in clutch engaging position for an additional cycle of operation.

6. In a calculating machine having ordinally shiftable reversible numeral wheels, uni-directionally operable actuating means for said numeral wheels, a clutch for operating said actuating means from a source of power, settable plus-minus gears between said numeral wheels and said actuating means for determining registration on said numeral wheels upon operation of said actuating means, and shift means for effecting ordinal spacing of said numeral wheels with respect to said actuating means; normally disabled control means for said shift means including a normally disconnected linkage and a normally unbiased spring operable through said linkage; a spring-urged member for engaging said clutch, for setting said settable gears, and for enabling said control means by connecting said linkage; means for holding said member in inactive position; a series of multiplier keys; means controlled by operation of a multiplier key for rendering said holding means ineffective, and means for moving said holding means to restore said member to ineffective position, said member operating to place a bias on said spring during restoration thereof.

7. In a calculating machine having ordinally shiftable numeral wheels, shifting mechanism for said numeral wheels, said shifting mechanism including a pair of manually operable control keys and means responsive to depression of said keys for controlling the direction of shifting movement and for causing one or more steps of movement in accordance with the depression of the selected key for one or more cycles of operation of said shifting mechanism, and tabulating control mechanism for controlling said shifting mechanism including a plurality of depressible keys for predetermining the number of steps of movement of said numeral wheels by said shifting mechanism in the direction selected by depression of one of said first named keys.

8. In a calculating machine having ordinally shiftable numeral wheels, shifting mechanism for said numeral wheels including a pair of control keys for selecting the direction of shifting movement and for causing one or more steps of shifting of said numeral wheels in the selected direction in accordance with the number of cycles of said shifting mechanism during which the selected key is held depressed, and tabulating control mechanism including a series of depressible keys adapted for simultaneous depression with the selected one of said first named keys, said tabulating control mechanism including means for predetermining the number of steps of movement of said numeral wheels in the selected direction in accordance with the value of the depressed tabulating control key.

9. In a calculating machine having ordinally shiftable numeral wheels, actuating means for said numeral wheels, and shift means for effecting ordinal spacing of said numeral wheels with respect to said actuating means; operation control mechanism including a normally disabled control for said shift means, said control including a pivotal arm movable to cause operation of

said shift means, said arm having a cam face adjacent an end thereof, a second arm for moving said first arm, a spring-urged pawl pivoted on said second arm and providing an interponent between said arms, said pawl being normally held in an ineffective position by engagement with said end of said first arm, a key for initiating operation of the machine, and means controlled by said key for causing movement of said second arm to allow said pawl to move to effective position in engagement with said cam face between said members.

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