March 7, 1944. J. L. MOODY 2,343,241

CALCULATING MACHINE

Filed July 23, 1938 6 Sheets-Sheet 1

FIG_2_

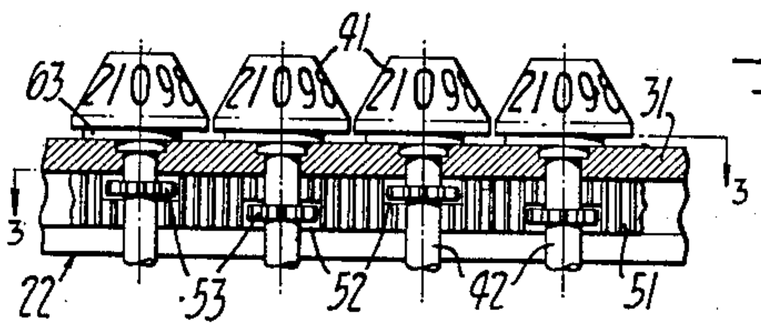
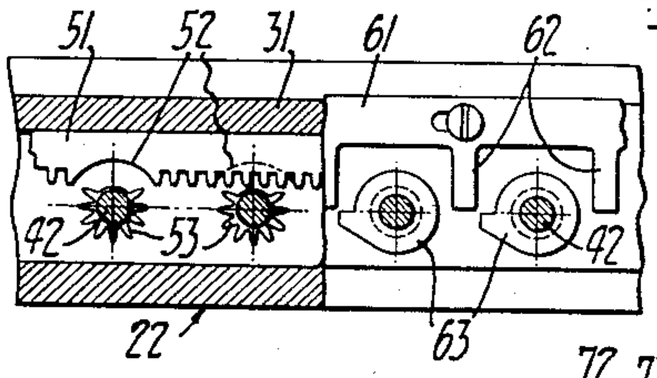


FIG_3_ FIG_1_



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March 7, 1944. J. L. MOODY 2,343,241

CALCULATING MACHINE

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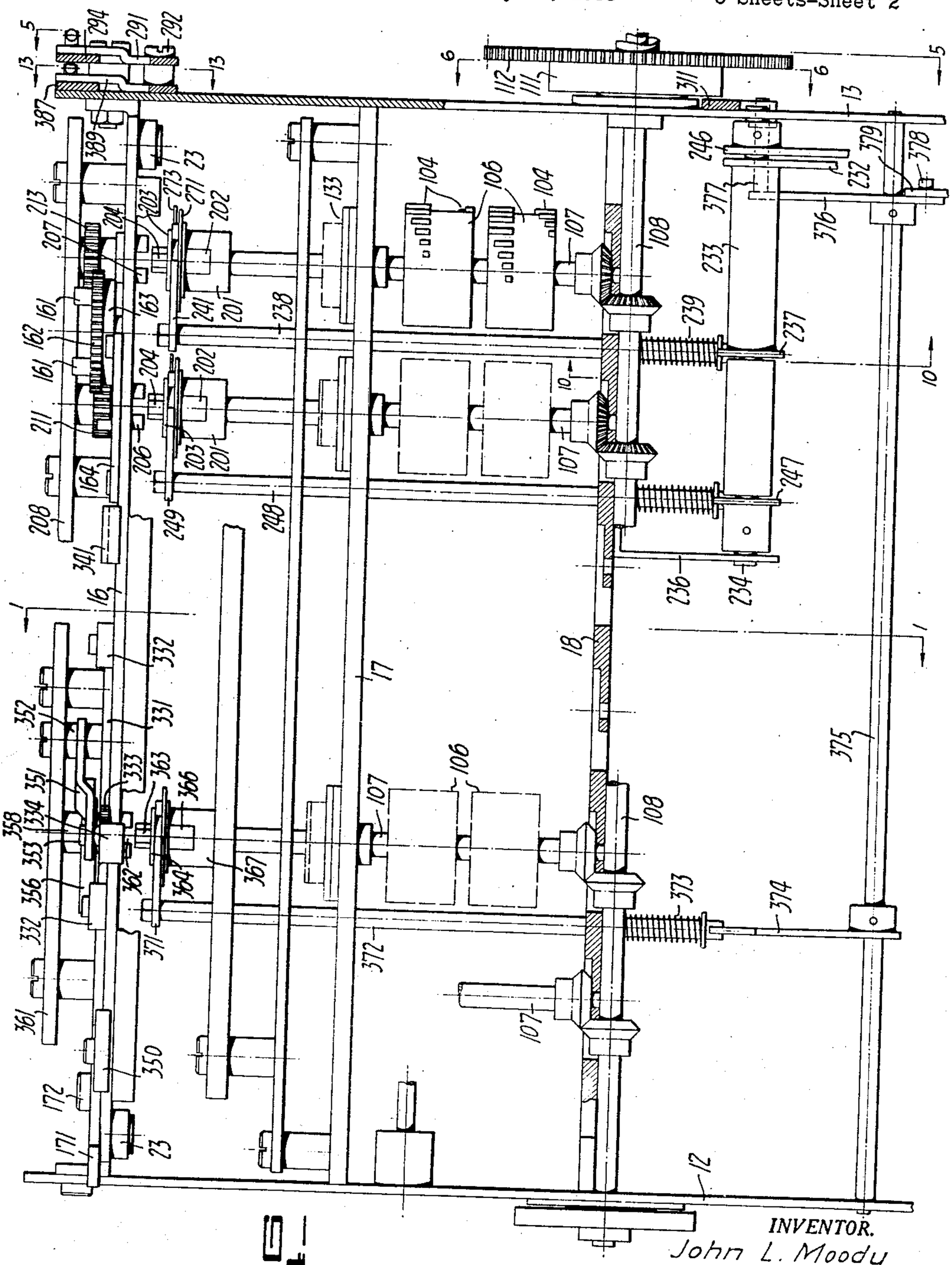

FIG 4

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CALCULATING MACHINE

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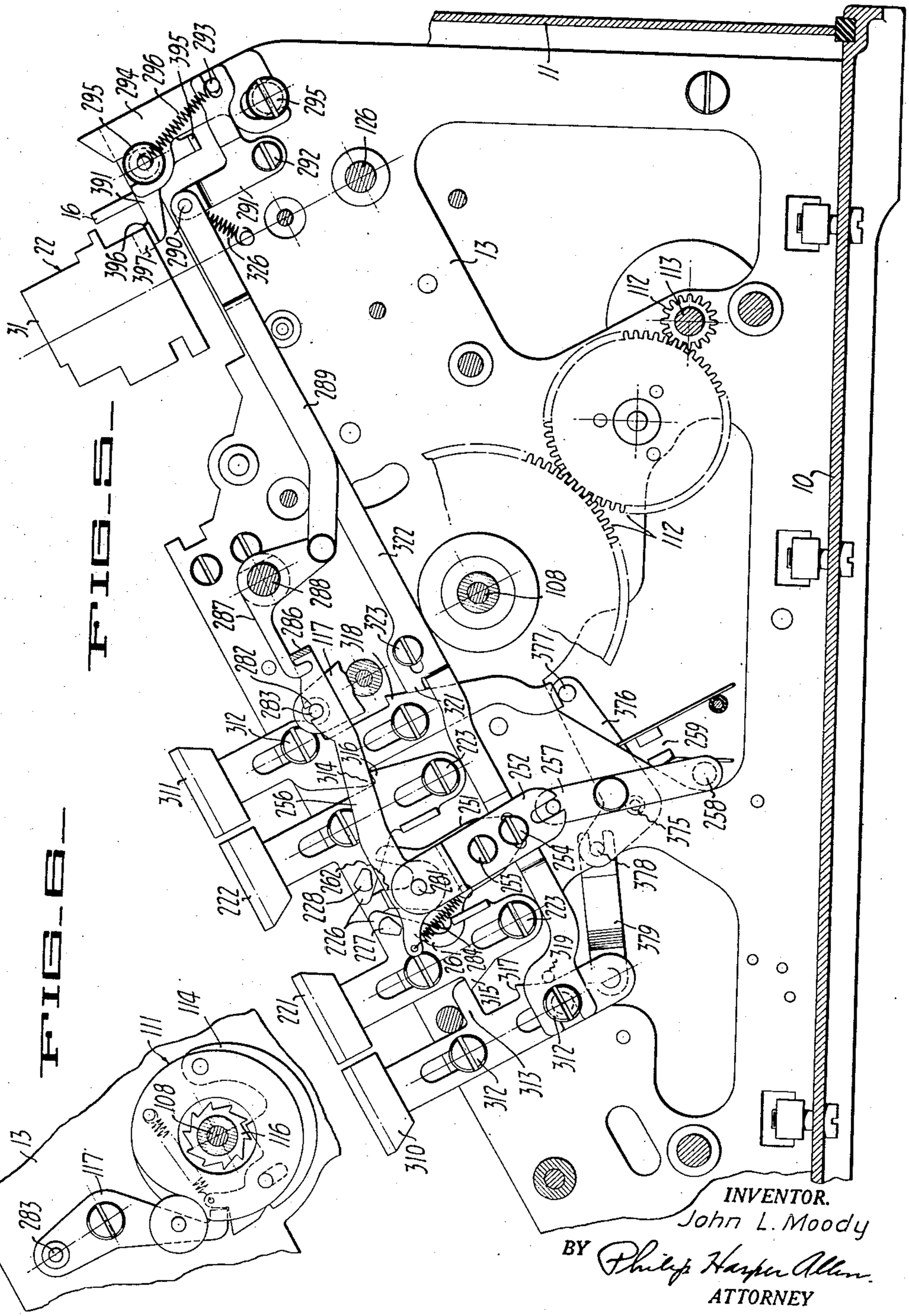
FIG. 5.

FIG. 6.



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CALCULATING MACHINE

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FIG. 7

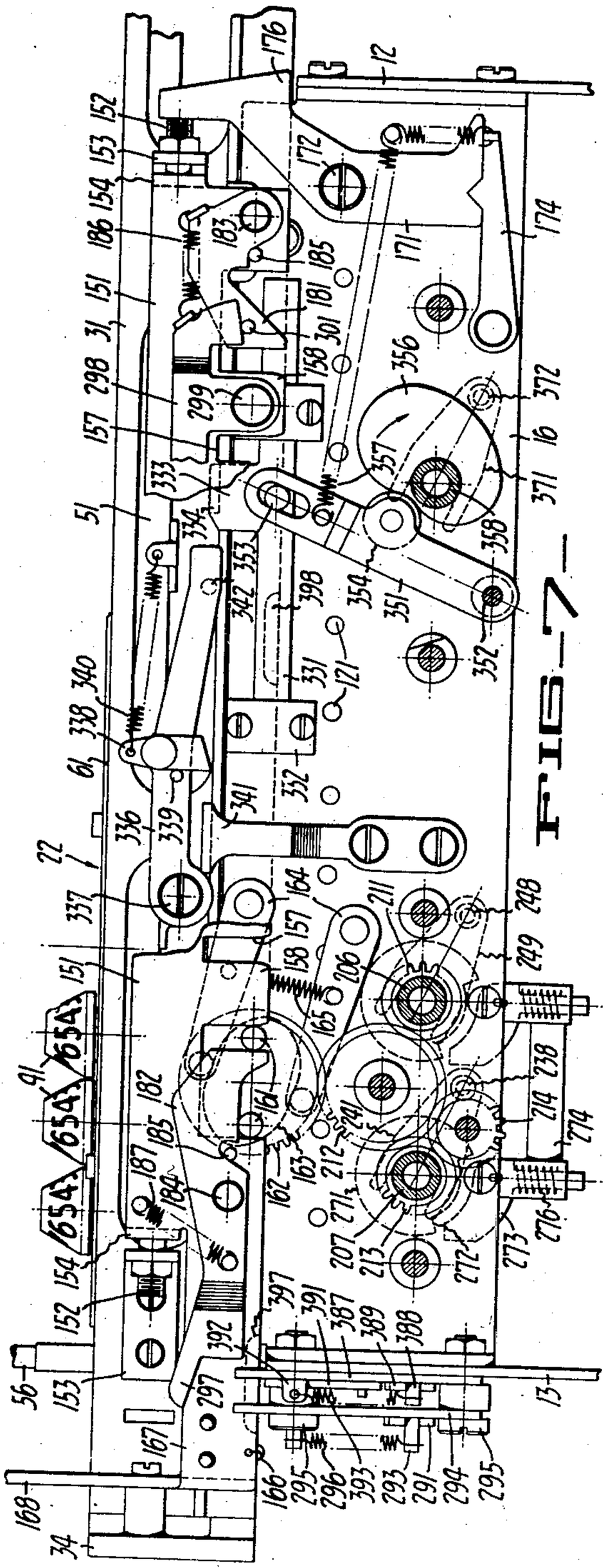

FIG. 9

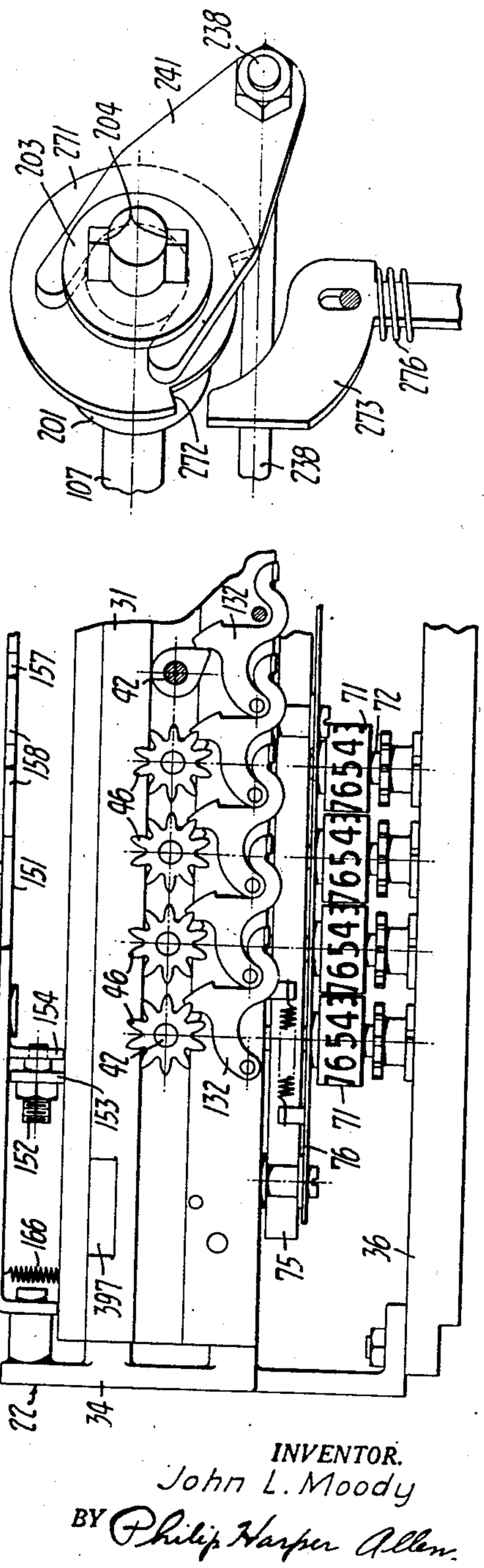

FIG. 8

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CALCULATING MACHINE

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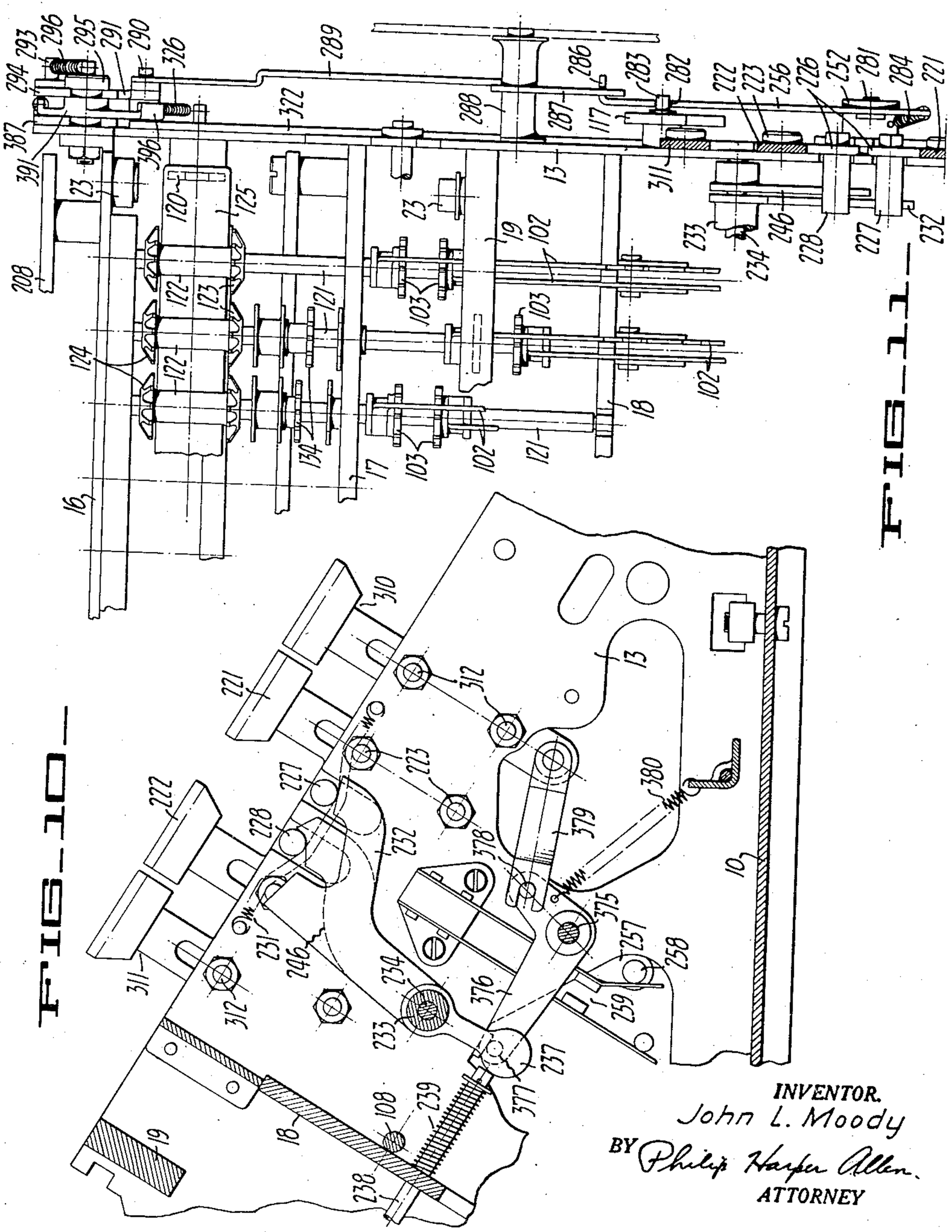

FIG. 10.

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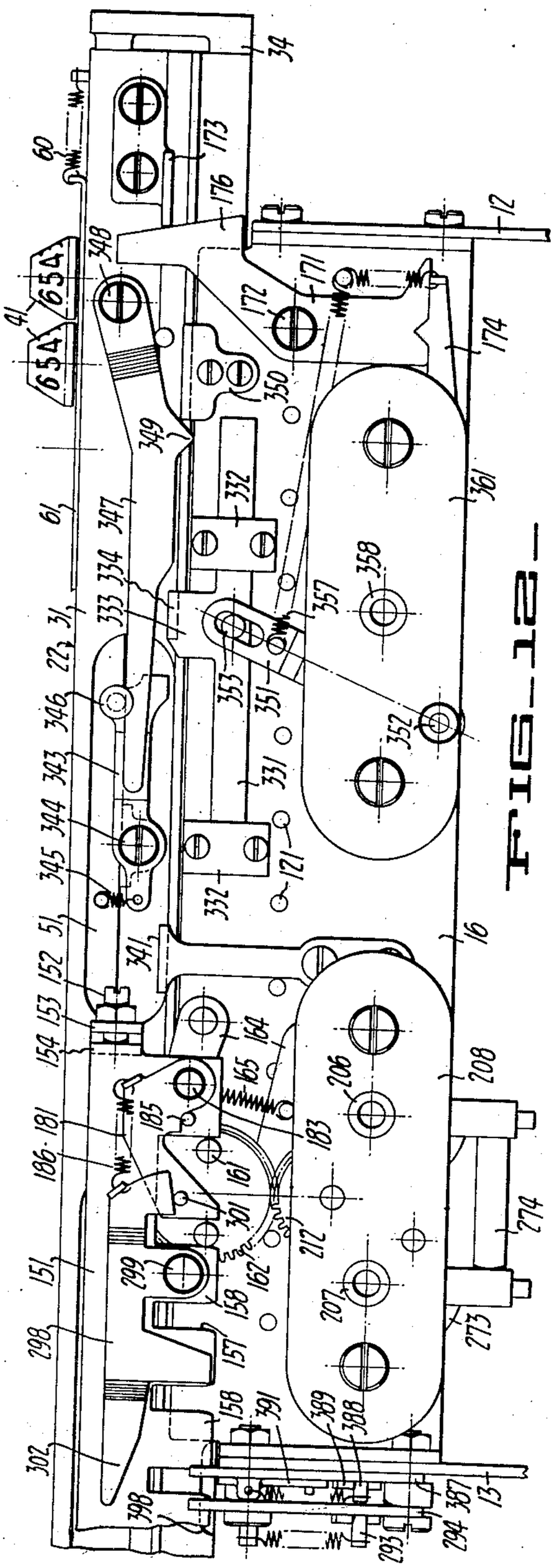

FIG. 12.

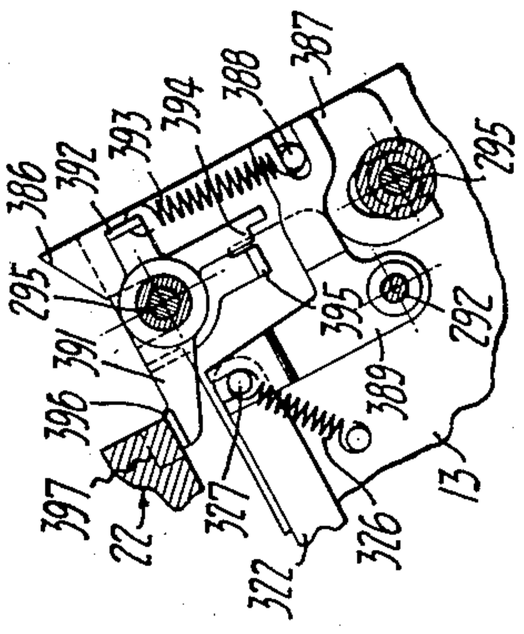

FIG. 13.

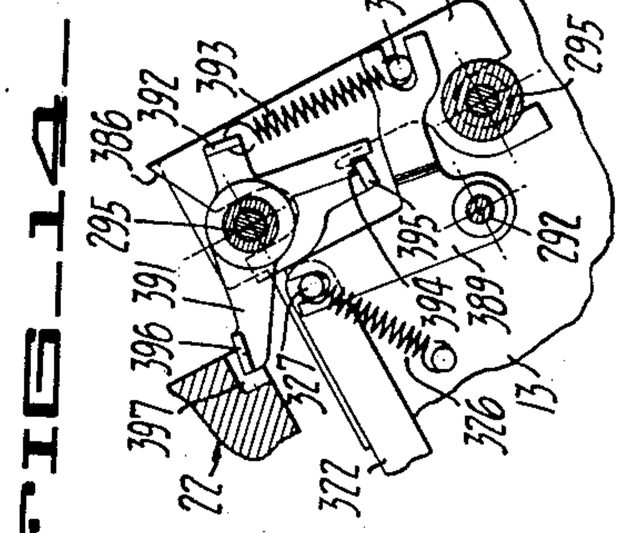

FIG. 14.

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Patented Mar. 7, 1944 2,343,241

UNITED STATES PATENT OFFICE

2,343,241

CALCULATING MACHINE

John L. Moody, Oakland, Calif., assignor to Friden Calculating Machine Co., Inc., a corporation of California

Application July 23, 1938, Serial No. 220,982

13 Claims. (Cl. 235—63)

My invention relates to calculating machines and is concerned more particularly with the provision of improved control means for operations involving shifting and resetting of the accumulator.

It is an object of my invention to provide carriage return and resetting mechanism in which the drive is interrupted after completion of the operation irrespective of continued depression of the control key by the operator to avoid repeated operation of such mechanism or any portion thereof.

Another object of the invention is to provide an improved calculating machine in which the drive is interrupted after shifting of the carriage into a predetermined position irrespective of continued depression of the control key by the operator to prevent useless overdrive of the shifting mechanism.

Another object of the invention is to provide improved accumulator shifting and resetting control means for a calculating machine in which the shiftable carriage is utilized in controlling the operation of the machine in accordance with the ordinally shifted position thereof.

Another object of the invention is to provide improved control means for a calculating machine which prevents misoperation of the machine, and provides against useless engagement of the drive when the control means is held in operative position after the completion of the operation controlled thereby.

Other objects will appear from the following description of a preferred embodiment of the invention as illustrated in the accompanying drawings.

Description of figures

Fig. 1 is a vertical, longitudinal section of the rear part of the machine taken in a plane thru the axis of the actuating means of one order of machine as indicated by the line 1—1 in Fig. 4.

Fig. 2 is a fragmentary elevational view of the accumulator resetting means as indicated by the line 2—2 in Fig. 1.

Fig. 3 is a fragmentary sectional view of the accumulator resetting means as indicated by the line 3—3 in Fig. 2.

Fig. 4 is a fragmentary plan view of the actuating means and the drive connections for the carriage shift and register zero resetting means, with certain parts shown in section.

Fig. 5 is an elevational view of the right side frame plate and the operating controls mounted thereon as indicated by the line 5—5 in Fig. 4. The register carriage is shown diagrammatically.

Fig. 6 is a fragmentary sectional view illustrating the clutch construction, and is taken as indicated by the line 6—6 in Fig. 4.

Fig. 7 is a rear elevational view of the machine and the carriage taken as indicated by the line 7—7 in Fig. 1.

Fig. 8 is a bottom plan view of the right end of the carriage.

Fig. 9 is a perspective view of the full cycle control mechanism of the carriage shifting means.

Fig. 10 is a sectional elevation of the controls for the carriage shift and carriage return and resetting means as indicated by line 10—10 in Fig. 4.

Fig. 11 is a fragmentary plan view of the right side of machine with key sections and carriage removed.

Fig. 12 is a rear elevation of the upper part of the machine similar to Fig. 7 but with the carriage shown in its opposite end position.

Fig. 13 is a fragmentary sectional view of a part of the resetting control means, and is taken in the plane of the line 13—13 in Fig. 4.

Fig. 14 is similar to Fig. 13 but shows the parts as conditioned at the end of a resetting operation.

Description of mechanism

My invention is disclosed as embodied in a calculating machine having an actuator of the universal operation continuous drive cycle type. A complete machine of this type is illustrated in the Patent of Carl M. Friden, No. 2,229,889.

Generally, the machine comprises a frame and a carriage mounted for lateral shifting movement on the frame. The carriage mounts the registers of the machine comprising the accumulator and the revolutions counter, while the frame provides a support for the various mechanisms for entering values in the registers. The frame includes base 10 (Fig. 1) which supports casing 11 and has left and right side frame plates 12, 13 (Figs. 1 and 4) mounted thereon. Side plates 12, 13 are connected by various cross frame brackets 16, 17, 18 and 19 which serve to mount various mechanisms referred to hereinafter. Register carriage 22 (Fig. 1) is mounted on frame brackets 16 and 19, as by rollers 23, for endwise shifting movement laterally of the machine in either direction to various ordinal positions as controlled by means described hereinafter.

Accumulator

Register carriage 22 (Figs. 1, 7 and 8) includes carriage frame 31 formed by a pair of opposite U-shaped members which are secured together by

suitable fastening means such as screws. Similar end plates 34 (Figs. 7 and 8) are secured to the ends of frame 31 and support cross member 36 (Figs. 1 and 8) in spaced relation from frame 31. The accumulator comprises numeral wheels 41 (Fig. 1) secured at the upper ends of numeral wheel shafts 42 journalled in ordinally spaced relation in carriage frame 31. The numeral displayed by each wheel 41 (Fig. 1) is maintained in alignment with corresponding sight opening 43 by suitable ball and gear aligning and overthrow preventing means 44. To transmit increments of value to numeral wheels 41, each shaft 42 extends below carriage frame 31 and has ten-tooth numeral wheel gear 46 which is actuated by means described later.

Accumulator resetting means

Means are provided in carriage 22 for resetting numeral wheels 41 to zero registration which includes means for restoring any displaced wheels 41 to zero position and means for arresting such wheels positively in zero position. The restoring means includes rack bar 51 (Figs. 1 and 2) mounted for endwise sliding movement in carriage frame 31 adjacent the upper ends of numeral wheel shafts 42. The teeth of rack bar 51 (Figs. 2 and 3) are cut away at 52 alternately at the top and bottom to form a plurality of separate racks for cooperation with mutilated gears 53 on numeral wheel shafts 42. Adjacent gears 53 are axially offset to cooperate with the adjacent vertically offset racks formed on rack bar 51 by cut away portions 52 thereof.

When rack bar 51 (Figs. 1–3) is in normal inactive position, gears 53 register with cut away portions 52 so that numeral wheels 41 can be actuated without interference. If rack bar 51 is moved to the right as viewed in Fig. 2, the unmutilated parts of gears 53 of any numeral wheels 41 displaced from zero position will be engaged by the associated racks on bar 51 and such displaced numeral wheels 41 are turned until restored to zero position. In this connection it will be noted that any numeral wheels 41 in zero position will not be moved by rack bar 51 because the mutilated portions of gears 53 of such numeral wheels face the rack bar. For manual operation rack bar 51 provided with handle 56 (Fig. 7) by means of which bar 51 can be actuated against the tension of a suitable spring (not shown) which normally maintains bar 51 in inactive position.

The movement of bar 51 to the right as viewed in Fig. 2 to restore any displaced numeral wheels 41 to zero position also enables the means for arresting wheels 41 in such position. Stop slide 61 (Figs. 1 and 3) is mounted for limited endwise movement on top of carriage frame 31 by suitable pin and slot connections, and is provided with a stop projection 62 (Fig. 3) for each numeral wheel 41. Each numeral wheel shaft 42 has a stop tooth 63 secured thereon for cooperation with projections 62 in the zero position of numeral wheels 41. Slide 61 is held normally in inactive position by suitable spring means 60 (Fig. 12) so each projection 62 is out of the path of the associated tooth 63. To provide for movement of projections 62 into path of teeth 63 when zeroizing the numeral wheels, slide 61 may be connected in any convenient manner to bar 51, so that when bar 51 is moved to restore numeral wheels 41 to zero position, slide 61 is moved to arrest wheels 41 in such position.

Thus, the accumulator register can be reset to zero registration manually by manipulation of handle 56. The power operation of the resetting or zeroizing means is described hereinafter.

Revolutions counter and resetting means therefor

The revolutions counter which is also carried by carriage 22 comprises numeral wheels 71 (Figs. 1 and 8) on respective shafts 72, which are journalled in carriage frame member 31 and cross member 36. A numeral wheel 71 is provided for each ordinal position of the carriage, and the displayed numeral of each wheel 71 (Fig. 1) is maintained in alignment with the associated sight opening 73 by ball and gear means 74.

Means are provided for resetting numeral wheel 71 (Figs. 1 and 8) of the counting register to zero, which is similar in construction and operation to that described in connection with accumulator wheels 41, and may include manually operable rack bar 75 and stop slide 76 suitably mounted in the carriage for cooperation with mutilated gears 77, and stop teeth 78 on shafts 72. If desired, the rack bar 75 may be coupled to the bar 51 of the accumulator as shown in the co-pending application of Carl M. Friden, Serial No. 42,268, filed September 26, 1935, now Patent No. 2,310,281, dated February 9, 1943.

From the foregoing description, it is seen that the shiftable register carriage provides a mounting for both the accumulator and revolutions counter, which are, therefore, shiftable with respect to the actuating means therefor which are mounted in the frame of the machine. Also, each register is provided with zeroizing means shiftable with the carriage. The actuating means and the associated driving and value selecting mechanisms for the registers will now be described briefly as they are generally similar to those described in said application.

Selecting and actuating mechanisms

The values to be introduced into accumulator numeral wheels 41 are selected by means of a plurality of banks or orders of settable value keys 101, one of which banks is illustrated in part in Fig. 1. Each bank of keys 101 cooperates with selecting mechanism including a pair of parallel spring-urged slides 102 mounted for endwise movement to position gears 103 selectively with respect to stepped teeth 104 of the associated actuating cylinder 106 in accordance with the value of the depressed key. One gear 103 of each ordinal pair and the associated slide 102 cooperate with value keys 101 from "1" to "5" and the left hand set of teeth 104 on the associated cylinder 106 as viewed in Fig. 1, while the other gear 103 and slide 102 cooperate with value keys 101 from "6" to "9" and the right hand set of teeth 104 on such cylinder.

Cylinders 106 (Figs. 1 and 4) are mounted on actuating shafts 107 having suitable bevel gear connections with transverse shaft 108 which is suitably journalled in side plates 12, 13. Each shaft 107 serves for two orders of the machine and has a pair of cylinders 106 mounted thereon. Shaft 108 and shafts 107 are driven cyclically from motor 109 (Fig. 1) thru clutch 111 (Figs. 4 and 6) which is driven by suitable gearing 112 from motor shaft 113. As explained in said co-pending application, clutch 111 is engaged or disengaged by oscillation of spring-urged clutch pawl or dog 114 (Fig. 6) mounted for rotation with shaft 108 and with respect to driving ratchet 116, which is journalled on shaft 108 and driven by gearing 112. Clutch control

lever 117 pivoted on side plate 13 determines engagement or disengagement of the clutch by releasing or engaging the nose of dog 114 in the full cycle position thereof.

From the above description, it is seen that the values set in the machine by depression of keys 101 will be entered in numeral wheels 41 by the cooperation of gears 103 with teeth 104 of cylinders 106 during cyclic operation of the clutch. Each pair of gears 103 is slidably mounted on a square shaft 121 (Fig. 1) supported in cross frame brackets 17, 18 and extending rearwardly of the machine thru cross member 17 and having its rear end journalled in cross frame bracket 16. Intermediate brackets 16, 17, a spool 122 is slidably and non-rotatably mounted on each shaft 121 and has opposite bevel gears 123, 124 at its ends positioned for cooperation with numeral wheel gear 46. Therefore, when one or the other set of gears 123, 124 is engaged with gears 46, numeral wheels 41 will be rotated forwardly or reversely to register a number of increments equal to the value of the depressed keys 101 in the aligned bank of keys.

To control the engagement of gears 123, 124 (Fig. 1) with gears 46, strap 125 is positioned between gears 123, 124 and is mounted by suitable arms 120 for rocking movement with shaft 126. Thus, by rocking shaft 126 either set of gears 123, 124 can be moved on shafts 121 by strap 125 from the position shown in Fig. 1 into engagement with gears 46. Gears 123 transmit positive increments and gears 124 transmit negative increments. Any suitable control means can be provided for controlling the position of shaft 126 and gears 123, 124 and for simultaneously enabling the drive through clutch 111, as for example, the plus and minus keys of the character disclosed in said patent.

Suitable spring-urged centralizing means are provided for maintaining shaft 126, strap 125 and gears 123, 124 in their central neutral position. Such means may comprise opposed centralizing arms 127 (Fig. 1) having respective pivotal supports 128 on side plate 12 and inter-connected by spring 129 so as to be urged against stop 130 on plate 12. The upper ends of centralizing arms 127 are bent inwardly for cooperative engagement with pin 131 carried by one of arms 120, so that arms 127 yieldably resist movement of gears 123 and 124 from their neutral position, and serve to return them thereto after a calculating operation.

Transferred increments in the accumulator are entered through gears 123, 124 (Fig. 1) by means of trip levers 132 (Figs. 1 and 8), transfer actuators 133 on shafts 107 and gears 134 on shafts 121 in a conventional manner as fully disclosed in said patent.

The number of actuations of accumulator numeral wheels 41 are registered either positively or negatively in counting numeral wheels 71 by actuator 136 (Fig. 1) which is driven and operated in a manner fully described in said application to enter single increments in the active order of the revolutions counter and to carry from order to order in higher orders thereof.

Carriage shifting mechanism

Means are provided for shifting the carriage in either direction from one ordinal position to another manually by releasing the carriage for free shifting movement and also by power driven means controlled by manually operable keys. Preferably, the power driven means is driven from the clutch through the actuating means for entering values into the accumulator, and the clutch is disengaged automatically when the carriage has been shifted to either end position thereof.

Carriage 22 (Figs. 7 and 8) has plate 151 mounted along the rear side thereof by means of adjusting screws 152 threaded in brackets 153 on carriage frame 31 and having smooth ends pivotally engaged with laterally projecting end portions 154 of plate 151. Plate 151 has vertical slots 157 formed in the lower edge thereof by teeth 158, slots 157 being spaced apart a distance equal to the ordinal spacing of the machine and aligned with drive shafts 121. Slots 157 are adapted for engagement by opposite shift pins 161 (Figs. 4 and 7) on shift gear 162, which is journalled on frame bracket 16 and is rotated by means described later to effect shifting of the carriage. One half revolution of gear 162 effects one ordinal spacing of carriage 22 and to provide for accurate centering of the carriage at the end of a shift, centralizing cam 163, is mounted for rotation with gear 162. Centralizing arms 164 suitably pivoted at one end on frame member 16 having suitable rollers at their opposite ends engaging opposite sides of cam 163 under the influence of spring 165 tensioned between arms 164. When pins 161 are in horizontal alignment the carriage is properly positioned and the centralizing rollers are seated in opposite depressions formed between the high portions of cam 163.

The manual release of the carriage for free shifting movement is effected by rocking plate 151 out of engagement with pins 161 of shift gear 162. Plate 151 is maintained resiliently in operative position by spring 166 (Fig. 8) tensioned between carriage frame 31 and end extension 167 of plate 151. Carriage release handle 168 (Fig. 7) is journalled on carriage end plate 34 in axial alignment with screws 152 forming the pivotal axis for plate 151, and has its inner end rigidly but removably connected to the bent end of extension 167 of plate 151. Thus by turning handle 168, plate 151 can be moved out of engagement with pins 161 to permit free shifting movement of the carriage.

Resilient bumper means is provided for preventing shifting of the carriage beyond its end positions, to one of which it is usually returned to begin a calculation. Bumper lever 171 (Fig. 7) is pivoted at 172 on frame bracket 16 and has its upper end positioned for engagement with the head of adjusting screw 152 when the carriage is in its left end position, (to the right as viewed in Fig. 7) and with stop lug 173 (Fig. 12) when in its other end position. The lower end of lever 171 is notched for engagement by the nose of spring-urged centering arm 174 which maintains bumper lever 171 resiliently in the position shown. The movement of lever 171 when struck by screw 152 is limited by the engagement of abutment 176 thereof with the top of left side frame plate 12, and when struck by lug 173, by the engagement of its lower end with side plate 12.

Yieldable means are provided to prevent attempted shifting of the register carriage beyond the lowest and highest ordinal positions thereof during power operation of the shifting means. End slots 157 are formed in part by end teeth 158 and in part by respective pawls 181, 182. Pawls 181, 182 are pivoted at 183, 184, respectively on plate 151 and extend inwardly to position the straight end edges thereof opposite end teeth

158 to form end slots 157. Pawls 181, 182 are held resiliently in the position shown against stop pins 185 by respective springs 186, 187 associated therewith. When carriage 22 is in the end position shown in Fig. 7, one pin 161 lies in an end slot 157 and the other is positioned beneath adjacent pawl 182 in engagement with a cam edge thereof. In this condition rotation of shift gear 162 and pins 161 in a direction to move the carriage beyond the end position merely results in oscillating pawl 182. However, upon rotation of gear 162 in a direction to effect carriage shifting to an intermediate ordinal position, the end edge of pawl 182 positively resists the pin 161 in end slot 157 and carriage shifting results. A similar action occurs if the carriage is in its other end position to place shift gear 162 adjacent pawl 181 as shown in Fig. 12. It is seen, therefore, that the carriage cannot be shifted beyond either end position thereof by operation of shift gear 162. The oscillations of pawls 181 and 182 are used in a manner described hereinafter to control stopping of the machine in carriage shifting operations after the carriage has entered an end position.

As stated above, shift gear 162 is rotatable in either direction by selectively operable drive connections with the actuating means of the machine. For this purpose, the two lowest order actuating shafts 107 (Fig. 4) are extended rearwardly and have respective collars 201 secured adjacent the ends thereof. Each collar 201 is provided with opposite slots slidably engaged by corresponding teeth 202 of a shiftable drive establishing collar 203 mounted freely on the end of shaft 107. Opposite teeth 202 thereof, each collar 203 has smaller teeth 204 adapted for engagement with corresponding slots in respective gear sleeves 206, 207, which are journalled in frame bracket 16 and small plate 208 mounted on member 16 by suitable spacers and fastening screws. Gear sleeve 206 (Figs. 4 and 7) has gear 211 meshing with idler gear 212 (Fig. 7) journalled in bracket 16 and plate 208 and meshing with shift gear 162. Gear sleeve 207 (Figs. 4 and 7) has gear 213 (Fig. 7) offset axially from idler gear 212 and meshing with wide reverse idler gear 214 suitably journalled in bracket 16 and plate 208 and also meshing with idler gear 212. Thus, rotation of gear sleeve 206 in a clockwise direction as viewed in Fig. 7 causes clockwise rotation of shift gear 162 and shifting of carriage 22 to the left as viewed from the front of the machine. Correspondingly, rotation of gear sleeve 207 in a clockwise direction as viewed in Fig. 7 effects counterclockwise rotation of shift gear 162 and shifting of carriage 22 to the right as viewed from the front of the machine. Thus, by selective establishing of drive connections between gear sleeves 206, 207 (Fig. 4) and collars 201 upon selective shifting of respective shiftable collars 203, carriage 22 can be shifted in either direction. The gear ratios are so chosen that one rotation of actuating shafts 107 effects one-half rotation of shift gear 162.

Manually operable control means are provided for the carriage shifting mechanism described above to enable selective shifting of the carriage in either direction through one or more ordinal spaces. Shift keys 221, 222 (Figs. 5 and 10) are depressible to initiate shifting of the carriage to the right and left respectively as viewed from the front of the machine. Depression of either key serves to enable a drive connection from the actuating means to the carriage shifting mechanism during the first part of its downward movement and thereafter to engage the clutch and energize the motor. Keys 221, 222 (Fig. 5) are mounted for endwise movement by suitable longitudinal slots formed therein and engaged by a plurality of studs 223 secured on frame plate 13. Keys 221, 222 have adjacent ears 226 with respective studs 227, 228 mounted therein and extending to either side thereof. To maintain the shift keys resiliently in raised position, coil spring 231 (Fig. 10) is provided having its ends fastened to side plate 13 and passing over upper studs 223 and under the ends of studs 227, 228 which extend through suitable slots in side plate 13.

To enable the drive connection from the actuating means to the carriage shifting mechanism upon depression of shift key 221, stud 227 (Fig. 10) engages the upper end of arm 232 secured on sleeve 233 (Figs 4 and 10). Sleeve 233 is journalled on transverse shaft 234 which is suitably journalled at its ends in side plate 13 and bracket 236 on cross bracket 18. At its left end, sleeve 233 is provided with depending arm 237 (Fig. 10) having its rounded end in engagement with the front end of rearwardly extending rod 238 (Figs 4 and 10). Rod 238 is mounted for sliding movement in cross brackets 17, 18 and is resiliently urged to its forward position by spring 239 compressed between cross member 18 and a suitable washer on rod 238. At its rear end, rod 238 (Fig. 4) has shift fork 241 secured thereon with its forked end in engagement with an annular groove in right-hand shiftable collar 203. From the foregoing description, it is seen that depression of key 221 is effective through stud 227 to rock arm 232, sleeve 233 and arm 237 to move rod 238 rearwardly. Such rearward movement of rod 238 is effective through shift fork 241 to engage teeth 204 of right-hand shift collar 203 with corresponding slots in gear sleeve 207. Thus, initial depression of shift key 221 is effected to enable a drive connection from the actuating means to the carriage shifting mechanism, and to determine shifting of the carriage to the night.

A similar mechanism is employed in connection with shift key 222 to enable the drive connection to determine shifting of the carriage to the left. Stud 228 (Fig. 10) is engaged with the upper end of arm 246 having its hub secured on shaft 234. At its left end, shaft 234 (Fig. 4) has depending arm 247 (similar to arm 237) secured thereon in operative relation with shift rod 248 having shift fork 249 at its rear end in engagement with an annular groove in left-hand shift collar 203. It is seen, therefore, that depression of key 222 results in rocking of shaft 234 and rearward movement of rod 248 to engage left-hand shift collar 203 with gear sleeve 206. This conditions the carraige shift mechanism for shifting of the carriage to the left. It is to be noted that only a small amount of movement is required to engage teeth 204 with the corresponding slots in gear sleeves 206, 207 so that the drive connection is enabled during the first part of the downward movement of keys 221, 222.

The latter part of the downward movement of keys 221, 222 is utilized to engage the clutch and energize the motor. Studs 227, 228 (Fig. 5) overlie respective cam surfaces at the upper end of lever 251. Lever 251 is adjustably secured on lever 252 by pivot 253 and by pin and slot connection 254 having suitable clamping means for maintaining the relative adjustment between le-

vers 251, 252. From the relation of studs 227, 228 and lever 251, it is evident that depression of either of keys 221, 222 is effective during the latter part of the movement to rock levers 251, 252 in a clockwise direction. Lever 252 is connected at its upper end by link 256 with clutch control lever 117 (Figs. 5 and 6) so that movement of link 256 will result upon depression of either of the shift keys. Such movement is effective in the manner previously described to engage the clutch. The motor is energized upon oscillation of lever 252 (Fig. 5) which has a pin and slot connection with lever 257 having pin 258 mounted adjacent contacts 259 of the motor circuit. Lever 251 also provides an interlock between shift keys 221, 222 by means of lock portions 261, 262 which are adapted to move beneath studs 227, 228 respectively. For example, if key 221 is depressed, lock portion 262 moves into blocking position beneath stud 228.

Means are provided for maintaining the drive connection from the actuating means to the carriage shifting mechanism throughout each cycle of movement even though the depressed shift key be released immediately after depression thereof and before complete shifting of the carriage. For this purpose each shiftable collar 203 is provided with a similar mechanism, only one of which will be described. Right-hand shiftable collar 203 (Figs. 4, 7 and 9) is provided with disc 271 having a cut away portion 272 which, in the full cycle position of collar 203, is in the position illustrated in Fig. 7. Immediately to the rear of disc 271, locking element 273 is provided mounted in bracket 274 for movement radially of collar 203, and urged to its extended position by spring 276. With shiftable collar 203 in its inactive position disc 271 is positioned forwardly of locking element 273 and when moved rearwardly of the machine to its active position passes by element 273 which is in alignment with the cut away portion 272. Upon subsequent rotation of disc 271 the solid portion thereof engages element 273 and prevents movement of collar 203 forwardly of the machine so that teeth 202 are maintained in engagement with gear sleeve 207 for one or more complete revolutions or cycles irrespective of release of the associated shift key before the end of a cycle. Left hand shiftable collar 203 is held in drive establishing position for each cycle of rotation by similar mechanism.

From the foregoing description it is seen that keys 221, 222 and the associated mechanism provide means for shifting the carriage selectively in either direction from one ordinal position of the carriage to another. If a shift key be maintained in depressed position, shifting will continue until the carriage reaches an end position, when, as previously described, continued operation of the shifting mechanism in the same direction becomes ineffective, and means is brought into play to disengage the clutch and stop operation of the shift mechanism irrespective of release of the depressed shift key by the operator.

For this purpose, clutch control link 256 (Figs. 5 and 11) has pivoted connection 281 with lever 252 at one end and adjacent its other rearward end is notched at 282 for detachable engagement with pin 283 on clutch control lever 117, the connection therebetween being maintained by spring 284. The rearward end of link 256 is bent to provide lateral extension 286 which lies under the hooked arm of bellcrank 287 pivoted by stud 288 on plate 13. The depending arm of bellcrank 287 is pivotally connected to link 289, which extends rearwardly for pivotal connection by pin 290 with the upright arm of bellcrank 291 pivoted at 292 on plate 13. The horizontal arm of bellcrank 291 is forked to engage pin 293 on slide 294 mounted for endwise sliding movement on studs 295 projecting outwardly from plate 13. Slide 294 is urged to its upper position by spring 296 tensioned between pin 293 and upper stud 295, spring 296 also being effective through bellcrank 291 and link 289 to urge bellcrank 287 in a clockwise direction. From the above-described relation of the parts, it will be seen that downward movement of slide 294 is effective through bellcrank 287 to move the rearward end of link 256 downwardly to disengage notch 282 from pin 283 and release clutch control lever 117 for movement to clutch disengaging position.

The clutch controlling movement of slide 294 is effected in either end position of the carriage by means operated by the shift gear during the first cycle of movement thereof with the carriage in an end position. To effect this control with the carriage in the end position thereof shown in Fig. 7, pawl 182 is provided with cam arm 297 which in the end position of the carriage overlies the bevelled upper end of slide 294 so as to move the slide downwardly when pawl 182 is oscillated by a pin 161 of shift gear 162 during the first cycle of movement with the carriage in the end position shown.

To effect the clutch disengaging control with the carriage in the end position shown in Fig. 12, lever 298 is pivoted at 299 on one of rack teeth 158 with one end thereof held in operative engagement with pin 301 of pawl 181 by spring 186. Lever 298 is provided with cam arm 302 overlying the upper end of slide 294 in the carriage position shown in Fig. 12, and is operated through pawl 181 from shift gear 162 to effect disengagement of the clutch in the same manner.

Thus, in either end position of the carriage, the drive for the shifting mechanism is disabled after one cycle of operation if the selected drive direction will determine shifting beyond the end position. This control is also utilized in the operation of the normalizing mechanism for effecting return of the carriage to an end position and subsequent zero resetting of the accumulator.

Normalizing mechanism

Means are provided for restoring the machine to normal condition between successive operations, and the restoring may be effected by returning the carriage to either end position and by resetting the accumulator to zero after its return to either of such positions, in accordance with the type of calculation which is to follow. This mechanism is of the character disclosed and claimed in the co-pending application of Carl M. Friden, Serial No. 220,981, filed July 23, 1938 now Patent No. 2,327,635, dated August 24, 1943. The normalizing mechanism includes selective control means in the form of keys 310 and 311 (Fig. 5) for controlling the return of the carriage to the selected end position and a subsequent zeroizing operation, after which the mechanism stops irrespective of whether or not the depressed key is held in this position.

Either of return and resetting keys 310 or 311 (Fig. 5) is operative upon depression thereof to establish a drive connection between the power

driven resetting mechanism and the actuating means and to initiate a carriage shifting operation. The depressed key is latched in depressed position until the carriage return and resetting operation are effected when the latch is automatically released and the drive interrupted. Keys 310 and 311 are mounted for endwise movement on side plate 13 adjacent shift keys 221 and 222, respectively, and for this purpose, each of keys 310 and 311 is slotted for engagement by spaced apart studs 312 on plate 13, and are urged to their raised position by virtue of respective projections 313, and 314 thereon overlying teeth 315 and 316 on shift keys 221 and 222, respectively. By virtue of the overlapping relation of the keys 310 and 311 with shift keys 221 and 222, respectively, depression of key 310 will initiate operation of the clutch and shifting of the carriage to the right, and depression of key 311 also enables the drive and effects carriage shifting to the left. Intermediate their ends, keys 310 and 311 (Fig. 5) are provided with respective latching teeth 317 and 318 for cooperation with pin 319 and nose 321, respectively of latching slide 322. Since 322 is mounted for endwise sliding movement on plate 13, being slotted intermediate its ends for engagement with stud 323 and at its front end for engagement with lower stud 312 associated with key 310. Spring 326 (Figs. 5 and 13) tensioned between a pin on side plate 13 and pin 327 at the rear end of slide 322 urges slide 322 to active position so that upon depression of either of keys 310 or 311, slide 322 will become effective and maintain the key in depressed position until it is released by means described hereinafter.

As stated above, depression of either of keys 310 or 311 enables a drive connection from the actuating means to zero resetting drive means. The zero resetting drive member comprises slide 331 (Figs. 4 and 7) mounted for endwise movement on frame bracket 16 by brackets 332. Slide 331 has vertical projection 333 terminating in lateral extension 334 which comprises the active part of actuating slide 331, and is adapted for operative relation with either of two drive receiving arms carried by resetting bar 51 of the accumulator zero resetting means.

When carriage 22 is in its left end position as illustrated in Fig. 7 where it is returned by operation of key 311, extension 334 is in operative relation with arm 336 pivoted at 337 (Fig. 7) on resetting bar 51 for numeral wheels 41 of the accumulator. Arm 336 has "live" pawl 338 pivoted thereon intermediate its ends and urged against pin 339 by spring 340 tensioned between pawl 338 and a suitable lug on bar 51. Pawl 338 is adapted to cooperate with fixed ledge 341 mounted on frame bracket 16 to maintain arm 336 raised to a position out of the path of slide extension 334 until the carriage is shifted into its left end position, or until arm 336 is out of the range of movement of slide extension 334. Spring 340 also urges arm 336 to the position shown with pin 342 engaged with a surface of carriage frame 31. With the parts positioned as illustrated in Fig. 7, it is seen that upon movement of slide 331 to the left, lateral extension 334 will engage the end of arm 336 to reciprocate resetting rack bar 51 and effect resetting of the accumulator wheels 41 in the manner previously described.

When carriage 22 is in its right end position as illustrated in Fig. 12 where it is returned by operation of key 310, extension 334 is in operative relation with arm 343 pivoted at 344 on resetting bar 51 and urged in a clockwise direction by spring 345. At its outer end arm 343 carries roller 346 operatively engaged with lever 347 pivoted at 348 on carriage frame 31 and having cam nose 349 intermediate its ends for cooperation with fixed ledge 350 on frame bracket 16 to maintain arm 343 raised to a position out of the path of slide extension 334 until the carriage is shifted into its right end position, or until arm 343 is moved out of the range of movement of slide extension 334.

The means for actuating slide 331 (Fig. 7) includes arm 351 pivoted at 352 on plate 16 and having a slot at its upper end engaged by pin 353 on slide 331. Intermediate its ends, arm 351 has roller 354 journalled thereon for cooperation with cam 356 under the influence of spring 357. Cam 356 (Fig. 4) has hub 358 journalled in bracket 16 and in small plate 361 mounted in spaced relation from bracket 16 by suitable spacers and studs. Hub 358 of cam 356 extends thru bracket 16 and has opposite notches 362 for cooperation with corresponding teeth 363 of collar 364 shiftably mounted on the end of an actuating shaft 107. Opposite teeth 363, shiftable collar 364 has similar teeth 366 constantly engaged with corresponding notches in collar 367 secured on said actuating shaft 107 adjacent the end thereof. Shiftable collar 364, therefore, provides means for establishing a drive connection from the actuating means to the zero resetting drive member. Collar 364 has an annular groove to receive control fork 371 mounted at the rear end of rod 372 which is supported for endwise sliding movement in cross brackets 17, 18. Rod 372 is spring-urged to its forward position by spring 373 in the same manner as rod 238 and spring 239 of the carriage shifting mechanism. The front end of rod 372 is normally engaged with the lower end surface of arm 374 (Figs. 1 and 4) secured on shaft 375 which is movably supported in side plates 12, 13. Arm 374 (Fig. 1) has an upper end surface of greater radius so that clockwise movement of arm 374, as viewed in Fig. 1, causes endwise movement of rod 372 until it is engaged with the end surface of greater radius. Shaft 375 (Figs. 4, 5 and 10) carries bellcrank 376, having pin 377 on one arm thereof disposed below the lower end of key 311, and having pin 378 on the other arm thereof operatively engaged with the forked end of arm 379 pivotally connected to the lower end of key 310. Spring 380 connected to bellcrank 376 holds it in operative engagement with keys 310 and 311. It is seen, therefore, that depression of either of return and reset keys 310 and 311 serves, by rocking shaft 375 and arm 374, to engage teeth 363 (Fig. 4) of shiftable collar 364 with notches 362 of cam hub 358 thereby enabling the drive connection from the actuating means to the zero resetting drive member. As the depressed resetting key is latched in depressed position, such drive connection will remain enabled until release of the latch so that the carriage is returned to the end position corresponding to the depressed key, if displaced therefrom, and the next revolution of the actuating means is effective to reset the accumulator to zero and to release the latch for the depressed key.

To effect the latch release, cam arm 297 (Fig. 7) of pawl 182 and cam arm 302 (Fig. 12) of lever 298 are cooperatively related in the respective end positions of the carriage with cam surface 386 (Figs. 4, 7, 11 and 13) of latch releas-

ing slide 387 which is mounted for endwise movement by studs 295 on side plate 13, so that slide 387 will be actuated thereby in the same manner as clutch disengaging slide 294, and at the same time, i. e., during the cycle of operation during which the zero resetting of the accumulator occurs. Latch releasing slide 387 (Fig. 13) carries pin 388 which is engaged by the forked end of bellcrank 389 pivoted by stud 292 on side plate 13 and having its other end connected by pin 327 to latch slide 322, so that spring 326 urges slide 387 to its upper position. Thus, when slide 294 is actuated by cam arm 297 (Fig. 7) or by cam arm 302 (Fig. 12), bellcrank 389 (Fig. 13) moves latch slide 322 (Figs. 13 and 5) rearwardly to release the depressed resetting key.

In accordance with my invention, means is provided to prevent latching a resetting key in depressed position when the carriage is in either one of its end positions so that if the operator maintains a key depressed after completion of the resetting operation it will be free to move to its raised position, and so that the connection for controlling engagement of the clutch can be re-established. Latch bellcrank 391 (Figs. 11 and 13) is pivoted on upper stud 295 between slides 294 and 387 and has ear 392 connected by spring 393 with pin 388 on slide 387 so that it is urged in a clockwise direction, spring 393 also urging slide 387 upwardly. The depending arm of bellcrank 391 (Fig. 13) is notched to provide latching shoulder 394 for operative engagement with laterally projecting latch tooth 395 of slide 387 in the depressed position thereof shown in Fig. 14. The horizontal arm of bellcrank 391 is provided with laterally projecting ear 396 which rides against the bottom face of carriage frame 31 at the rear edge thereof so that bellcrank 391 is held inactive except in the end positions of the carriage where one of the respective recesses 397 (Figs. 5, 7 and 8) and 398 (Fig. 12) is aligned therewith. As shown in Fig. 14, when recess 397 is aligned with latch bellcrank 391, which condition will obtain at the end of each resetting operation controlled by key 311, bellcrank 391 will move into active position to maintain slide 387 depressed, so that latch slide 322 (Fig. 5) will be held in inactive position with respect to keys 310 and 311. Upon subsequent displacement of the carriage from an end position, bellcrank 391 will be moved to inactive position so that latch releasing slide 387 and latch slide 322 will be returned to their normal positions shown in Figs. 5 and 13.

Shifting operation

The shifting operation will be described, assuming that the carriage is to be shifted to an end position from some other position by depression of shift key 221, for example. Depression of key 221 (Figs. 10 and 11) serves thru arm 232 to rock sleeve 234 and arm 237 depending therefrom, so that rod 238 (Fig. 4) is moved rearwardly to engage right hand collar 203 with sleeve 207 to enable the drive to shift gear 162.

After the drive connection to the shift gear is established further depression of key 221 (Fig. 5) serves thru levers 251 and 252 to close the motor circuit by engaging contacts 259 and to engage the clutch thru link 256 which rocks clutch control lever 117 (Figs. 5 and 6) in a direction to release clutch pawl 114.

The machine begins to turn over and shift gear 162 is rotated in a counter-clockwise direction as viewed in Fig. 12 until the carriage enters the end position illustrated. Assuming that the operator continues to hold the shift key 221 depressed during the next cycle of operation, one of pins 161 oscillates pawl 181 in a clockwise direction so that pawl 298 is oscillated thereby. Arm 302 of pawl 298 strikes the end of slide 294 so that the slide moves downwardly against the tension of its spring 296 and serves to oscillate bellcrank 291 in a clockwise direction. Such movement of bellcrank 291 operates thru link 289 to rock bellcrank 287 in a counter-clockwise direction so that link 256 is moved downwardly to disengage the notch 282 from pin 283 on clutch control lever 117. Thus, lever 117 is free to move by gravity into the path of clutch pawl 114 and move this pawl to clutch disengaging position at the end of the cycle of operation then in progress to interrupt the drive even though the shift key be maintained in depressed position. Subsequently, when key 221 is released, link 256 (Fig. 5) moves upwardly under the influence of its spring 284 and is also moved forwardly (to the left in Fig. 5) by the return of lever 251 to its neutral position to re-engage its notch 282 with pin 283 so that the parts are reconditioned for subsequent operation.

If the shifting operation is performed by depressing key 222 so that the carriage is shifted to its other end position as shown in Fig. 7, pins 161 of shift gear 162 are operatively related to pawl 182 so that its arm 297 serves to operate slide 294 and cause the subsequent disengagement of the clutch irrespective of continued depression of key 222.

Normalizing operation

The operation of the normalizing mechanism will be described in connection with depression of the key 310 (Fig. 5) which also causes depression of key 221 to operate the shifting mechanism in the manner described above. Key 310 is connected by link 379 with bellcrank 376 so as to cause oscillation of shaft 375 (Figs. 1 and 4) which operates thru cam arm 374 to move control rod 372 rearwardly so that resetting collar 364 is moved into driving engagement with hub 358 of resetting cam 356 (Fig. 7). Consequently, during the operation of the shifting mechanism cam 356 serves thru arm 351 to reciprocate actuating slide 331 once for each cycle of operation. Thus, when the carriage enters the position shown in Fig. 12 its arm 343 is permitted to move into the path of travel of actuating tooth 334, rack bar 51 will be oscillated to reset the accumulator to zero registration. The arm 343 is allowed to drop as the carriage finishes its last step of shifting movement by arm 347 whose cam tooth 349 rides off of ledge 350 at this time.

As a result, actuating slide 331 performs a resetting operation during the first cycle of the actuating means following the shift cycle which placed the carriage in its end position. During this cycle of operation as previously described, pawl 181 (Fig. 12) is oscillated to correspondingly oscillate pawl 298 so that its arm 302 moves slide 294 downwardly to disengage the clutch in the manner described in connection with the shifting operation. Arm 302 is also effective with respect to latch disabling slide 387 (Figs. 12 and 13) which operates thru bellcrank 389 to move latch slide 322 rearwardly of the machine to remove pin 319 from its latching engagement with tooth 317 on key 310.

At the same time that slide 387 is moved downwardly latching bellcrank 391 moves from the

position shown in Fig. 13 to that shown in Fig. 14, so that slide 387 and its associated latching slide 322 cannot again be moved to operative position until the carriage is shifted out of its end position where recess 397 in carriage frame 31 enables the active movement of latch bellcrank 391.

The operation under control of carriage return and resetting key 311 is similar to that described above except that pawl 182 and its arm 397 are effective with respect to slides 294 and 387 as shown in Fig. 7.

While I have shown and described a preferred embodiment of the invention, it is to be understood that the invention is capable of both variation and modification from the form shown without departing from the true scope thereof, which should be limited only by the scope of the claims appended hereto.

I, therefore, claim as my invention:

1. In a calculating machine, a register carriage mounted for endwise shifting movement, shift means for said register carriage, drive means for said shift means, a key for initiating operation of said drive means and controlling operation of said shift means to move said register carriage to a predetermined position if displaced therefrom, means for latching said key in drive initiating position, means for interrupting operation of said drive means with said register carriage in said predetermined position and with said key held in operative position, and means controlled by said register carriage for disabling said latching means when the register carriage is in said predetermined position, whereby to prevent latching of said key in said operative position with said register carriage in said predetermined position.

2. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame to a plurality of ordinal positions, a key, a latch for said key, and means controlled by said carriage in a predetermined ordinal position thereof for disabling said latch including spring-urged latching means for maintaining said latch in disabled condition.

3. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame to a plurality of ordinal positions, a key, a latch for said key, means for moving said latch to inactive position, latch means for maintaining said latch in said inactive position, and means on said carriage for releasing said latch from said maintaining latch means.

4. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame, means including a key for controlling a machine operation involving shifting of said carriage to a predetermined ordinal position thereof if displaced therefrom, a latch for maintaining said key in operative position, and spring-urged latching means controlled by said carriage for holding said latch in inactive position with said carriage in said predetermined position.

5. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame, means including a plurality of keys for controlling machine operations involving shifting of said carriage, each of said keys determining shifting of said carriage to a predetermined ordinal position thereof if displaced therefrom, a latch for maintaining said keys in operative position, and means controlled by said carriage for holding said latch in inactive position with said carriage in any of said predetermined positions.

6. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame, means including a key for controlling a machine operation involving shifting of said carriage to a predetermined ordinal position thereof if displaced therefrom, a latch for maintaining said key in operative position, latching means for said latch spring urged into operative latching position to hold said latch inactive, and means comprising said carriage for restraining and releasing said spring urged latching means.

7. In a calculating machine, a register mounted for endwise shifting movement, zeroizing means for said register, means for shifting said register, drive means for said zeroizing means and said shifting means, a key, means controlled by said key for initiating operation of said drive means to effect shifting of said register to a predetermined position if displaced therefrom and to effect zeroizing of said register, said last-named means including a disengageable drive control connection, and means for interrupting operation of said drive means at the end of the zeroizing operation with said key held in drive initiating position by disengaging said drive control connection.

8. In a calculating machine, actuating means, a register mounted for endwise shifting movement relative to said actuating means, drive means including a cyclically operable clutch, shift means for said register having a controllable drive connection with said drive means, zeroizing means for said register having a controllable drive connection with said drive means, a register return and clear key, means associated with said key for engaging said clutch and for enabling said controllable drive connections to effect shifting of said register to a predetermined position if displaced therefrom for a zeroizing operation, means for latching said key in operative position, means for releasing said latching means, and means operable in time with said releasing means for disengaging said clutch with said key held in clutch engaging position.

9. In a calculating machine, actuating means, a register mounted for endwise shifting movement relative to said actuating means, drive means including a cyclically operable clutch, shift means for said register having a controllable drive connection with said drive means, zeroizing means for said register having a controllable drive connection with said drive means, a register return and clear key, means associated with said key for engaging said clutch and for enabling said controllable drive connections to effect shifting of said register to a predetermined position if displaced therefrom for a zeroizing operation, means for latching said key in operative position, means for releasing said latching means, means operable in time with said releasing means for disengaging said clutch with said key held in clutch engaging position, and means controlled by said register and rendered operative with said register in said predetermined position for holding said latching means inactive after release of said key, whereby to prevent latching of the key upon subsequent operation thereof with said register in said predetermined position.

10. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame, a rack on said carriage including a yieldable pawl at an end thereof, a shift gear cooperating with said rack for shifting said carriage, said pawl yielding upon engagement with said gear to prevent shifting of said carriage beyond an end position thereof, drive means for

said gear including a clutch, a control lever for said clutch, a key, a disengageable controlling connection between said key and said lever, a latch for holding said key in clutch engaging position, means for releasing said latch including a slide mounted for movement on said frame, means for effecting disengagement of said controlling connection including a second slide mounted for movement on said frame adjacent said first-named slide, and means movable with said pawl for operating said slides.

11. In a calculating machine, a frame, a carriage mounted for endwise shifting movement on said frame, a register in said carriage, means for shifting said carriage, zeroizing means for said register mounted in said carriage, power-driven means on said frame including a clutch for driving said zeroizing means, manually operable control means on said frame associated with said clutch and said zeroizing means for initiating and controlling a zeroizing operation of said register, said manually operable control means also being operable to control said shifting means to effect shifting of said register to a pre-determined position if displaced therefrom, and means responsive to overdriving of said shifting means when in said predetermined position for disengaging said clutch at the end of the zeroizing and shifting operations with said manually operable control means held in operative position.

12. In a calculating machine, a register carriage mounted for endwise shifting movement, shift means for said register carriage, drive means for said shift means, a key for initiating operation of said drive means and controlling operation of said shift means to move said register carriage to a predetermined position if displaced therefrom, means for latching said key in drive-initiating position, means operated by said shift means to move said latching means to key releasing position upon movement of said carriage by said shift means to said predetermined position, and means controlled by said carriage for holding said latching means in said key releasing position when the carriage is in said predetermined position.

13. In a calculating machine, a register carriage mounted for endwise shifting movement, shift means for said register carriage, drive means for said shift means, a plurality of keys for initiating and controlling operation of said drive means and said shift means, each of said keys determining shifting movement of said register carriage to a corresponding predetermined position if displaced therefrom, latch means for said keys, means controlled by said register carriage when in any of said predetermined positions for interrupting operation of said drive means with said key held depressed, means operated by said shift means to move said latching means to key releasing position upon movement of said carriage by said shift means to said predetermined position, and means controlled by said register carriage for holding said latch means inoperative when the register carriage is moved to said predetermined position by operation of said shift means.

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