July 2, 1946. C. M. FRIDEN ET AL 2,403,273

CALCULATING MACHINE

Filed Jan. 27, 1940 10 Sheets-Sheet 1

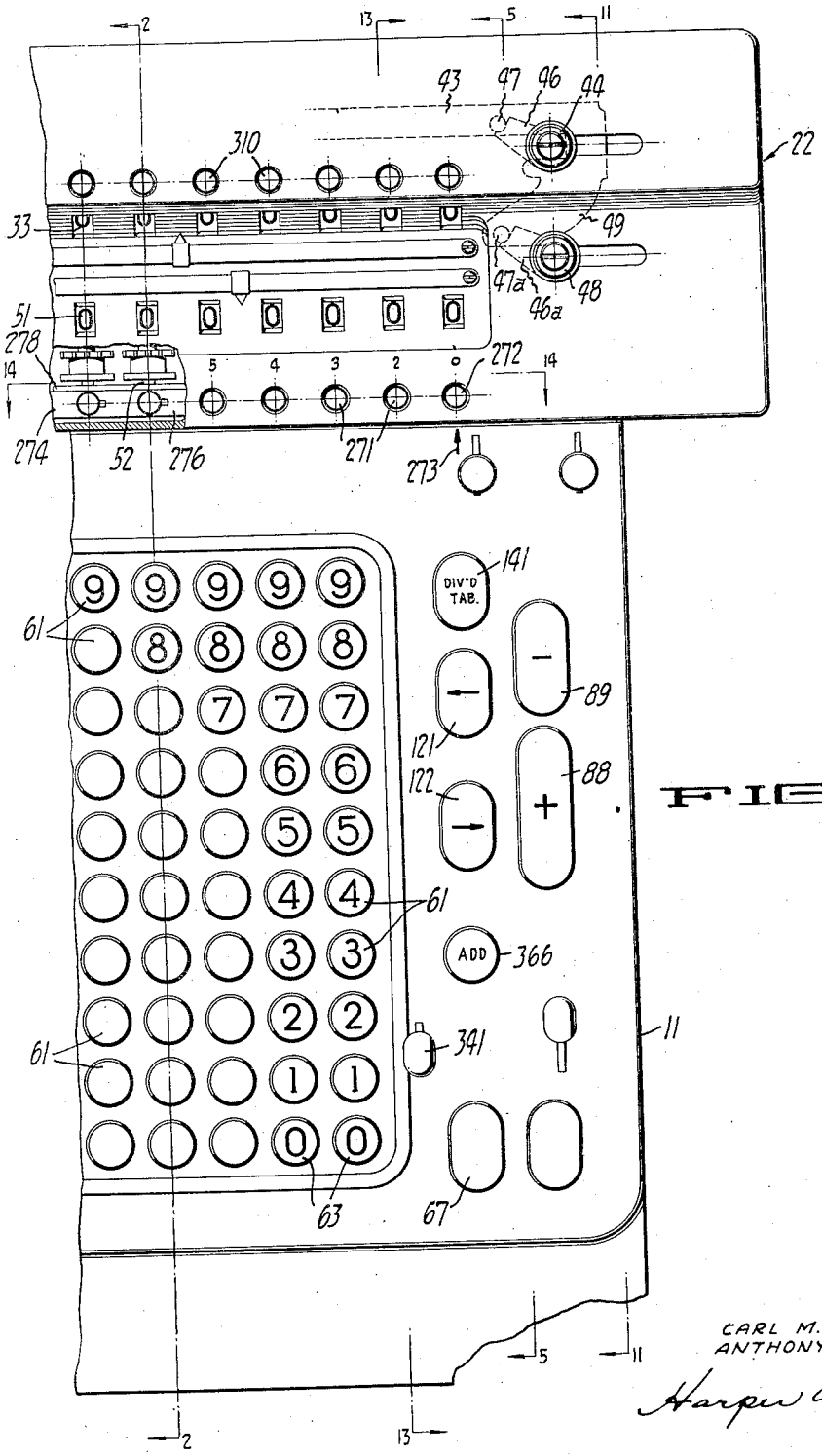

FIG. 1.

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CALCULATING MACHINE

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FIG. 3

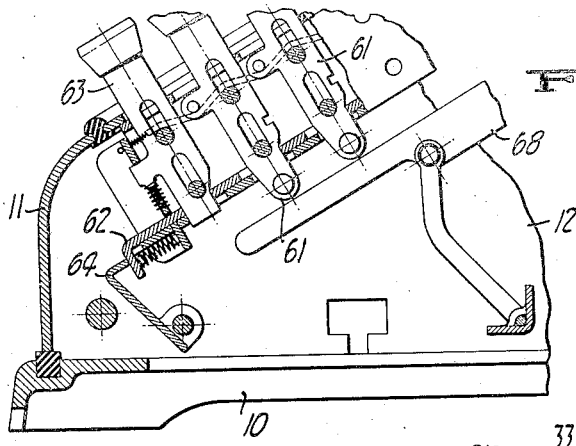

FIG. 2

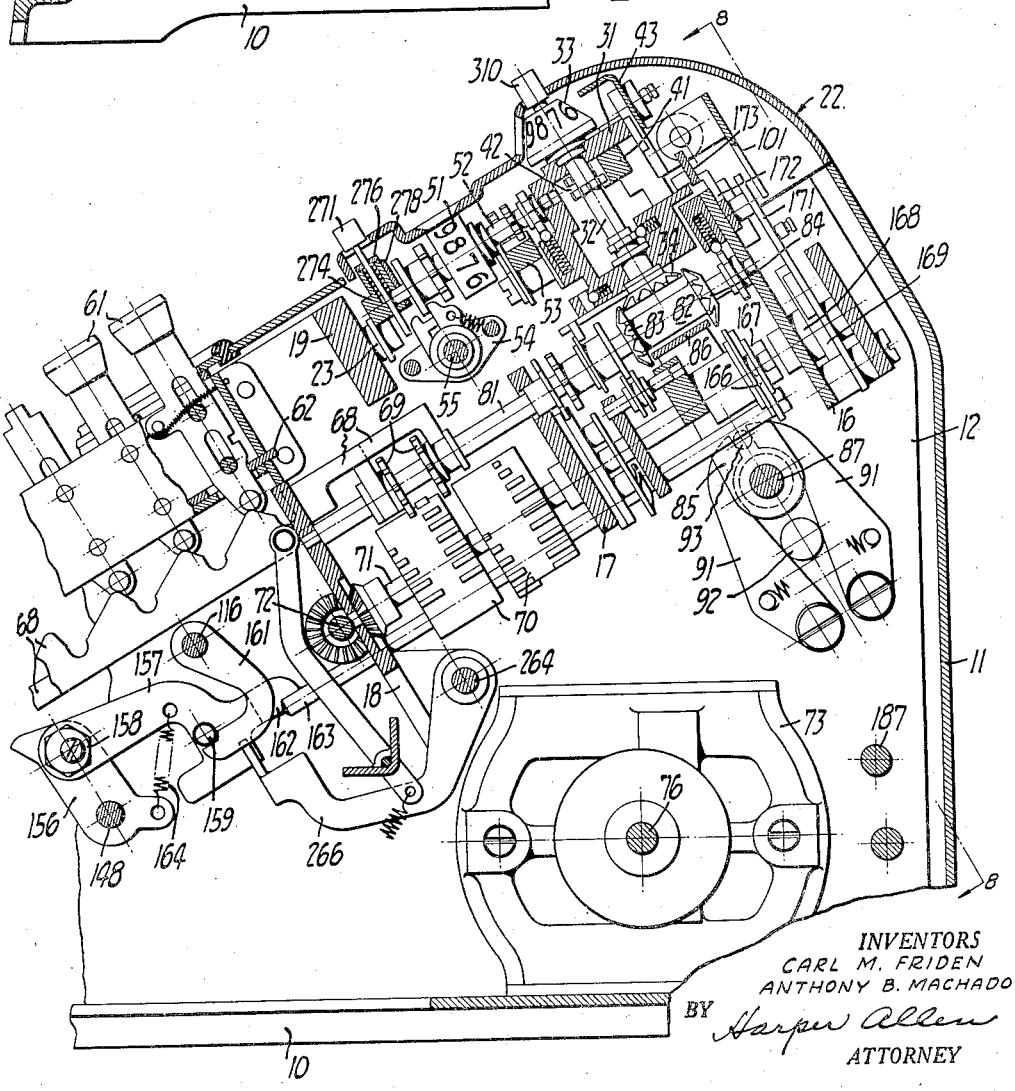

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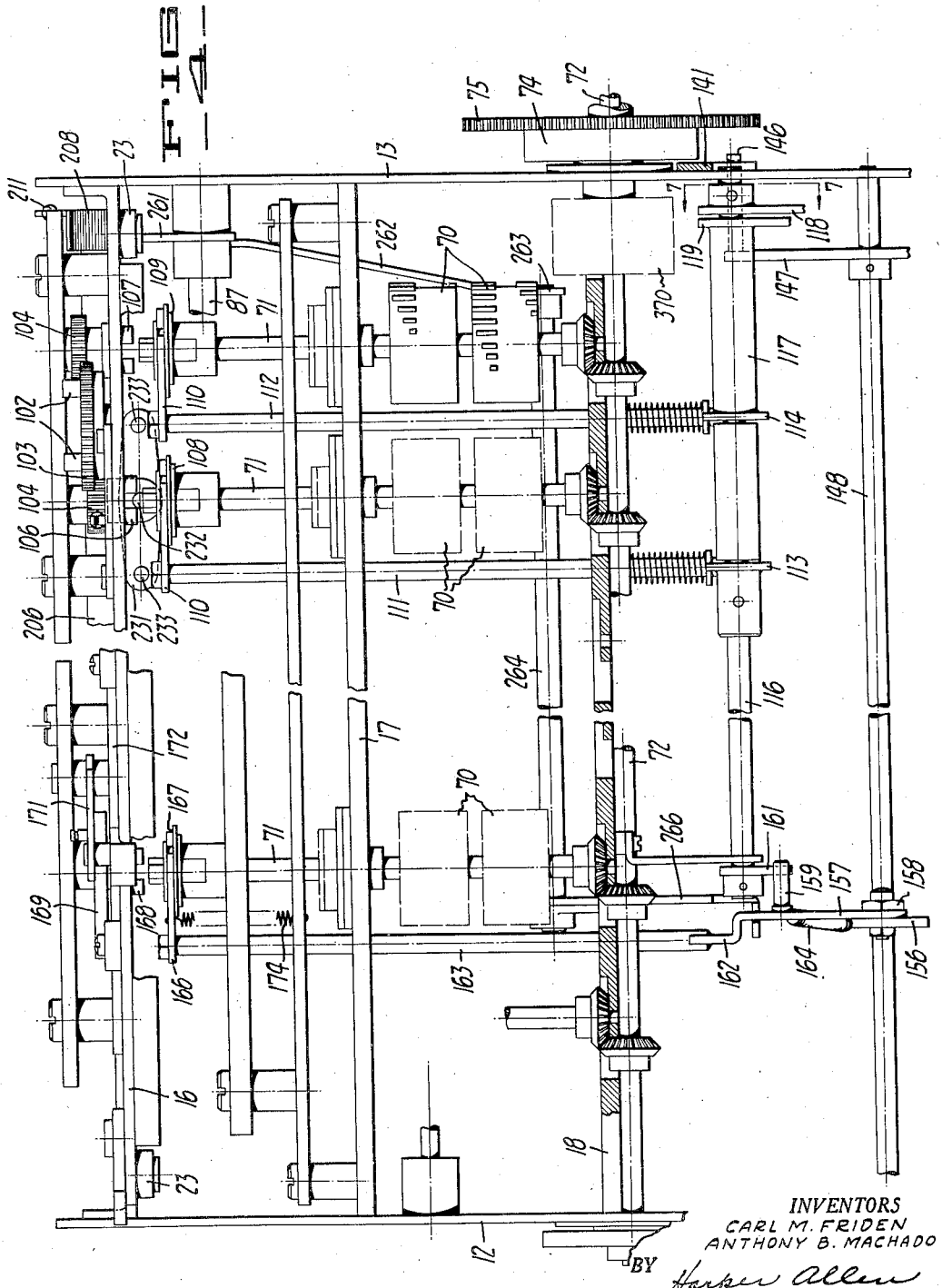
FIG. 4



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CALCULATING MACHINE

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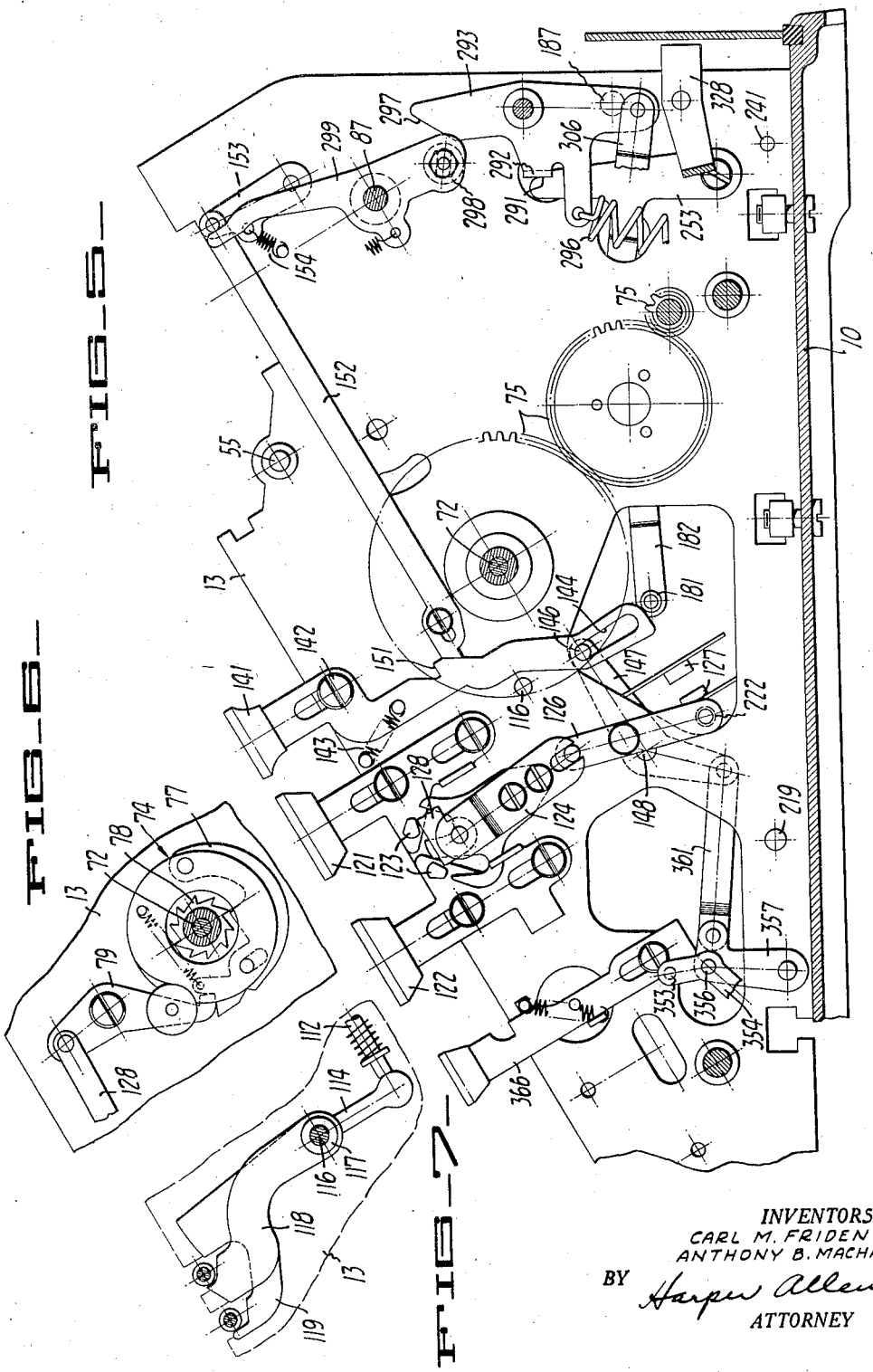

FIG-5

FIG-6

FIG-7

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CALCULATING MACHINE

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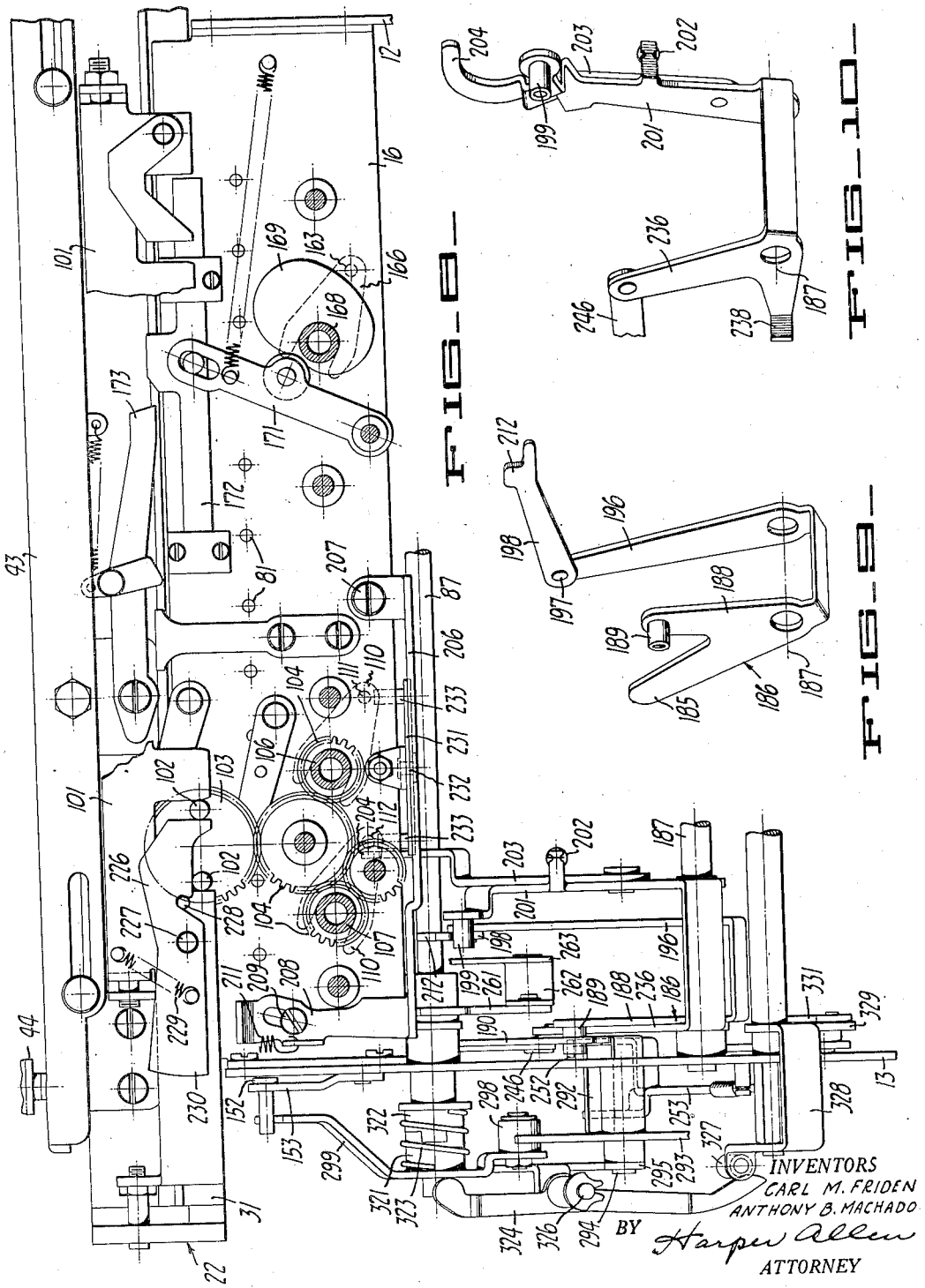

FIG-8

FIG-10

FIG-9

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FIG. 11.

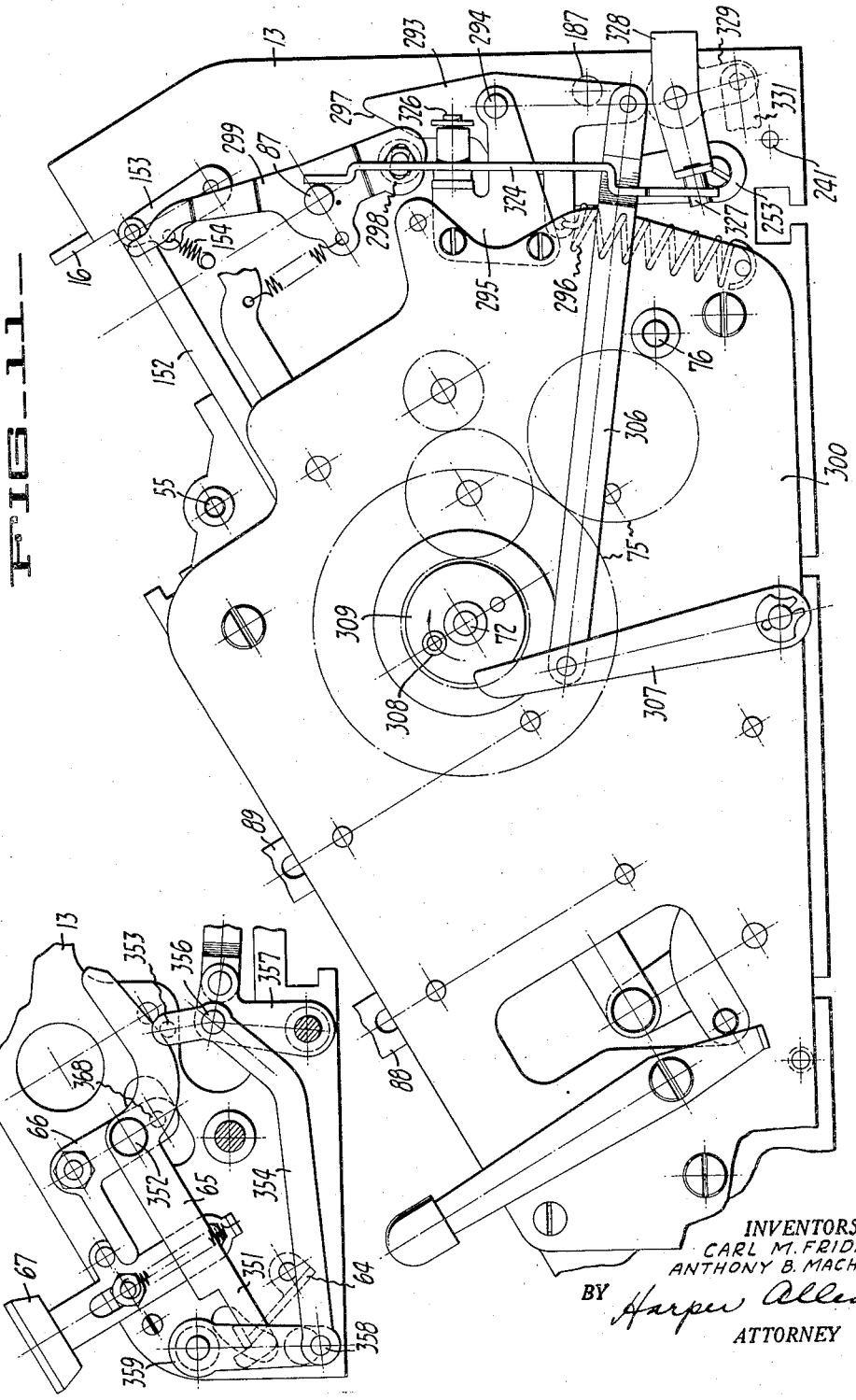

FIG. 12.

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CALCULATING MACHINE

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FIG. 14.

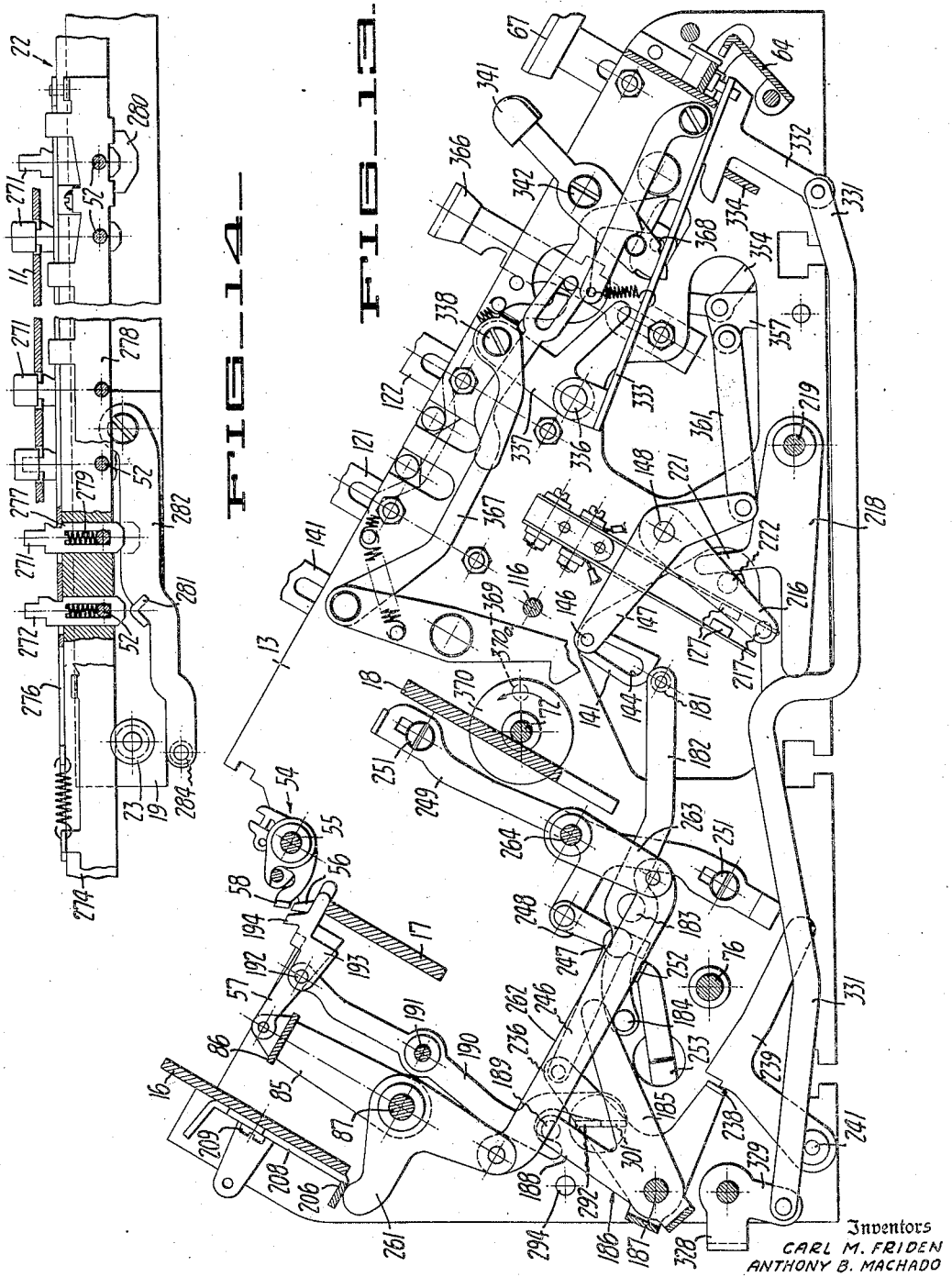

FIG. 13.

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CALCULATING MACHINE

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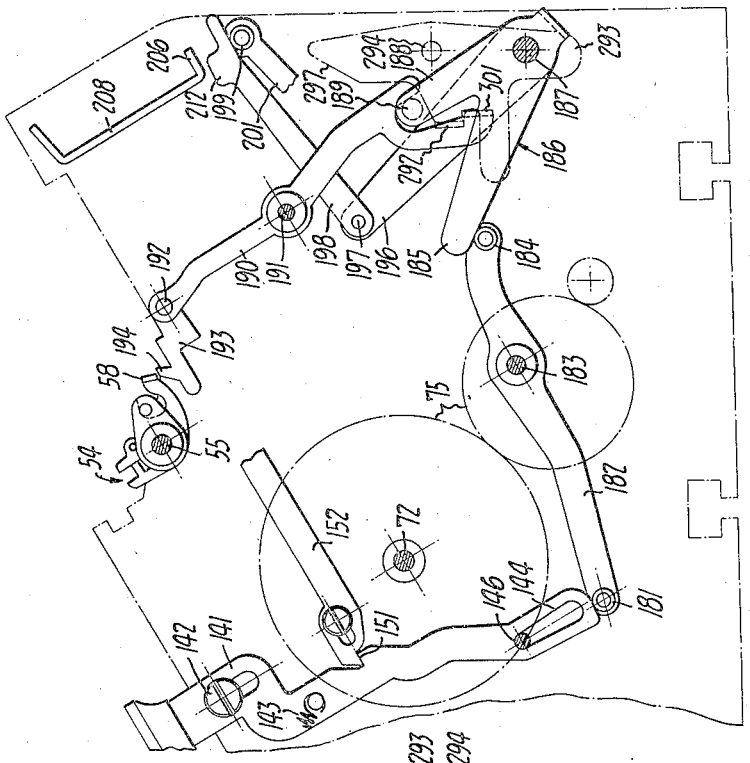

FIG. 16

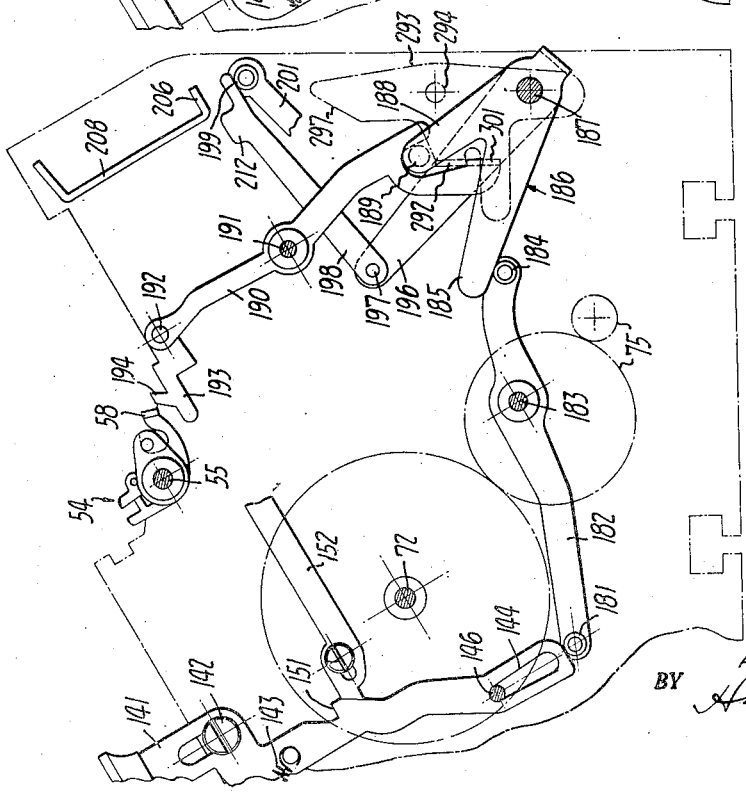

FIG. 15

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CALCULATING MACHINE

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FIG-16-

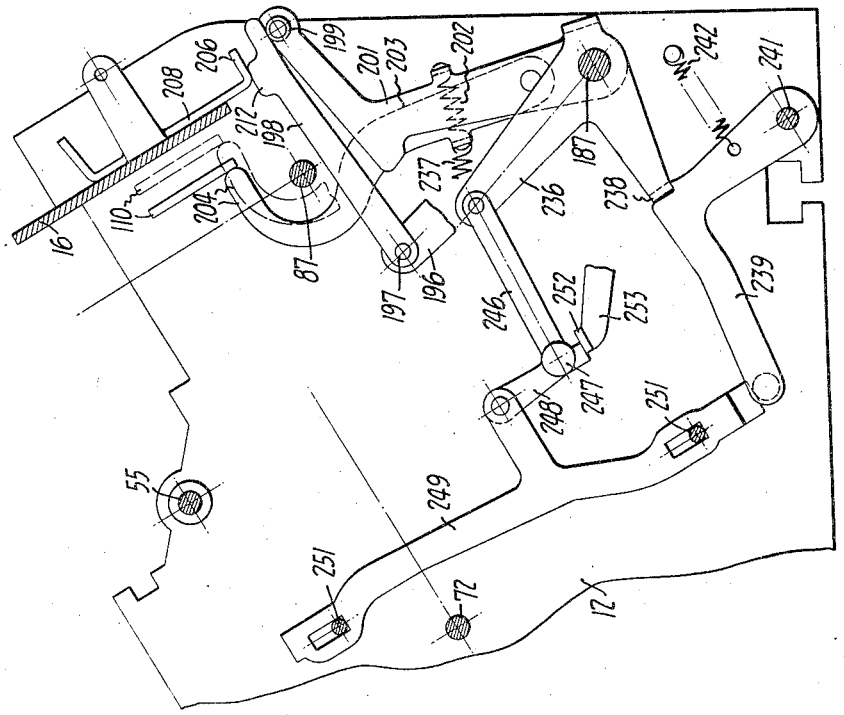
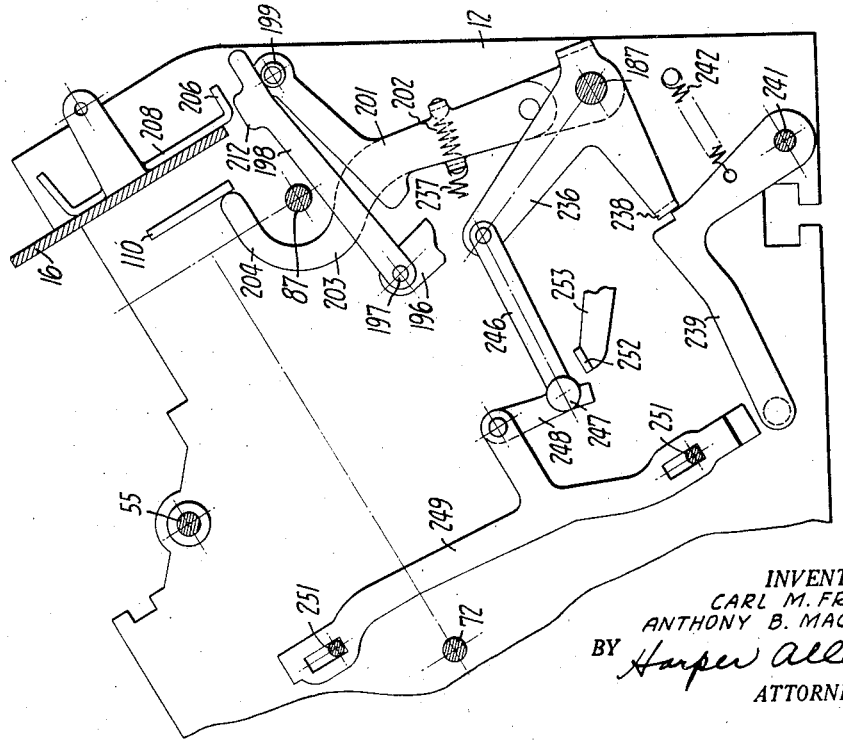


FIG-17-



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CALCULATING MACHINE

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FIG. 20.

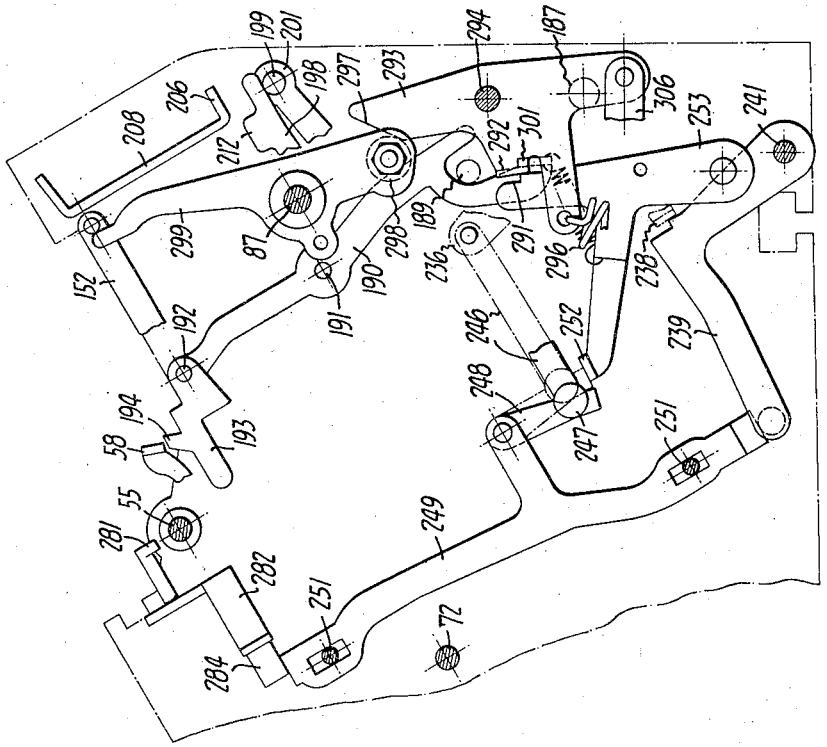
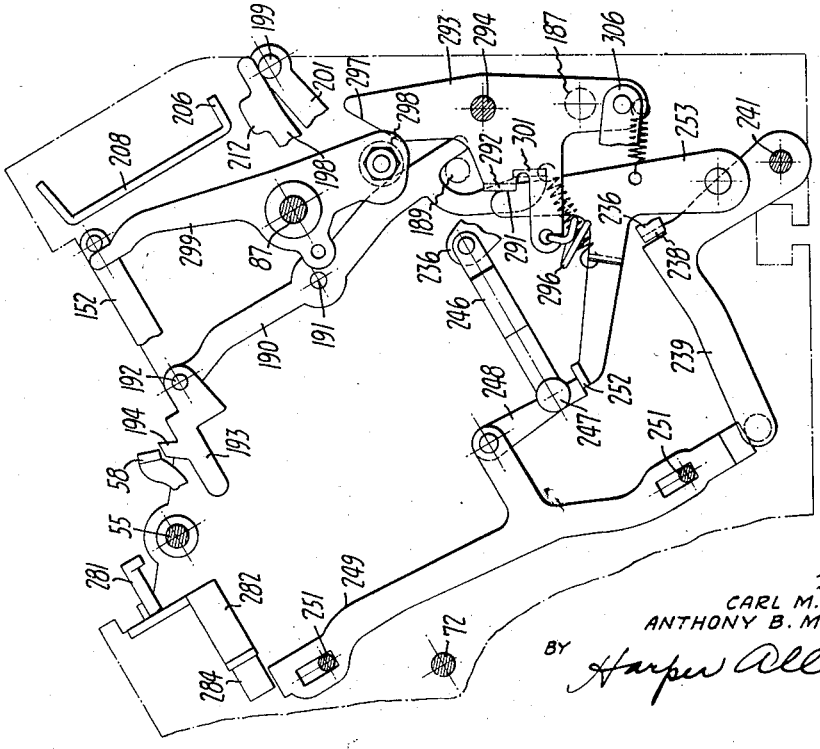


FIG. 19.



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Patented July 2, 1946 2,403,273

UNITED STATES PATENT OFFICE

2,403,273

CALCULATING MACHINE

Carl M. Friden, Pleasanton, and Anthony B. Machado, Oakland, Calif., assignors to Friden Calculating Machine Co., Inc., a corporation of California

Application January 27, 1940, Serial No. 315,986

3 Claims. (Cl. 235—63)

1

This invention relates to calculating machines and is concerned more particularly with the provision of improved automatic control means therefor.

It is a general object of the invention to provide an improved calculating machine having automatic controls.

Another object of the invention is to provide an improved calculating machine with facilitates conditioning of the machine as a preliminary to a calculating operation, such as division.

Another object of the invention is to provide an improved calculating machine which facilitates tabulating of the shiftable carriage to a desired position.

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

Figure 1 is a fragmentary plan view showing the right hand portion of a calculating machine embodying our invention.

Figure 2 is a fragmentary longitudinal sectional view, partly in elevation, illustrating certain features of the mechanism, the view being taken in a plane indicated by the line 2—2 in Figure 1;

Figure 3 is similar to Figure 2 but shows the front end of the keyboard;

Figure 4 is a plan view of a machine with the carriage and keyboard removed and with certain parts omitted for greater clarity;

Figure 5 is an elevational view of the right side frame plate and the control means mounted thereon, the view being partly in section as indicated by the line 5—5 in Figure 1;

Figure 6 is a sectional elevation of the clutch mechanism;

Figure 7 is a fragmentary sectional elevational view taken in a plane indicated by the line 7—7 in Figure 4;

Figure 8 is a rear elevational view of the machine partly in section, the view being indicated by the line 8—8 in Figure 2;

Figure 9 is a detail perspective view of one of the control members;

Figure 10 is a detail perspective view of another of the control members;

Figure 11 is a side elevational view of the machine as indicated by the line 11—11 in Figure 1, with certain parts omitted and others broken away to clarify the view;

Figure 12 is a detail view of certain of the keyboard control mechanism, including the keyboard clear key;

Figure 13 is a sectional elevation of the right

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side frame plate and the parts associated therewith as viewed from the left side, the view being indicated by the line 13—13 in Figure 1;

Figure 14 is a transverse elevational view partly in section, as indicated by the line 14—14 in Figure 1;

Figure 15 is a schematic elevational view of a part of the dividend key control mechanism with the parts in inactive position;

Figure 16 is a view similar to Figure 15 but shows the condition of the parts at the beginning of an operation with the dividend key depressed, but before the operation commences;

Figure 17 is a view similar to Figures 15 and 16, but showing the parts as conditioned during the carriage return operation;

Figure 18 is a view similar to Figures 15 to 17 but showing the parts positioned during the clear or reset cycle at the end of the carriage-return.

Figure 19 is an operation view showing the condition of the parts during a tabulating shift operation; and

Figure 20 is an operation view showing the parts as conditioned for entry of the dividend at the end of the tabulating operation.

The invention is disclosed as embodied in a calculating machine having actuating mechanism of the uni-directional, continuous drive cycle type wherein all power driven operations are effected by engagement and disengagement of a single clutch providing the only path of power flow from the motor of the machine to the motor-driven parts thereof. A calculating machine of this construction is disclosed in the copending application of Carl M. Friden, Serial No. 42,268, filed September 26, 1935 (Patent No. 2,310,281 issued Feb. 9, 1943).

The frame of the machine includes a base 10 (Figs. 2 and 3) on which left and right side frame plates 12 and 13 are mounted within casing 11. Side plates 12 and 13 may be connected by cross brackets 16, 17, 18 and 19 which serve to support various mechanisms of the machine. The register carriage 22 (Figs. 1 and 2) which supports the accumulator and the revolutions counter is mounted on the frame brackets 16 and 19 by rollers 23 for endwise shifting movement laterally of the machine in either direction to various ordinal positions as controlled by means described hereinafter.

Carriage 22 (Fig. 2) includes a frame 31 in which numeral wheel shafts 32 are journaled to carry numeral wheels 33 of conventional construction. Numeral wheels 33 have projecting twirler knobs 310 for manual setting thereof. To

transmit increments of value to numeral wheels 33, each shaft 32 extends below the frame 31 and has a ten-tooth gear 34 which is actuated by means later described.

Accumulator resetting means

Means are provided on the carriage for re-setting the numeral wheels 33 (Fig. 2) to zero registration including means such as a rack bar 41 mounted for endwise sliding movement in the carriage frame adjacent the upper end of the numeral wheel shafts 32 for cooperation with mutilated gears 42 carried by numeral wheel shafts 32. Adjacent gears 42 are actually offset to cooperate with the adjacent vertically offset racks formed on rack bar 41 in the usual manner. When rack bar 41 is moved from its normal position to which it is spring urged in the usual manner, it will engage the gear 42 of a numeral wheel 33 displaced from the zero position and reset the numeral wheel to such position. Rack 41 carries a handle 44 (Figs. 1 and 8) for manual operation and may be connected to an actuating bar 43 for power operation. Bar 43 is suitably mounted for sliding movement on the frame 31 and may be selectively coupled with rack bar 41 by means of interponent arm 46 (Fig. 1) engageable with a pin 47 carried by slide 43 by turning handle 44. This mechanism is disclosed and claimed in the co-pending application of Carl M. Friden, Serial Number 240,269, filed November 14, 1938 (Patent No. 2,294,083 issued Aug. 25, 1942).

Drive, selecting and actuating mechanisms

The values to be introduced into numeral wheels 33 are selected by means of a plurality of banks or orders of settable value keys 61 (Figs. 1 to 3) of conventional construction. Keys 61 are mounted for endwise sliding movement and are adapted to be latched in depressed position by a latching bar 62 associated with each bank of keys 61 and adapted to be operated to release a depressed key by zero key 63 in each order. All of the orders of keys can be released simultaneously by the operation of a key releasing gate 64 extending along the front edge thereof. Gate 64 is operable through link 65 (Fig. 12) and bell-crank 66 by means of keyboard release key 67 in the usual manner.

The keys 61 (Figs. 2 and 3) cooperate with selecting mechanism including spring urged selecting slides 68 mounted for endwise movement to position gears 69 selectively with respect to the stepped teeth of the associated actuating cylinders 70. Cylinders 70 for adjacent orders are mounted on actuating shafts 71 (Figs. 2 and 4) having suitable bevel gear connections with a transverse drive shaft 72 which is suitably journaled in side plates 12 and 13.

Shaft 72 and shafts 71 are driven cyclically from motor 73 through clutch 74 (Figs. 4 and 6) which may be driven by suitable gearing 75 from the motor shaft 76. Clutch 74 may be engaged or disengaged by oscillation of spring urged clutch pawl or dog 77 mounted for rotation with shaft 72 and with respect to ratchet 78 journaled on shaft 72 and driven by gearing 75. Clutch control lever 79 is pivoted on side plate 13 to determine engagement or disengagement of the clutch by releasing or engaging the nose of dog 77 in the full cycle position thereon.

The number of increments transmitted to a gear 69 (Fig. 2) by a cylinder 70 during cyclic operation of the clutch is transmitted to a square shaft 81 which carries each ordinal pair of gears 69 and extends rearwardly of the machine in the usual manner. Each shaft 81 carries a spool 82 having bevel gears 83 and 84 for cooperation with the aligned numeral wheel gear 34.

The engagement of gears 83 and 84 with gears 34 is controlled by strap 86 positioned between the gears and mounted by suitable arms 85 for rocking movement with shaft 87. Thus, rocking of shaft 87 determines transmission of said increments to the numeral wheels and also the direction of entering thereon. Any suitable control means such as plus key 88 (Fig. 1) and minus key 89 may be provided for rocking the shaft 87 to cause positive and negative registration. Shaft 87 may be centralized by a pair of spring urged centralizing arms 91 (Fig. 2) cooperating with a central stop 92 and engaging a pin 93 carried by one of arms 85.

Revolutions counter mechanism

The revolutions counter may comprise numeral wheels 51 (Fig. 2) on shafts 52 which may be re-set to zero by rack bar 53 similar to the rack bar 41 described above. Rack bar 53 carries handle 48 (Fig. 1) for manual operation and may be connected to extension 49 of actuating bar 43 by interponent 46a cooperating with pin 47a.

The numeral wheels 51 (Fig. 2) are actuated by means of a conventional actuator 54 mounted on a shaft 55 which is rocked from drive shaft 72 through a spring connection in a clockwise direction from the position shown in Figure 2 into operative engagement with the aligned numeral wheel 51, and then is translated axially to effect entry of the digit. When no count is to be made, the clockwise rocking movement may be restrained by means of a neutralizing finger 56 (Fig. 13) carried by a slide 57 guided on cross bracket 17 and pivotally connected to plus-minus gate or strap 86 to be controlled thereby. In the central neutral position of strap 86, finger 56 underlies arm 58 of the counter actuator and thereby blocks rocking movement thereof.

Carriage shift mechanism

The carriage can be shifted selectively in either direction by power driven means controlled by manually operable keys, and this mechanism is of conventional construction. Carrage 22 is provided with toothed shift rack 101 (Figs. 2, 4 and 8) along the rear side thereof for cooperation with shift pins 102 on shift gears 103. Shift gear 103 can be rotated in either direction and receives one-half rotation for each rotation of the clutch referred to above. For this purpose the shift gear 103 is connected by suitable gearing 104 to respective gear sleeves 106, 107, the gearing being arranged so that the drive from gear sleeve 106 rotates gear 103 in one direction, and the drive from gear sleeve 107 rotates gear 103 in the other direction. The respective gear sleeves 106, 107 (Fig. 4) are slotted for engagement by toothed collars 108, 109 mounted slidably but non-rotatably on the rearward ends of a pair of adjacent actuating shafts 71.

The sliding movement of collars 108, 109 (Figs. 4 and 8) is controlled through forks 110 by means of spring-urged rods 111, 112 which extend forwardly of the machine and abut similar depending arms 113, 114 carried by shaft 116 and sleeve 117 mounted thereon. Adjacent side plate 13 (Figs. 4 and 7) shaft 116 and sleeve 117 have upstanding arms 118 and 119 operated by suitable rollers on shift keys 121 and 122 so that selec-

tive depression of the keys controls the direction of carriage shifting.

To enable the power drive shift keys 121 and 122 (Fig. 5) have respective pins 123 cooperating with lever 124 operatively connected by lever 126 to control contacts 127 of the motor drive, and connected by link 128 (Figs. 5 and 6) with clutch control lever 79. Thus, on depression of either of keys 121 or 122, the clutch is engaged and the motor circuit enabled.

From the foregoing it is seen that the carriage can be shifted selectively in either direction.

Tabulation and dividend entry

The tabulating and dividend entering mechanism of the instant invention operates to zeroize the registers as a preliminary to a division operation, and to effect entry of the dividend into the accumulator in any selected ordinal position which may be pre-set in accordance with the problem being solved, while suppressing the usual count made in the revolutions counter during entry of a number in the acumulator. After setting of the dividend into the keyboard, the only other operation necessary is the depression of the dividend control means or key, after which the machine automatically operates to perform the above described functions, the desired ordinal position of the carriage upon entry of the dividend having been pre-set in accordance with the number of quotient figures desired, or the desired position of the decimal point in the quotient.

In the embodiment of the invention selected for illustration, the first operation which occurs upon depression of the dividend key is a shifting of the carriage to its leftmost position if displaced therefrom for a power clearance operation.

Dividend key.—Referring to Figures 1 and 5, dividend key 141 is mounted for endwise sliding movement on side plate 13 by means of pin 142 engaging a slot therein. Spring 143 urges key 141 to the raised position shown in Figure 5. The lower end of key 141 is provided with elongated slot 144 which is engaged by pin 146 carried at the end of lever 147 mounted on transverse shaft 148 (Figs. 4 and 5).

Intermediate its ends, key 141 (Fig. 5) is provided with latching face 151 for engagement by the latching end of a latch slide 152 mounted for endwise sliding movement on side plate 13 with its rear end pivotally supported on upstanding pivotally mounted arm 153. Spring 154 is associated with arm 153 to urge slide 152 to latching position. Thus, upon depression of key 141 it is latched in depressed position, and it remains there until the end of the operation when unlatching occurs by means described later.

Depression of key 141 serves to enable a shift of the carriage to the left, to enable a power clearance mechanism, to condition the shift to the right, to block out the counter actuator, and to enable the drive.

The shift of the carriage to the left and the power clearance mechanism for the registers is enabled upon depression of key 141 (Figs. 4 and 5) when the key operates through arm 147 to rock the shaft 148 in a clockwise direction as viewed in Figures 2 and 5. Referring to Figure 2, shaft 148 carries an upstanding arm 156 which is connected to a forwardly extending pusher link 157 by an eccentric pivot 158. Pusher link 157 carries a pin 159 cooperatively related with depending arm 161 secured on transverse shaft 116. Shaft 116, as previously described, carries a depending arm 113 (Figs. 4 and 7) which abuts the end of shift control rod 111 for the shift drive connection to the left. Thus, upon depression of the dividend key the shift drive connection determining shifting to the left will be engaged by the above described linkage.

To enable the power driven re-setting mechanism, pusher link 157 (Figs. 2 and 4) is provided with offset notched end 162 in operative pushing engagement with the end of control rod 163 for the power clearance drive. This engagement is maintained by the tension of spring 164 connected between pusher link 157 and arm 156. As seen in Figure 4, rod 163 extends rearwardly and carries control fork 166 for shiftable drive establishing collar 167 having a slidable but non-rotatable driving engagement with one of the actuating shafts 71, and being toothed for engagement with the slotted hub 168 of cam 169. As seen in Figure 8, cam 169 is operatively related with arm 171 to drive actuating slide 172 for power re-setting, which in the leftmost position of the carriage is operatively related to arm 173 carried by actuating bar 43. The above described mechanism forms part of a conventional power return clearance mechanism as described in said application of Carl M. Friden, Serial No. 240,269 (Patent No. 2,294,083).

From the foregoing it will be seen that upon clockwise oscillation of shaft 148, as viewed in Figure 2, caused by depression of the dividend key, pusher link 157 operates to push rod 163 rearwardly against the tension of spring 174, and to thereby engage the drive connection between collar 167 and hub 168, so that power re-setting will occur when the carriage is in its leftmost position. As described later, this control is disabled at the end of the re-setting operation.

As previously stated, depression of the dividend key 141 also serves to block out the counter actuator and prevent operation thereof, and to condition the shift mechanism for shifting to the right at the end of the return-clear operation.

As seen in Figures 5, 13, and 15, the lower end of dividend key 141 is engaged in its uppermost position with a roller 181 carried by lever 182, pivoted at 183 on side plate 13. Lever 182 carries a roller 184 operatively disposed beneath the forwardly extending arm 185 of a bellcrank 186 pivoted on shaft 187, which is suitably mounted on side plate 13. The movement of bellcrank 186 is utilized to block the counter actuator from operation and also to condition the shift mechanism for shifting the carriage to the right at the end of the return-clear operation.

In order to block out the operation of the counter actuator by movement of the bellcrank 186 (Figs. 13 and 15), the upright arm 188 of the bellcrank 186 carries a pin 189 operatively engaged with lever 190, pivoted at 191 on side plate 13. The upper end of lever 190 is pivotally connected at 192 with blocking slide 193 having projection 194 lying normally out of the path of oscillation of arm 58 of the counter actuator assembly. Clockwise rocking movement of bellcrank 186 operates through lever 190 to move the slide 193 and projection 194 thereof from the position shown in Figure 15 to that shown in Figure 16, where movement of the counter actuator to active position is prevented as previously explained in connection with the neutralizer slide 57.

In order to condition the shifting mechanism for tabulation to the right, arm 196 (Figs. 3, 9 and 15) is formed integrally with bellcrank 186 and is pivotally connected at 197 to a link 198

extending rearwardly and riding on roller 199 on an arm 201 (Figs. 8, 10 and 18) also pivoted on shaft 187. Arm 201 has an arm 203 pivoted thereon and is connected thereto by spring 202 so that arm 203 is biased to move with arm 201. Shift engaging arm 203 has a curved upper end 204 operatively engaged with shift controlling fork 110 of the right hand shifting mechanism. Link 198 is adapted to be disposed between the roller 199 and a lever 206 (Figs. 8 and 15) pivoted at 207 on bracket 16. Upright end 208 of lever 206 has slotted engagement with a stud 209 on bracket 16 and is spring-urged upwardly to spring 211.

In order to establish a driivng relation between the lever 206 and arm 201, link 198 is provided with a raised portion 212 which normally is disposed out of the path of the lever 206, as shown in Figure 15, but is moved into the position shown in Figure 16 upon depression of the dividend key, so that when the lever 206 is subsequently depressed, as later described, arm 201 is rocked to operate through spring 202 (Fig. 17) to place a bias on arm 203 to engage the shift clutch for determining shifting or tabulation to the right as later described.

The dividend key 141 also engages the clutch and enables the motor circuit. It will be recalled that shaft 148 (Fig. 13) is rocked in a counterclockwise direction upon depression of the dividend key, and during such movement a depending arm 216 serves through its pin 217 to rock an arm 218 pivoted at 219 on side plate 13, and having an upstanding finger 221 operatively related with roller 222, carried at the lower end of lever 126 (Figs. 5 and 13). Upon counterclockwise movement of arm 218 (as viewed in Fig. 13), lever 126 (Fig. 5) will be rocked in a counterclockwise direction to close contacts 127, and to operate through lever 124 and link 128 (Figs. 5 and 6) to move clutch control lever 79 from the position shown in Figure 6 to its clutch engaging position out of engagement with the clutch dog 77.

Thus, upon depression of the dividend key 141, the first operation which ensues is a shifting of the carriage to its leftmost position if displaced therefrom, where a clearing or resetting operation is performed on either or both of the accumulator and counter. The clearing of the registers occurs during a cycle of operation with the carriage in its leftmost position, as shown in Figure 8, where one of shift pins 102 is engaged in the endmost tooth space of shift rack 101, which is formed in part by pawl 226, pivoted at 227 on the rack and urged against pin 228 by spring 229. With the carriage in the position shown, shift pin 102 during the clearing cycle, rotating in a clockwise direction serves to oscillate pawl 226 so that its extension 230 strikes end 208 of lever 206, and moves it downwardly, and this movement is utilized to initiate shifting of the carriage to the right to the selected position for entering the dividend.

At the beginning of the clear cycle, the parts are positioned as shown in Figure 17, where interponent arm 198 has its projection 212 disposed between the end 208 of lever 206 and roller 199 on shift conditioning arm 201. Thus, when pawl 226 moves downwardly, lever end 208 is depressed from the position shown in Figure 17 to that shown in Figure 18, when lever 201 operates through spring 202 to place tension on shift engaging arm 203. The movement of shift engaging arm 203 from the position shown in full lines in Figure 18 to that shown in dotted lines is delayed until the end of the cycle by interlock means associated with the shift engaging mechanism.

Referring to Figures 4 and 8, the interlock means comprises lever 231, pivoted at 232 on rear frame bracket 16, and having a pair of upstanding pins 233 spaced from and disposed in the path of respective shift forks 110 carried by rods 111 and 112. As seen in Figure 4, when one shift fork is moved rearwardly to engage the corresponding shift drive connection, the opposite pin 233 moves into blocking engagement with the other shift fork 110 to prevent operative movement thereof until the other shift drive is disengaged. Inasmuch as the shift drive for determining shifting to the left remains engaged until rocking of pawl 226 during the clear cycle, initiation of the shift to the right by movement of shift rod 112 by the hooked end 204 of arm 203 cannot occur until the end of the re-setting cycle.

During the resetting cycle, certain other conditionings are effected in the machine. As seen in Figures 8, 10 and 17, arm 201 has integrally formed therewith a bellcrank 236 and both arm 201 and bellcrank 236 are urged to the position shown in Figure 17 by spring 237 attached to arm 201 and to the frame. The movement of the bellcrank 236 with arm 201 from the position shown in Figure 17 to that shown in Figure 18 is utilized to condition the control for entering the dividend at the end of the shifting operation to the right, and for maintaining the shift engaged until the selected tabulated position is reached.

To latch the bellcrank 236 and arm 201 in the position shown in Figure 18, the lower horizontal arm of bellcrank 236 is provided with laterally extending ear 238 adapted for engagement with a seat in a latch lever 239, pivoted at 241 on side plate 13, and urged in a clockwise direction by spring 242. As shown in Figure 18, upon clockwise movement of arm 201 and bellcrank 236, they are latched in position by latch lever 239.

The movement of bellcrank 236 also serves to condition means for engaging the plus-minus gears to enter the dividend at the end of the shift operation. For this purpose the upper arm of bellcrank 236 is pivotally connected to a link 246, which is pivotally connected at 247 with a depending arm 248 pivoted to an actuating slide 249 mounted for vertical sliding movement on side plate 13, by slotted engagement with respective pins 251. As shown in Figure 17, depending arm 248 is normally to one side of an ear 252 of a latching bellcrank 253 which serves to determine engagement of the plus-minus gears for entry of the dividend. As shown in Figures 18 and 19, arm 248 is operatively related to ear 252 so that downward movement of slide 249 will release latch lever 253 as later described.

The movement of lever 206 and end 208 thereof during the re-setting operation also determines release of the shift connection determining shifting to the left. For this purpose bellcrank 261 (Fig. 13) is pivoted on shaft 87 and has one arm disposed beneath end 208 of lever 206. The depending arm of bellcrank 261 is pivotally connected to link 262, having its forward end pivotally connected to depending arm 263 secured on transverse shaft 264 (Figs. 4 and 13). Shaft 264 (Figs. 2 and 4) carries an arm 266 which is slotted at its offset end to receive pusher link 157. Thus, counter-clockwise movement of the bellcrank 261,

as viewed in Figure 13, moves link 262 forwardly to rock shaft 264 in a counter-clockwise direction (in a clockwise direction as viewed in Figure 2) so that arm 267 lifts pusher link 157 against the urgency of spring 164 to move end 162 thereof out of engagement with push rod 163 for the clear mechanism, and to disengage pin 159 from arm 161 of the control means for determining shifting to the left. In this manner, both the shift connection for left hand shifting and the drive connection for resetting are disabled during the cycle performing the resetting operation so that they can be disengaged near the end of such cycle.

Tabulation control

It will be recalled that when the right hand shift mechanism is acting as shown in Figure 18 by the dotted line position of shift control fork 116, the control linkage therefor is latched in operative position by the engagement of latch 239 with bellcrank 236, and also that arm 248 carried by actuating slide 249 is in operative position to release bellcrank 252. A tabulation control is provided for effecting this release selectively in any shifted position of the carriage, so that the dividend will be entered in such position. Alternatively, as later deescribed, the carriage may be tabulated to the selected position, without entry of the dividend.

As seen in Figures 1, 2 and 14, the carriage 22 is provided with a series of tabulator keys 271, numbered 0 and 2 to 10 in accordance with the position of the carriage. In the first or leftmost position of the carriage zero tabulator key 272 is aligned with arrow 273 on the casing of the machine. Tabulator keys 271, 272 (Figs. 2 and 14) are mounted for vertical endwise movement in broached slots in carriage frame bar 274, and keys 271 can be latched in depressed position by spring urged latching slide 276, which is adapted to engage over the tooth 277 of a depressed key. Zero key 272 provides a release key for any depressed key 271 which it may be desired to release in changing the setting of the machine to cause positioning of the carriage in its rightmost position. In alignment with the "10" key 271 (Fig. 14) a beveled fixed cam 280 is provided which operates arm 282 irrespective of the depression of "10" key 271. Thus, "10" key 271 is a dummy key provided merely for the operator's convenience. Latching slide 276 is maintained in position in the frame bar 274 by retaining bracket 278. Keys 271 and 272 are urged to their raised positions by respective springs 279 associated therewith.

A depressed key 271, as indicated in dotted lines in Figure 14, is adapted to engage a V-shaped laterally extending ear 281 of an arm 282, pivoted at 283 on frame bracket 19. As shown in Figure 14, in the leftmost position of the carriage, release key 272 is aligned with the extension 281, and correspondingly if the carriage is displaced one or more ordinal spaces from its leftmost position, the corresponding key 271 will engage the nose 281 and depress the arm 282. Adjacent its end, arm 282 (Figs. 14 and 18) carries roller 284 which is disposed above the upper end of actuating slide 249. Thus, when the carriage shifts into a predetermined position, the actuating slide 249 is operated to move latch 239 from the position shown in Fig. 19 to that shown in Fig. 20, to release bellcrank 236 and arm 201 and thereby permit disengagement of the shift mechanism for shifting the carriage to the right. This operation will occur toward the end of the last shift cycle.

The downward movement of actuating slide 249 as the carriage enters its selected position also serves to release spring actuated means for meshing the plus-minus gears, and for releasing the dividend key. The downward movement of slide 249 (Figure 19) acts through interponent arm 248 to rock latching bellcrank 252 in a counter-clockwise direction and thereby move its latching notch 291 out of the path of offset ear 292 of a bellcrank 293, pivoted on pin 294 extending between side plate 13 and bracket 295 on plate 300 (Figs. 8 and 11). Bellcrank 294 is urged in a counter-clockwise direction by a relatively strong spring 296 (Figs. 11, 19 and 20), and has its upper end formed as a cam nose 297 for operative engagement with a roller 298, carried at the lower end of a lever 299, secured on shaft 87. As seen in Figure 19, the cam nose 297 of bellcrank 293 is spaced from roller 298 in the neutral positions thereof to permit normal movement of shaft 87 and lever 299 therewith during registration of a negative character. Upon release of bellcrank 293, cam nose 297 becomes effective as shown in Figure 20 to rock lever 299 and shaft 87 in a clockwise direction, and thereby mesh gears 83 with the numeral wheel gears 34 (Fig. 2) to determine a positive registration therein during the dividend entering cycle, when the amount set up in the keyboard will be entered as the dividend in the selected tabulated position of the carriage.

Movement of lever 299 also serves to actuate latch slide 152 (Fig. 5) and thereby release the dividend key. It will be recalled that the dividend key serves to hold counter blocking slide in active position, and means is brought into play to prevent movement of counter blocking slide 192 out of active position when the key is released. For this purpose the offset ear 292 (Fig. 20) of bellcrank 293 moves downwardly in front of offset ear 301 on lever 190, and maintains slide 193 in the position shown in Figure 20 during entering of the dividend.

The movement of bellcrank 293 which initiates the dividend entering operation also enables means for restoring such bellcrank to inoperative position. As shown in Figure 11, the lower end of bellcrank 293 is connected by link 306 with an arm 307 pivoted on plate 300 and having its upper end normally disposed out of the path of a roller 308, carried by a disc 309 on the end of transverse shaft 72. However, counter-clockwise movement of bellcrank 293 serves through link 306 to move arm 307 into the path of roller 308, so that near the end of the dividend entering cycle of operation after entry of the dividend into the accumulator, roller 308 rocks arm 307, and through link 306 oscillates bellcrank 293 in a clockwise direction so that latch 252 can again move to active position as shown in Figure 19. The return of bellcrank 293 also moves tooth 292 thereof out of engagement with tooth 301 so that lever 190 and link 193 can return to inactive position, as shown in Figure 15. Lever 190 and link 193 are returned to their Figure 15 position by gravity action. If desired, a suitable spring may be employed to aid in such return.

Tabulation without dividend entering

If desired, a control may be set whereby the carriage may be tabulated to a selected position

without entering of the dividend, for example, if the amount set in the keyboard is to be used as a constant divisor and the dividend is set in the accumulator by means of twirlers 310. As seen in Figure 8, lever 299 is not directly secured to shaft 87, but is provided with a hub 321 having a clutch connection with a second clutch element 322 secured on shaft 87. Clutch elements 321 and 322 are normally urged apart by spring 323, but are held in engaged position by the lever 324, pivoted at 326 to bracket 295. The lower end of lever 324 is held in the position shown by roller 327 on double arm lever 328 (Figs. 8 and 11) pivoted on side plate 13, and having depending arm 329 pivotally connected to forwardly extending link 331 (Figures 8 and 13).

As seen in Figure 13, link 331 is pivoted to downwardly extending arm 332 of the slide 333, supported on cross brace 334, and pivoted at 335 to depending arm 337, pivoted at 338 on the side plate 13. Slide 333 is controlled by keyboard lock lever 341, pivoted at 342 on side plate 13. Keyboard lever 341 is shown in its unloacking position in Figure 13, but as moved therefrom operates through slide 333, arm 332 thereof, link 331, and double lever 329 to move roller 327 (Fig. 8) upwardly and allow lever 324 to move outwardly and disengage clutch hub 321 on the corresponding clutch member 322 under the influence of spring 333 so that oscillation of lever 299 no longer oscillates shaft 87. At the same time, however, arm 299 remains in engagement with the cam nose 297 of bellcrank 293 to insure release of the dividend key. Arm 299 (Figure 11) being secured on shaft 87 controlling the action of the plus-minus gears is returned to its inactive position at the end of the operation by the centralizer members 91 for the plus-minus gears as shown in Figure 2.

If desired, the amount keys may be released at the end of the dividend entering cycle. Key-releasing gate 64 (Fig. 12) has its end engaged by notched end 351 of lever 65 pivoted at 352 on bellcrank 66 and spring urged to the position shown. The forward end of lever 65 is engaged by pin 353 on lever 354 pivoted at 356 to arm 357 and at 358 to arm 359. Arm 357 is also pivotally connected to link 361 which extends rearwardly and laterally through an opening in side plate 13 (Fig. 13) for pivotal connection to lever 147. Thus, when key 141 is depressed the linkage described operates to depress the forward end 351 (Fig. 12) of lever 65 and disengage it from bail 64. Thus, the keyboard will not be released until key 141 is unlatched. This control is operative only when "add" key 366 is depressed to engage link 367 with pin 368 on bellcrank 66, link 367 being operated in the usual manner from arm 369 and pin 370a (Figure 13) on drum 370.

Operation.—The operation of the dividend entering and tabulating mechanism will be reviewed briefly. The machine is conditioned by setting the amount keys 61 to the dividend value to be entered in the accumulator, and by determining the point of entry of the amount set therein by depressing the selected tabulating control key 271. Thereafter the dividend tabulating key 141 (Figs. 1, 5, and 15) is depressed.

As previously stated the depression of key 141 serves to enable the shift mechanism for a left-hand carriage shifting, to enable the power clearance mechanism, to condition the right hand shift mechanism, to block out the counter actuator, and to enable the drive mechanism.

Upon depression of the key 141, the key operates through arm 147 and shaft 148 (Figs. 2 and 5) to move pusher link 157 rearwardly and thereby move control rod 163 for the power clearance mechanism rearwardly to enable the drive connection for the resetting mechanism. Pusher link 157 also carries pin 159 which works through arms 161 and shaft 116, having arm 114 operatively related to shift control rod 111 for the left hand shift drive connection thereby enabling this connection.

To block out the counter actuator, key 141 (Figs. 15 and 16) operates through lever 182 to rock bellcrank 186, having pin 189 operatively related to lever 190. Lever 190 is connected to blocking slide 193 and moves it underneath the offset ear 58 of the counter actuator and thereby blocks movement of the actuator to active position. At the same time, arm 196 is rocked to move interponent arm 198 between roller 199 and end 208 of lever 206 to enable the right hand shift mechanism, whose initiation however is delayed until the end of the left-hand shifting and clearing cycles.

To engage the clutch and enable the circuit for the motor, shaft 148 which is rocked upon depression of key 141 operates through arm 216 (Fig. 13) and arm 218 to rock lever 126 to close the contact 127 and to operate through lever 124 and link 128 to move clutch control lever 79 to clutch engaging position.

When the drive begins, shift gear 102 (Fig. 8) operates to shift the carriage to the right as viewed in Figure 8, that is to its leftmost position as viewed from the front of the machine, and when it reaches this position the resetting actuating slide 172 becomes active with respect to arm 173 to operate resetting actuator slide 43, and thereby reset the accumulator and the revolutions counter to zero. During this cycle, pawl 226 is rocked to depress end 208 of lever 206 and thereby determine shifting to the right to the tabulated position.

Thus, end 208 of lever 206 is moved from the position shown in Figure 17 to that shown in Figure 18 during the resetting cycle to condition the right hand shift mechanism by depressing arm 201 and tensioning spring 202 to place a bias on shift engaging arm 203. At the end of the resetting cycle, spring 202 becomes effective to move arm 204 and shift fork 110 from the full line position in Figure 18 to the dotted line position and thereby to engage the right hand shift mechanism.

The parts are latched in the position shown in Figure 18 by the engagement of latch 239 with ear 238 of bellcrank 236 formed integrally with arm 201. This movement also serves to position interponent arm 248 over ear 252 of lever 253 to condition the dividend entering mechanism.

To release the left hand shift and resetting drive connections lever 206 operates through bellcrank 261, link 262, arm 263 and shaft 264 (Figs. 4 and 13) and arm 266 thereon (Fig. 2) to lift pusher link 157. This enables withdrawal of the resetting and shift control rods controlled by the pusher link 157.

The right hand shifting operation, therefore, follows the shifting to the leftmost end position and the clearing cycle in that position. The right hand shift continues until the position determined by the depressed tabulation control key 271. When the carriage enters the position de-

termined by the depressed key 271, such key strikes cam nose 281 of arm 282 to depress the same and thereby move actuating slide 249 from the position shown in Figure 19 to that shown in Figure 20.

Movement of actuating slide 249 moves latch arm 239 to inactive position to allow the right hand shift mechanism to be disengaged and also through interponent arm 248 releases latch 252 for the dividend entering control bellcrank 293. Bellcrank 293 moves under the influence of its spring 296 to rock arm 299 and shaft 87 to mesh the plus gears with the numeral wheel gears and thereby determine entry of the value set in the keyboard. At the same time offset ear 292 on bellcrank 293 moves in front of ear 301 on arm 190 to maintain blocking slide 193 in active blocking position with respect to the counter actuator. Rocking of lever 299 also moves latch slide 152 for the dividend key to determine release thereof at the beginning of the dividend entering cycle so that at the end of this cycle the machine will stop.

From the foregoing description it is seen that upon depression of the dividend key the first operation is to shift the carriage to its leftmost position for a resetting or clearing operation and then to shift the carriage back to the right to the selected position for entering the amount set in the keyboard.

If desired, the keyboard can be cleared at the end of the dividend entering cycle by depressing the "Add" key 366 (Fig. 13) so that link 367 will reciprocate once each cycle, but cannot become effective until the last cycle when the release of key 141 allows lever 65 to move back to the position shown in Figure 12 to rock key releasing bail 64 after the dividend entering cycle.

If it is desired merely to clear the register and to set the carriage in a predetermined position, as for example in using a constant divisor, this may be effected by setting keyboard lock lever 341 to its locking position. In this way the divisor value is locked in the keyboard, and the clutch connection 321, 322 (Fig. 8), is disengaged so that the rocking of lever 299 does not move the plus gears to active position. The dividend value is set in the accumulator by twirlers 310 on the numeral wheels thereof.

We claim:

1. In a calculating machine having an accumulator, actuating means therefor, selecting mechanism, numeral keys for setting said selecting mechanism, a revolutions counter, a counter actuator, means for shifting said accumulator, and resetting means for said accumulator; an operation key, means controlled by said key for effecting a combined operation of said shifting and resetting means to first position said accumulator in an end position and to then cause resetting thereof, means brought into play by said shifting and resetting effecting means for thereafter causing entry of a dividend value into said accumulator, and means controlled by said key preventing entry of a count in the counter during the dividend entering operation.

2. In a calculating machine having an ordinally shiftable accumulator, actuating means for said accumulator, means for selectively shifting said accumulator in either direction, a revolutions counter, a counter actuator; and resetting means for said accumulator and said counter; a manually operable key, means controlled by said key for effecting a combined operation of said shifting and resetting means to cause positioning of said accumulator in an end position and to cause resetting of said accumulator, means controlled by said key and brought into play at the end of the resetting operation for tabulating said accumulator by operation of said shifting means from said end position to any selected one of a plurality of ordinal positions, means controlled by said key and brought into operation with said accumulator in said selected ordinal position for entering a dividend value in said accumulator, and means also controlled by said key for preventing entry of a count in the counter during said dividend entering operation.

3. In a calculating machine having an ordinally shiftable accumulator, actuating means for said accumulator, means for selectively shifting said accumulator in either direction, a revolutions counter, a counter actuator yieldably urged to active position, and resetting means for said accumulator and said counter; a manually operable key, means controlled by said key for effecting a combined operation of said shifting and resetting means to cause positioning of said accumulator in an end position and to cause resetting of said accumulator, means controlled by said key and brought into play at the end of the resetting operation for tabulating said accumulator by operation of said shifting means from said end position to any selected one of a plurality of ordinal positions, means controlled by said key and brought into operation with said accumulator in said selected ordinal position for entering a dividend value in said accumulator, and a blocking element positioned by said key to cause yielding of said actuator and thereby suppress entry of a count in the counter during said dividend entering operation.

4. In a calculating machine having an ordinally shiftable accumulator, actuating means for said accumulator, resetting means for said accumulator, and means for selectively shifting said accumulator in either direction; a manually operable dividend entry key, means controlled by said key for causing operation of said shifting means to position said accumulator in an end position thereof, means enabled by said key and operative with said accumulator in said end position for causing operation of said resetting means, means conditioned by said key and brought into play at the end of the resetting operation for causing shifting of said accumulator in the opposite direction to any one of a plurality of selected ordinal positions for dividend entry, and means controlled by said accumulator upon shifting thereof to said selected ordinal position for rendering said actuating means effective to cause entry of a value in said accumulator.

5. In a calculating machine having an ordinally shiftable accumulator, actuating means for said accumulator, resetting means for said accumulator, and means for selectively shifting said accumulator in either direction; a manually operable dividend entry key, means controlled by said key for enabling shifting of said accumulator in one direction to an end position thereof, means enabled by said key and operative with said accumulator in said end position for causing operation of said resetting means, means conditioned by said key and brought into play at the end of the resetting operation for causing shifting of said accumulator in the opposite direction to any one of a plurality of selected ordinal positions for dividend entry, power-operated normally restrained means for rendering said actuating means effective, and means controlled by

said accumulator upon shifting thereof to said selected ordinal position for releasing said normally restrained means.

6. In a calculating machine having an ordinally shiftable accumulator, actuating means therefor, and selecting means including keys; a dividend entry control key, means controlled by said key for effecting resetting of said accumulator and for causing shifting of said accumulator to a selected ordinal position, means controlled by said key and brought into play with said accumulator in said selected position for effecting operation of said actuating means to enter a value in said accumulator, means for locking depressed keys in depressed position, and means controlled by said locking means for disabling said operation effecting means whereby with said locking means active said accumulator is reset and shifted to the desired selected position without entry of a value therein.

7. In a calculating machine having an accumulator, actuating means therefor, selecting mechanism, numeral keys for setting said selecting mechanism, means for shifting said accumulator, and resetting means for said accumulator; and operation key, means controlled by said key for effecting a combined operation of said shifting and resetting means to first position said accumulator in an end position and then cause resetting thereof, means brought into play by said shifting and resetting effecting means for thereafter causing entry of a dividend value into said accumulator, and means including a manually settable member for rendering said dividend entry causing means ineffective.

8. In a calculating machine having an accumulator, actuating means therefor, selecting mechanism, numeral keys for setting said selecting mechanism, means for shifting said accumulator, and resetting means for said accumulator; an operation key, means controlled by said key for effecting a combined operation of said shifting and resetting means to first position said accumulator in an end position and then cause resetting thereof, means brought into play by said shifting and resetting effecting means for thereafter causing entry of a dividend value into said accumulator, means including a manually settable member for rendering said dividend entry causing means ineffective, and locking means for said numeral keys controlled by said settable member.

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