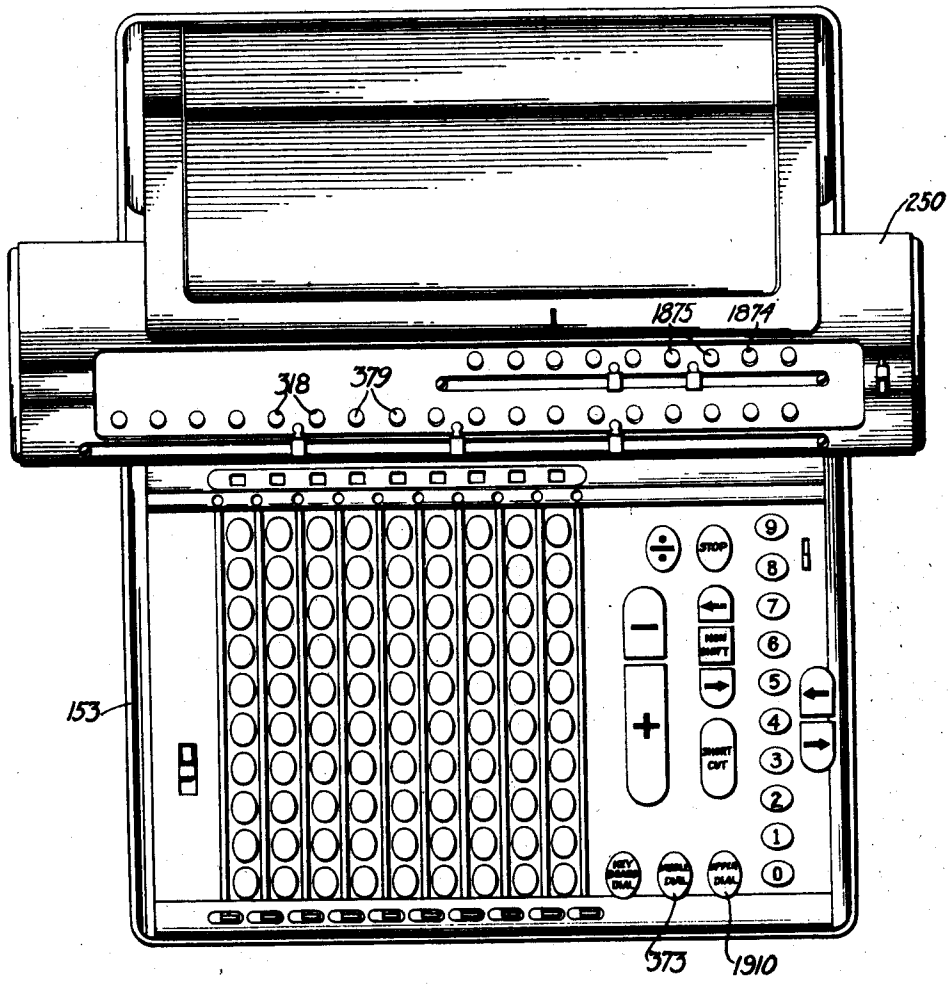
Sept. 8, 1942. H. T. AVERY 2,294,949

CALCULATING MACHINE

Original Filed Jan. 22, 1940 7 Sheets-Sheet 1

FIG. 1.



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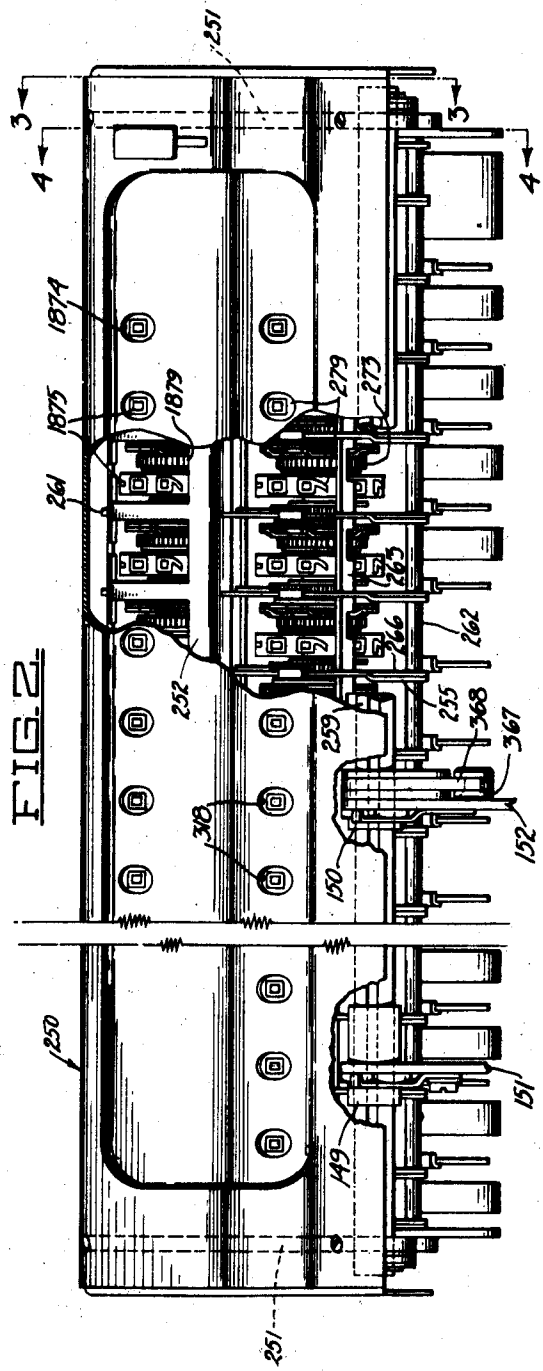
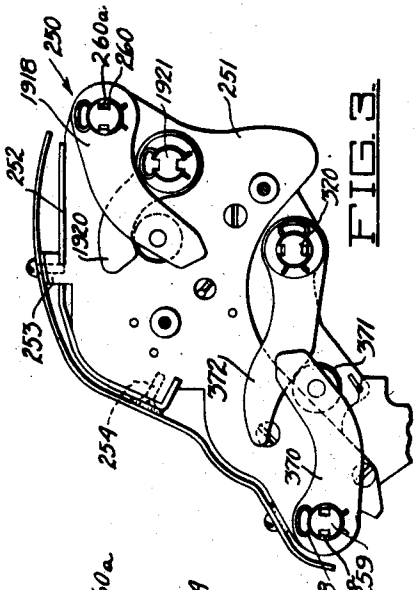
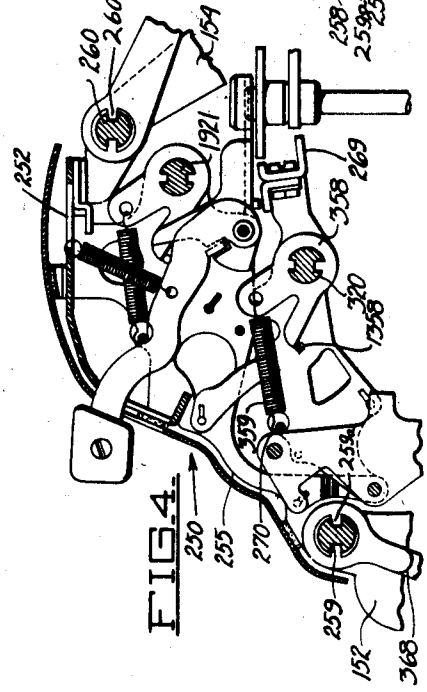
Sept. 8, 1942. H. T. AVERY 2,294,949

CALCULATING MACHINE

Original Filed Jan. 22, 1940 7 Sheets-Sheet 2







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Sept. 8, 1942. H. T. AVERY 2,294,949

CALCULATING MACHINE

Original Filed Jan. 22, 1940 7 Sheets-Sheet 3

FIG. 5.

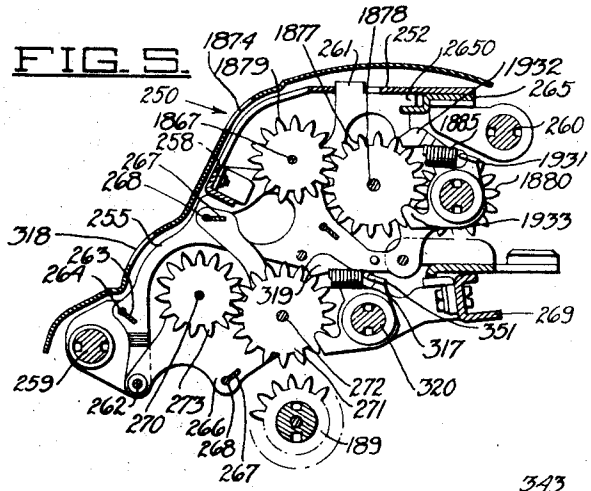


FIG. 6.

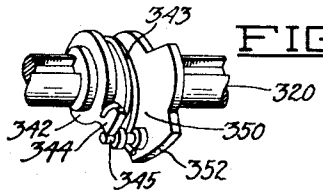
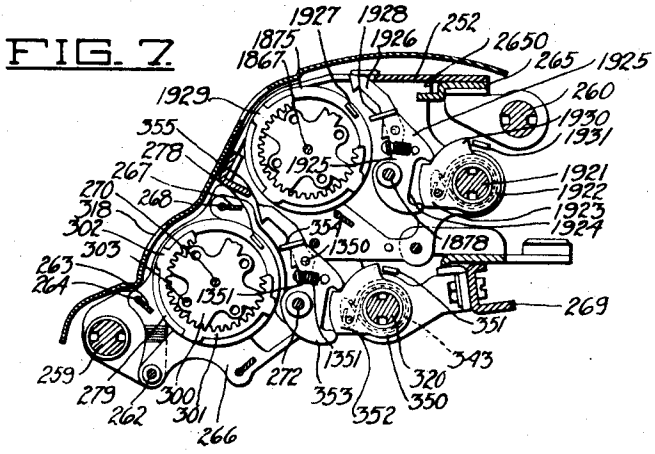


FIG. 7.



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CALCULATING MACHINE

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FIG. 8

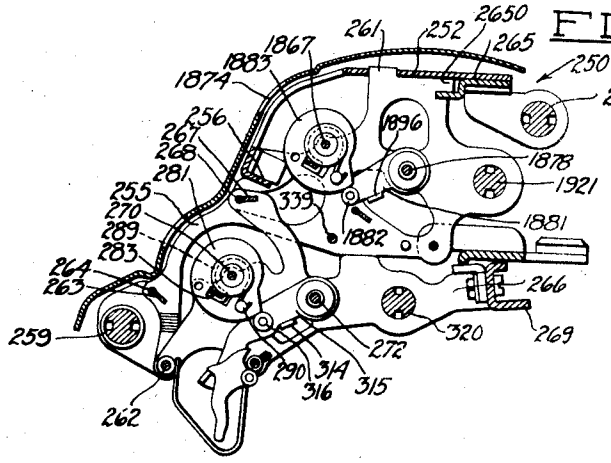
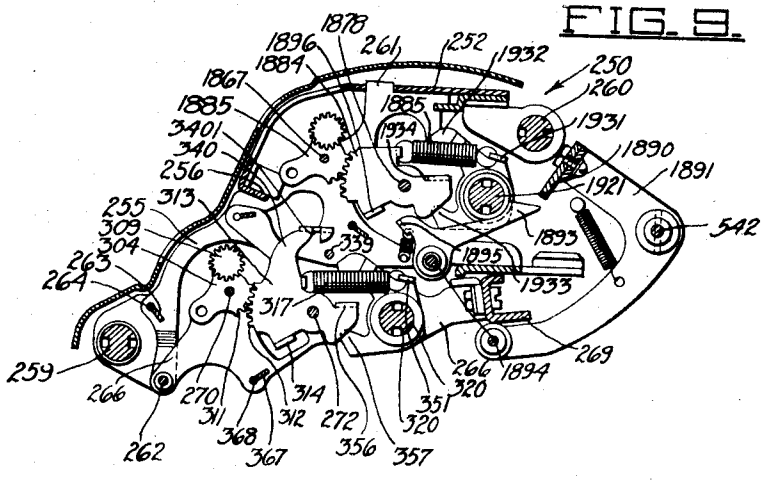


FIG. 9



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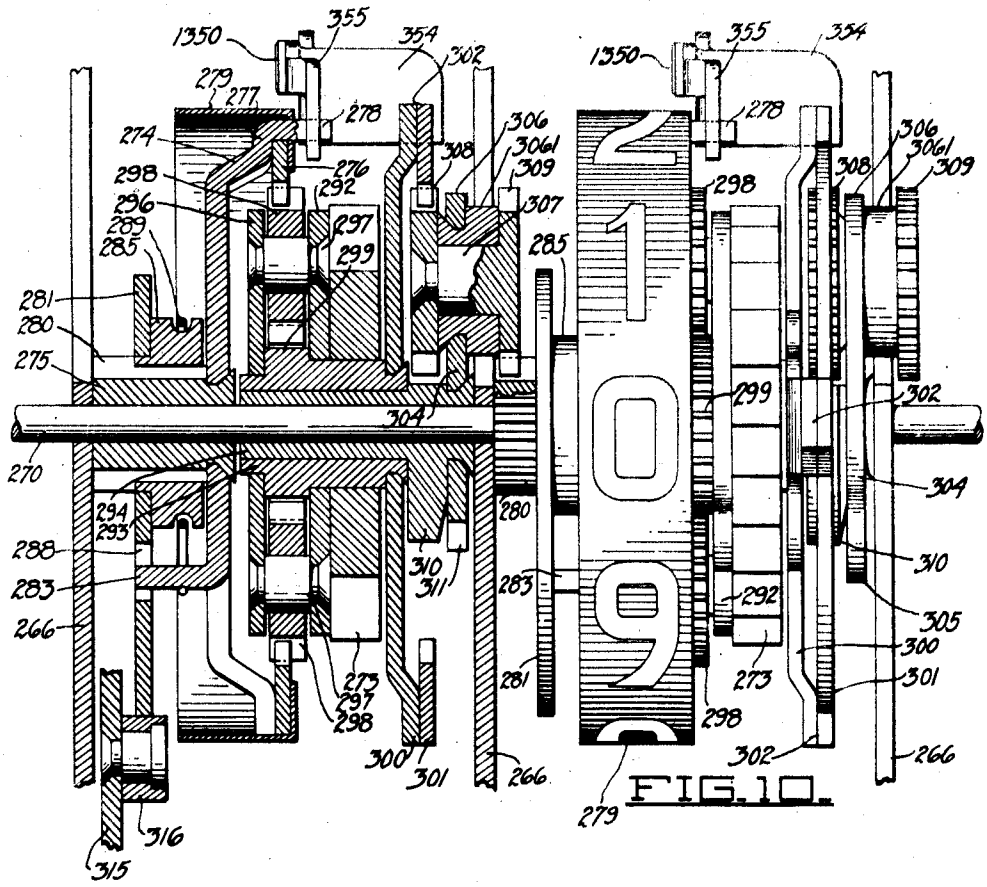

FIG. 10.

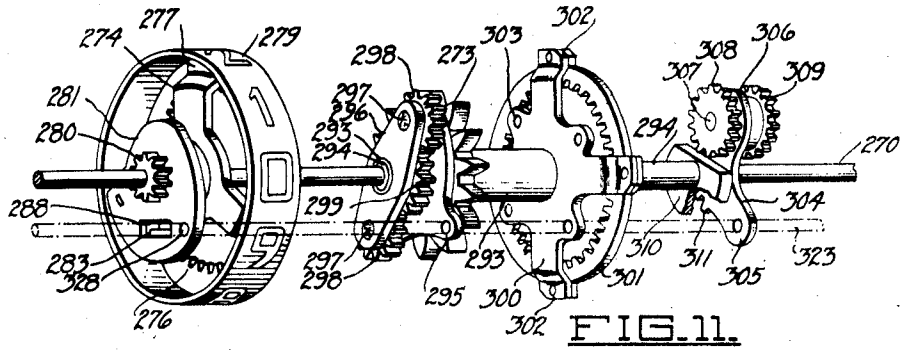

FIG. 11.

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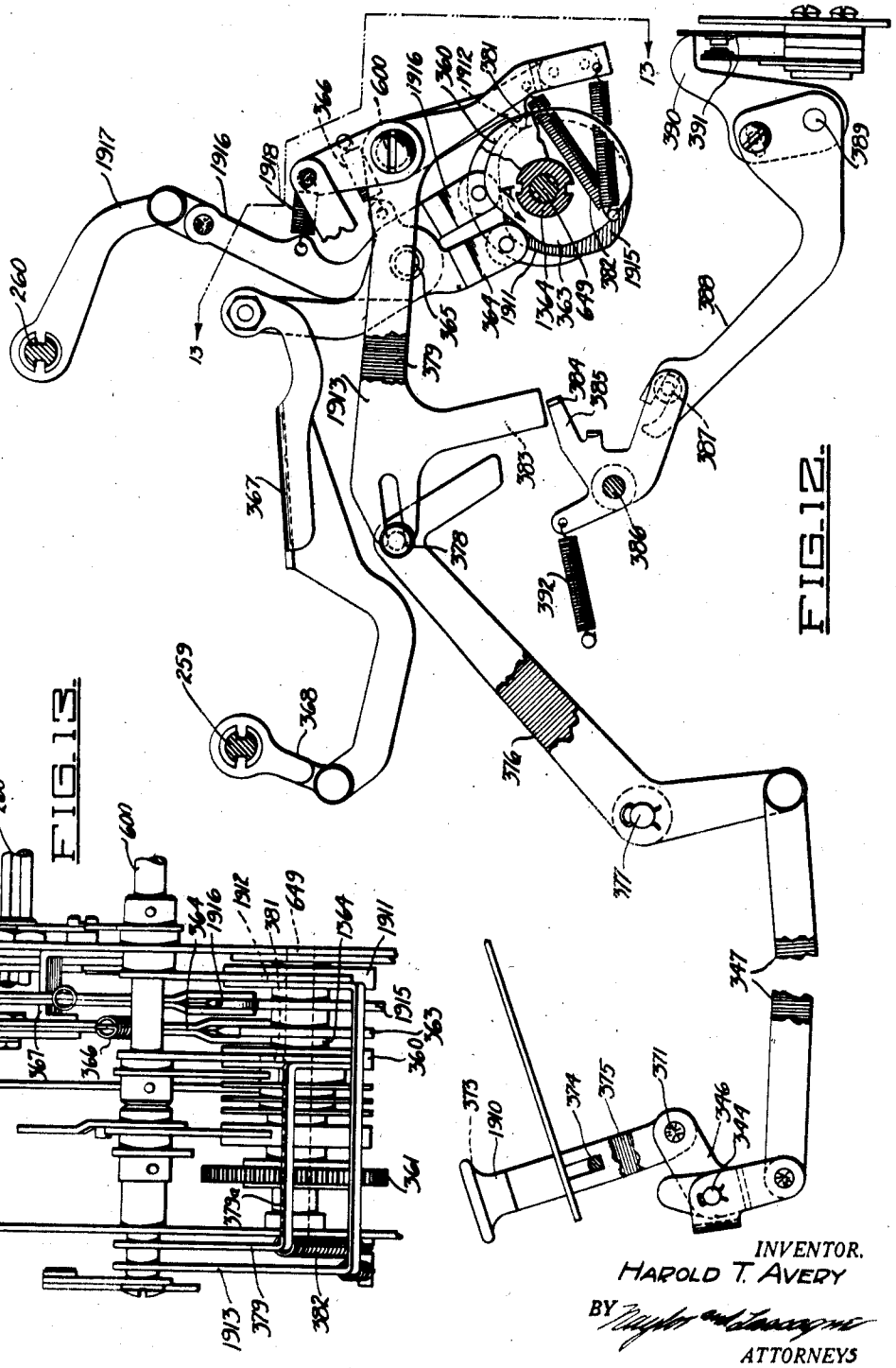

FIG. 12.

FIG. 13.

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FIG. 14.

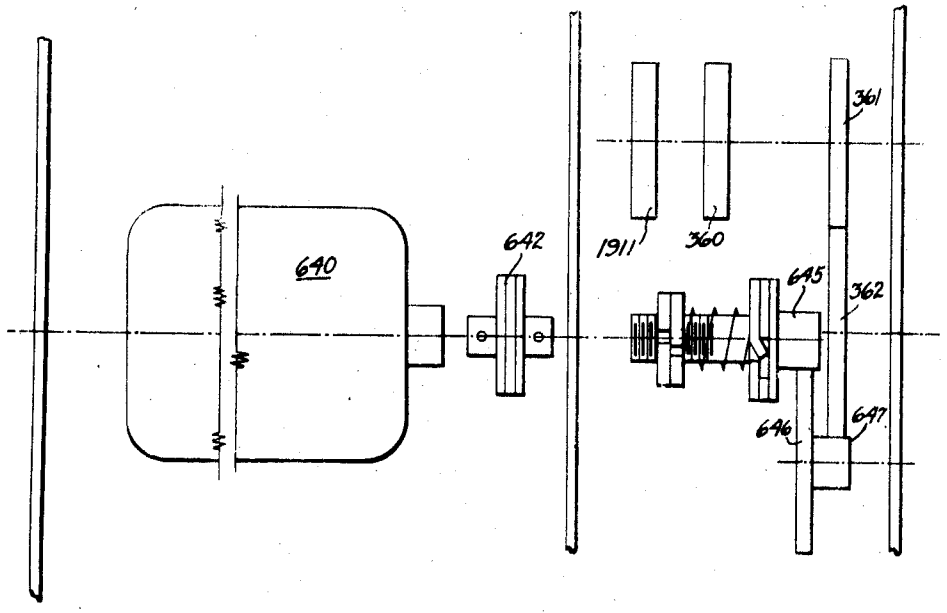
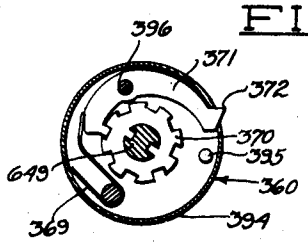


FIG. 15.



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Patented Sept. 8, 1942 2,294,949

UNITED STATES PATENT OFFICE

2,294,949

CALCULATING MACHINE

Harold T. Avery, Oakland, Calif., assignor to Marchant Calculating Machine Company, a corporation of California

Original application January 22, 1940, Serial No. 315,055. Divided and this application January 27, 1941, Serial No. 376,172

8 Claims. (Cl. 235—144)

The present invention relates to means for automatically clearing or returning to zero the registering mechanism of a calculating machine, and particularly a machine of the type in which the clearance is accomplished by power derived from a motor, and controlled by manually operable means.

The present application is a division of application Serial Number 315,055, filed January 22, 1940, which, in turn, is a continuation-in-part of the Avery patent application Serial Number 653,207, filed January 23, 1933 and since matured into Patent Number 2,229,630, issued on January 28, 1941; the Avery patent application Serial Number 702,949, filed December 18, 1933 and since matured into Patent Number 2,211,736, issued on August 13, 1940; and the Avery patent application Serial Number 84,927, filed June 12, 1936 and since matured into Patent Number 2,271,240, issued on January 27, 1942, to which application and patents reference may be had for a disclosure of the complete calculating machine including mechanism not specifically disclosed herein.

The principal object of the present invention is to provide a power operated mechanism for clearing the shiftable registers of calculating machines, which mechanism requires a minimum number of additional parts.

A more specific object of the invention is to utilize certain mechanical elements now serving other purposes, for the purpose of clearing the shiftable registers of calculating machines without impairing the original function of such elements.

Other objects will appear during the following detailed description of a preferred form of the invention, reference being made to the accompanying drawings, forming a part of this specification, in which:

Figure 1 is a top plan view of a machine embodying the present invention and showing the various control keys and a shiftable carriage carrying accumulator and counting registers.

Figure 2 is a front view of the carriage, a portion of the cover being broken away to show the registering mechanism therein.

Figure 3 is a transverse sectional view of the carriage and is taken on the line 3—3 of Figure 2, showing the mechanism for rocking the clearing shafts of the carriage.

Figure 4 is a transverse sectional view taken on the line 4—4 of Figure 2.

Figures 5, 7, 8, and 9 are transverse sectional views taken through the carriage to illustrate the construction of the accumulator registering mechanism, the sections being taken so as to bring out the interaction and relationship between certain of the parts.

Figure 6 is a fragmentary view illustrating the yieldable clear lever.

Figure 10 is an enlarged front view, partially in section, of two connected dial assemblies, illustrating the manner of construction thereof.

Figure 11 is an exploded perspective view of the dial assembly.

Figure 12 is a right side view, partially in section, of mechanism for clearing the registering mechanism.

Figure 13 is a rear view of a portion of the power transmission mechanism and its control and is taken substantially on the line 13—13 of Figure 12.

Figure 14 is a schematic view showing the motor and its connection to the various clutches of the machine.

Figure 15 is a detailed sectional view of one of the irreversible clear clutches.

Calculating machines of the general type disclosed in the above mentioned application and patents, such as the commercially known Marchant calculating machines to which these application and patents relate, comprise a main frame in which keyboard controlled value selecting and actuating mechanism is mounted, together with various operation controlling keys, and a transversely shiftable carriage in which accumulator mechanism and counting mechanism is mounted.

Amounts set upon the keyboard are entered into the accumulator either additively or subtractively upon operation of the actuating mechanism, the number of times the set up amount is entered being totaled by the counting mechanism. At the conclusion of a computation either or both of these registers may be reset to zero, or "cleared" by the mechanism hereinafter described in detail.

Registering mechanism

In the present machine the accumulator registering mechanism is mounted on a shiftable carriage 250 (Figures 1 and 2), transversely shiftable into different operating positions on the main body portion or frame 153 of the machine. The frame of the carriage comprises end plates 251 (Figures 2 and 3) connected by a formed top plate 252, having apertures to receive lugs 253 on the end plates 251 and secured at its for-

ward end by screws 254 which extend into the end plates.

Mounted at even intervals between the two end plates 251 are a series of carriage brace plates 255 (Figures 2 and 9) having lugs 261 projecting through spaced slots in the top plate 252.

The forward end of plate 252 is notched to interlock with notches in the brace plates 255 and to provide extensions 256 (Figure 8) fitting between adjacent brace plates 255. This forward end of plate 252 enters the notches in brace plates 255 in such a manner as to support the forward ends thereof. Screws 258 (Figure 5) secure ears on some of the brace plates to the top plate 252. Locked spacing combs 263 (Figures 5 and 7) extend through spaced slots in each brace plate and are locked in place by rods 264. A retaining comb 265 suitably secured to the top plate 252 spaces the rear edges of the plates 255 and underlies lugs 2650 on said plates in such a manner as to support the rear end of the plates 255.

Supported by the several brace plates 255, is a cross rod 262 which serves as a pivotal support for a series of plates 266 (Figure 5), one of which is mounted on said rod 262 adjacent each of the carriage brace plates 255. These plates 266 are spaced and braced adjacent their forward ends by two combs 267 interlocking with slots in each plate 255 and held in place by rods 268, and are connected at their rear ends by a common bail 269 known as the "dipping bail," by means of which the entire body of plates 266 can be simultaneously rocked about shaft 262 during operations completely described in the above Avery Patent Number 2,271,240, in which description the mechanism supported by said plates 266 is referred to as the "dipping carriage."

The units of the accumulator or product register are assembled on a shaft 270, supported by plates 266, there being one of such plates 266 between each adjacent unit. Each unit is adapted to be driven by a gear 189 of the actuator gear units, also described in the aforesaid application, with which intermediate gears 271 (Figure 5) rotatably mounted on a shaft 272 and entrained with gears 273 of the several accumulator units, may be meshed by lowering the dipping carriage. Suitable clearances are provided on the several plates 266 to permit the necessary connections between the orders of the accumulator for effecting tens transfer or carry operation.

Referring more particularly to Figures 10 and 11, it will be noted that each accumulator unit comprises a spider 274 which is rigidly secured to a sleeve 275, rotatably mounted on the shaft 270. This spider 274 carries an internal ring gear 276 on its right side, which is spot welded or riveted to an offset portion 277 formed on each of the spider arms. A right angular extension 278 of one of said arms projects toward the right from said spider, slightly beyond the right side face of a thin shell 279 fixed to the spider 274 and the internal gear 276 thereon, and serves to stop the dial in a zero position when it abuts the shelf 354 of a rockable lever 353 (Figure 7) during the resetting operations as described hereinafter. The periphery of the shell 279 is sufficiently wide to accommodate the digits ranging from "zero" to "nine," arranged as shown.

Integrally formed on the sleeve 275, surrounding said shaft 270, is a sun gear 280 abutting one of the brace plates 266, and interposed between said sun gear 280 and the spider 274, is a snail cam 281. The snail cam 281 and spider 274 may be relatively secured to rotate as a unit. It is preferable, however, that a limited relative movement of these elements be permitted. For this purpose the snail cam is secured on a sleeve 285 (Figure 10) which sleeve is mounted for rotation about a cut-away portion of the sun gear 280. A lateral extension 283 of the spider 274 projects through an enlarged aperture 288 in cam 281 to permit limited movement of the cam with respect to the spider. A small wire torsion spring 289 is disposed around sleeve 285 and extends between the projection 283 and pin 290 (Figure 8) on the cam, urging the cam to its extreme counter-clockwise position relative to the spider 274. This construction has the advantage that spring 289 may be temporarily overcome and the cam moved slightly without moving the rest of the functional unit just described.

The elements just described are assembled in a definite timed relation. The ring gear 276 is welded to the spider 274 after being properly located thereon by passing the lug 278 of the spider through a notch formed in the ring gear for its reception. The lug 283 locates the snail cam, and the relative position of the sun gear 280 on its integral sleeve 275 and the ring gear 276 may be found by a suitable assembly jig. Assembly by skilled mechanics is thus made unnecessary and the three units may be secured in their proper relation by riveting over the end of the sleeve 275 where it extends through the spider.

Located immediately to the right of the mechanism just described is a plate 292 fixed to the spur gear 273 which is driven by the actuator mechanism through an intermediate gear 271 (Figure 5) when the plates 266 are dipped. Plate 292 and gear 273 are rotatably mounted on a sleeve 293 which in turn is rotatably mounted on a sleeve 294 rotatably mounted on shaft 270. The plate 292, which includes an apertured ear 295 (Figure 11) for use in timing, as will presently appear, is fixed to a plate 296 by studs 297 provided at each end of said plate, and on each of said studs is rotatably mounted a planet gear 298 meshing with the ring gear 276 carried by spider 274 and with another sun gear 299 formed integrally with sleeve 293. Thus, the spur gear 273, the plates 292 and 296, the planet gears 298, and the ring gear 276, constitute a planetary assembly which rotates about the sun gear 299 and constitutes a means by which the numeral bearing shell 279 can be rotated by the actuating mechanism of the machine.

In order to perform any mathematical computation such as addition, subtraction, multiplication, or division, mechanism must be provided for advancing the higher registering element of a register one extra increment whenever the next lower element has made a complete rotation. This process is known as "carrying the tens," in a machine operating according to the decimal system.

Secured to the right end of the above mentioned sun gear sleeve 293 is a spider 300 carrying an internal gear 301, the spider and gear being provided with four lugs 302 (Figure 11) which serve as assembly guides and as stops, as will be hereinafter described. The spider also includes four apertured ears 303 for use in timing, as will appear.

For the purpose of carrying tens, means are provided for driving the spider 274 (Figure 10) and its associated dial shell 279 by means of the spider 274 of the next lower order inde-

pendently of any movement of gear 273. This means includes the aforementioned internal gear 301 and another unit subassembly now to be described. Sleeve 294 which, as previously described, supports the sleeve 293 on shaft 270, is provided with a double arm member 304, one arm 305 (Figure 11) of which is apertured, while to the other, 306, is secured a bushing 306' in which is rotatably mounted a stub shaft 307 with planet gears 308 and 309 fixed thereto. The planet gear 308 meshes with the internal gear 301 on spider 300 while the other planet gear 309 meshes with the sun gear 280 of the adjacent lower order dial shell 279. Sleeve 294 includes an integral spacer 310 so that gear 308 is positioned in alignment with ring gear 301 and does not abut the spider 300, and the end of the sleeve is riveted over to secure member 304, thus providing another unit assembly.

The central portion of member 304 is equipped with a gear segment 311 (Figures 9 and 11) meshing with a similar segment 312 formed on a lever 313 pivoted on the shaft 272 which is mounted parallel to the shaft 270 in the plates 266. Lever 313 includes an ear 314 extending to the right through an aperture formed in the adjacent plate 266 and engaging a lever 315 (Figure 8) to the right of the plate, said lever being mounted on shaft 272 and carrying a roller 316 in the same plane as snail cam 281. Lever 313 is urged clockwise (as viewed in Figures 8 and 9) by a spring 317 so that the roller 316 carried by lever 315 is urged thereby into contact with the adjacent snail cam 281. In the units order the sleeve 293 may be secured directly to the plate 266 adjoining it at the right, inasmuch as there is no lower order from which tens must be carried.

The units of the register are so designed that they may be simply and positively assembled in timed relationship. In assembling the register, the units shown in perspective in Figure 11, are assembled on the shaft 270 as it passed through the plates 255 (Figure 2), each one of the unit assemblies being positioned on the shaft as it is advanced. The previously described unit assemblies are quickly and easily brought into timed relationship with each other, by simultaneously, with the positioning of the successive units on shaft 270, passing a timing rod indicated by the dot and dash lines 323 through the aperture provided in each unit. Thus the timing rod is first passed through the aperture 328 in the snail cam 281 as appears in Figure 11. The unit assemblies of the planetary gears and gear 273, and ring gear 301, are then placed on shaft 270. The planetary gears are then revolved about shaft 270 until the timing rod will pass through the aperture 295 in the plate 292, as well as through an aperture in one of the ears 303 of spider 300. Arm 304 is then revolved about the shaft 270 until the timing rod can pass through apertured arm 305. When the rod has been passed through the several apertures in the different subassemblies, the whole will be in proper timed relationship. In the same manner the successive orders can be assembled and the carriage thus readily timed. After completely assembling the parts of the register in their proper relative positions the timing rod 323 is, of course, removed.

The arrangement of the several register units permits simultaneous digitation and tens carry, i. e., entry of increments set up on the keyboard, and tens transfer operations, and is therefore of the type known in the art as "duplexing."

In operation, the gear 273 is driven by the actuating mechanism and revolves planetary gears 298 about shaft 270 as a center. Where, as in the units order, the sleeve 293 with its sun gear 299 is fixed, this revolution of the gears 298 will, since they are in mesh with sun gear 299, cause them also to rotate about studs 297 and thus drive the ring gear 276 ahead in the direction in which gear 273 is being driven. Since ring gear 276 is fixed to the indicia bearing shell 279, this movement will bring a numeral into view beneath a sight opening 318 in the carriage cover indicative of the portion of a rotation given gear 273.

Whenever a given amount is thus entered in any one unit of the accumulator, one-tenth of that amount will be entered in the next higher unit by means of the carrying mechanism, providing member 304 be held in a fixed position, which is accomplished during calculation in a manner hereinafter described. The carrying mechanism which transmits the movement to the higher unit comprises the sun gear 280 fixed to the spider 274 and which drives planetary gears 309 and 308; these, in turn, driving internal gear 301 fixed to sleeve 293 of the next higher unit in a direction opposite to that of spider 274 of the lower order, and, by rotating said sleeve, drives sun gear 299 integral therewith. If gear 273 and studs 297 are stationary, the movement of sun gear 299 rotates ring gear 276 in the same direction as that of the lower order dial transmitting the carry. If gear 273 is moving to introduce digitation, ring gear 276 will move by an amount equal to the resultant of that produced by the rotation of gear 299 and that produced by the rotation of gear 273, the movement of the ring gear 276, of course, being the resultant of the movement of the sun gear and the displacement of planetary centers. Thus, the movement of any higher order dial becomes the resultant of the digitation entry into its own order and the carry movement from the next lower order. The gear ratios are in usual practice, of course, such that the carry movement received by the higher order dial is one-tenth of that of the lower order dial.

In order that this tens-carrying movement may be properly transmitted to all units of the accumulator, it is desirable that digitation gears 273 move only in accordance with values being introduced into the register. To this end, means are provided to prevent movement of the gears 273 except as values are being introduced. This means comprises pawls 319 (Figure 5), freely mounted on a shaft 320 journaled in the various plates 266, each pawl being adapted to be engaged with the associated intermediate gear 271 in each order by a spring 317 tensioned between the lever 313 and the respective pawl 319 (Figure 9). As described above, the gears 271 mesh directly with the gears of each actuator unit and each pawl 319 therefore acts as a retaining means for one of said gears 271 to retain the respective numeral wheel, being released during actuation of gears 271 as described in the application and patents identified above.

Thus, from the foregoing description, it is apparent that rotation of a numeral wheel 279 in any order will cause the numeral wheels in the higher orders or to the left thereof, to also rotate a certain amount successively either in additive or subtractive direction, depending upon the direction of rotation of gears 273, while in all the orders of a lower value or to the right of the last order in which digitation takes place, no such fractional values are entered.

By virtue of this continuous gearing between the various orders, the dials are advanced fractions of positions so that the numerals are not in general, properly lined up at the sight openings 318 at the completion of the cycle of calculation, and, in order to overcome this condition and display a readable indication of the result, mechanisms have been provided which will turn every numeral wheel to proper alignment with said sight opening directly after an actuation.

The mechanism for attaining this lineup operation of said dials comprises the snail cam 281 (Figure 11) which is connected to its respective spider 274, and which cooperates with and serves to position the indirectly spring tensioned lever 315 pivoted at 272 as shown in Figure 8. In this figure the snail cam 281 and lever 315 are shown in a position in which the roller 316 on said lever contacts the point of greatest radius of said snail cam, which condition represents the zero position of its associated dial wheel 279. The contour of said snail cams is proportioned in such a manner that, as the dial or dial wheel 279 displays each higher digit up to nine, the radius of the cam to the point of roller contact becomes successively smaller until the lowest radius on said cam represents the digit "9" on said numeral wheels. The values increase on the dials as well as on the cams in clockwise direction, so that for addition the dials and cams are rotated in counter-clockwise direction and for subtraction in clockwise direction, when viewing the machine from the right hand side.

It will be evident that if the dials were displaying a larger digit, roller 316 would contact a shorter radius of cam 281, thereby resulting in the roller lever 315 and the segment lever 313 standing in a position somewhat further clockwise than the positions in which they are shown in Figures 8 and 9. Thus, as the size of the digit displayed by any dial increases, the segment lever 313 to the left thereof is advanced successively further clockwise, so that the upwardly extending arm 340 thereof comes successively closer to a shaft 339 which is supported in the carriage braces 255.

In starting a calculation, the dipping carriage comprising the plates 266 and mechanism carried thereby is rocked down about the shaft 262 until the accumulator gears 271 are brought into mesh with the respective actuator gears 189 (Figure 5). As the dipping carriage is rocked down about shaft 262 into its lowered position, extension arm 340 of segment lever 313 engages shaft 339 thereby rocking segment lever 313 in a counter-clockwise direction as it moves downwardly, terminating with its slot 340' embracing shaft 339. In this terminal position segment lever 313 is rocked just slightly further counter-clockwise than the position which it normally occupies when the dial to the right of it registers zero. It will therefore, in this position, permit roller 316 to stand just slightly clear of the maximum radius of cam 281. Thus, if the dials 279 display zero, levers 313 are scarcely displaced by this operation, but if any dial displays a higher digit, its segment is rocked counter-clockwise by an amount substantially proportional to the digit displayed.

With the carriage thus dipped, member 304 (Figures 9 and 11) is held in its rearmost position during the ensuing operation and planetary pinions 308 and 309 revolve on a fixed center, so that each dial is, in general, advanced to a partial position depending on the digitation it has received and the carry from all orders to the right. For instance, if the resultant value entered is "2,375," the first dial stands between a "2" and a "3" registration being 0.375 of the way from the "2" to the "3" registration. The next dial stands 0.75 of the way from a "3" to "4" registration, and the next 0.5 of the way from a "7" to an "8" registration, and the next dial squarely at a "5" registration.

When the calculation is completed, the dipping carriage is raised, and it is desired to back up each dial by the fractional amount it stands ahead of an even registration to secure a clear registration in the sight openings. To this end, each lever 315 (Figures 8 and 9) is allowed to rock clockwise under the tension of the spring 317 until roller 316 rests against snail cam 281 which, with the cam shaped as already described, allows lever 315 to rock clockwise by an amount proportional to the registration on the dial to which the cam is attached. This rocking of each lever 315 rocks each associated member 304 in a counter-clockwise direction, carrying stub shaft 307 forward by an amount proportional to the registration on the dial to the right of it, thus rocking ring gear 301 by a corresponding amount proportional to the registration of the next lower order dial, which is the amount by which the dial stood ahead of an even position. The arrangement is therefore such, that each increment of carry received from a lower order will be backed out, upon completion of the calculation, unless the increment amounts to an entire position, in which case the high portion of the snail cam standing under the roller prevents such backing out. The result is that when the dipping carriage is raised, each dial is controlled by the snail cam on the next lower order dial so that the proper figure will be squarely lined up with its sight opening.

The above described planetary tens-carrying system combined with the resilient connections between the numeral wheels and their respective snail cams 281 is disclosed and claimed in the copending Avery application Serial Number 159,523, filed August 17, 1939, and since matured into Patent Number 2,222,164, issued on November 19, 1940.

A counter register is provided for counting machine cycles as disclosed in detail in the Avery application and patents mentioned at the beginning of this specification and includes a plurality of dials 1875 which may be observed through sight openings 1874 (Figures 1 and 2) in the carriage cover. The construction of these dials is similar to that of the product or accumulator register to the description of which reference may be had for a detailed description of the construction thereof.

In the present case, the dials 1875 are mounted upon a shaft 1867 (Figures 5 and 7) extending through and supported by the end plates 251 and the brace plates 255. Each order of the counter unit includes a gear 1877 rotatably mounted upon a shaft 1878 being engaged with a gear 1879 and its cooperatively associated counter dial 1875. Gear 1877 is also in mesh with a gear 1880 which, in each actuated order may be driven by an actuating finger as described in the aforesaid Avery application and patents.

Immediately prior to each operation of the counter dials, either clockwise or counter-clockwise, roller carriers 1881 (Figure 8), rockable about the shafts 1878, are freed from spring ten-

sion to permit rollers 1882, carried thereby and corresponding to rollers 316, to move out of contact with and out of the path of snail cams 1883. This occurs, upon each dip of the dipping carriage, only in the operated order and all orders to the left thereof, and obviates the strain on the mechanism which would result if the rollers had to be backed up the steep rise of the cam 1883 in additive operations.

Levers 1884 (Figure 9), having the lugs 1896 thereon extending beneath their corresponding levers 1881, are rocked against the tension of their springs 1885 about the shaft 1878, upon each carriage dipping, by a bar 1890 carried by bell cranks 1891 on a rockable shaft 542 (Figure 9). Bar 1890 is aligned only with the order being operated and all orders to the left. The lower arms of the bell cranks lie beneath the dipping bail 269 so that each time the dipping carriage dips, bar 1890 rocks downwardly to rock levers 1893 about a shaft 1894. Levers 1893 have ears 1895 which engage tails formed on the levers 1884 and thereby rock those levers 1884 which are opposite such of the levers 1893 as are engaged by bar 1890. Roller carrier levers 1881 (Figure 8), being held against the snail cams only by springs 1885, are thus freed from this tension and do not interfere with actuation of the counter in either direction.

Product register clearing mechanism

It may be seen from the foregoing, that if ring gears 301 (Figures 10 and 11) are stopped against movement while segments 313 are rocked, the teeth 312, meshing with teeth 311, will act to rock arms 304 and rotate planetary pinions 308 and 309 by feeding pinions 308 over the teeth of locked ring gears 301. If the gears 271 (Figure 5) are now freed from the retaining or pawling action of the retaining pawls 319, the rotation of planetary pinions 309 (Figures 10 and 11) can, since gears 273 are free to rotate, drive gears 280 to rotate spiders 274 and their attached numeral wheels 279 backwardly, toward the position in which their zero digits register with the sight openings 318. If a stopping means be placed in the path of lugs 278 carried on said numeral wheels to prevent them from being driven beyond zero position, the pawls 319 may be restored to pawling positions and the stopping means withdrawn from ring gears 301, leaving the numeral wheels 279 aligned in zero position.

This mode of operation is used to reset the product dials to zero, by means of the following mechanism. Mounted for rocking movement with the shaft 320 (Figure 7), supported in plates 266, are rocking levers 350. The shaft 320 is rocked by the automatic clearance mechanism presently to be described, and movement of rocking levers 350 is transmitted to pawls 319 (Figure 9), each pawl having a lateral projection 351 thereon which may be engaged by a shoulder formed on the associated lever 350 to free the associated gear 271.

The lever 350 (Figure 7) also acts to effect locking of the ring gears 301 and place zero stops for the numeral wheels in effective position, and for this purpose is provided with an extension 352 engaging an elongated notch within the lever 353 rockably mounted on a shaft 272, so that, upon clockwise rocking of lever 350, lever 353 is forced in a counter-clockwise direction and the lateral projection 354 thereon is placed in its effective position. The lateral projection 354 is of sufficient width, as shown in Figure 10, to engage the zero stop projections 278 on the respective dial assembly as well as to engage one of the four projections 302 on the spider 300 and gear 301 and limit the latter against movement past zero position during clearing of the register, thus providing the aforementioned stopping means.

It should be noted that there is enough space between each lever 350 and the lateral projection 351 of its respective pawl 319 to allow the lever 353 to start to be moved into stopping position before the pawl is raised from engagement with its respective gear 271. This design provides a convenient way of adjusting the various pawls to obtain correct timing, which may be accomplished by merely bending the projection 351 backward or forward so that the lever 350 will contact the projection 351 just as the lever 353 is being rocked to its stopping position.

Rebound of the dials is prevented by a spring pressed latch 355 (Figure 7), provided on each lever 353, which latch engages the other side of projection 278 on each dial assembly from that engaged by projection 354, and positively retains each dial shell against rebound. Latch 355 is pivoted at 1350 to the lever 353 and is urged into the position shown in Figure 7, relative to the lever 353, by a spring 1351 interposed between a pin on lever 353 and an ear on latch 355 which overlies the forward edge of the lever and thus serves as a stop to limit counter-clockwise movement of latch 355 beyond that shown.

The clear lever 350 is provided with a yieldable connection to shaft 320, as shown in Figures 6 and 7, so that if the lug 354 should fall on top of one of the projections 302 on gear 301 the shaft could complete its stroke without damaging the parts. In viewing Figure 6, it will be seen that a member 342 is keyed to shaft 320 while the lever 350 is free on the shaft. A torsion spring 343 is tensioned between a stud 345 secured to the clear lever 350 and a nose 344 on member 342, so as to urge the lever 350 counter-clockwise (Figure 7) relative to the member 342 until the end of stud 345 abuts the underneath side of nose 344 and serves as a limit stop for the clear lever 350. It will be seen that if shaft 320 is rocked clockwise, as viewed in Figure 7, and the clear lever 350 is held, the spring will be merely tightened further and no damage to the parts will ensue.

The yieldable connection between the shaft 320 and each clear lever 350 also provides tolerance for a slight misalignment between the various clearing assemblies individual to different ones of the numeral wheels 279. This is of considerable importance, since the clearing or zeroizing of the various numeral wheels is accomplished with only a small increment of angular movement of shaft 320 and, therefore, a very slight amount of misalignment might otherwise prove detrimental.

The dials are returned to zero position upon rocking of shaft 320 first clockwise and then counter-clockwise, by mechanism comprising lateral projections 356 on the segments 313 (Figure 9), which are engaged by extensions 357 on the respective pawls 319 when rocked by the shaft 320 to rock the levers 313 counter-clockwise on the shaft 272 against the pull of springs 317. Teeth 312 on the segments 313 mesh with the teeth 311 on the arms 304 to rock arms 304 clockwise and rotate planetary pinions 308 and 309 (Figures 10 and 11), by feeding the former over the teeth of the ring gears 301 which, by this time, are stopped by the stop lugs 354. Since gears 271 are free to rotate, rotation of planetary

pinions 308 and 309 drives sun gears 280 to rotate spiders 274, and their attached numeral wheels 279, backwardly to the position in which the zero digits register with sight openings 318.

The shaft 320 is then rocked in a counter-clockwise direction back to its normal illustrated position and during this movement lever 350 on shaft 320 first permits spring 317 to reseat pawls 319 (Figure 5) between the teeth of gears 271 and thus permit the segments 313 (Figures 8 and 9) to return under tension of the springs 317 until the engagement of the roller 316 with the periphery of the snail cam 281 blocks further movement of the segment 313 by engagement of the lug 314 thereon with the roller carrying lever 315. For this purpose, the shaft 320 has keyed thereto a lever 358 (Figure 4) which is pulled by a spring 359 in a counter-clockwise direction so that, when the shaft 320 is rocked clockwise to clear the dials, the spring is tensioned. As the power clearance mechanism, to be described, is centralized, this spring returns the shaft 320 to the position shown in Figure 4, wherein the lever 358 abuts a pin 1358, leaving all the zero numerals on the dials aligned with the sight openings. After pawls 319 (Figure 5) have engaged between the teeth of gears 271, the latches 355 and stop lugs 354 (Figure 7) are withdrawn from lugs 278 and projections 302, this sequence of operation insuring against displacement of the dials from zero position during return of shaft 320 to its normal position.

The above described arrangement of the pawls 319, levers 313, stop members 353 and levers 350 relative to the shaft 320, as well as the double function of springs 317, not only provides a simplified mechanism for releasing the numeral wheels and for returning and stopping them at their zero positions, but also enables a compact construction of the carriage 250.

Power operation of product register clearing mechanism

To clear the previously described product registering mechanism it is necessary to rock the clearing shaft 320 the requisite amount, as has been previously described. Power for rocking the clearing shaft is transmitted through a one revolution clutch 360 (Figures 12, 13, and 15) rotatably mounted on a shaft 649 (Figures 12 and 13). As shown diagrammatically in Figure 14, the driving side of the clutch 360 is driven by an electric motor 640 through a coupling 642 and a train of enmeshed gears 645, 646, 647, 362, and 361.

The clutch 360 is controlled by a "middle dial" clear key 373 situated on the keyboard provided on the stationary body portion of the machine (Figures 1 and 12). The clear key 373 is secured to the upper end of a key stem 375, which is slidably mounted on a stationary rod 374, and pivotally connected at its lower end to a bail 346, by means of a pin 371. This bail is pivotally mounted on a shaft 344 and has a depending arm pivotally attached to the left end of a link 347. A bell crank 376 is pivoted on a stud 377 and has a downwardly extending arm pivoted to the right end of link 347, and on the upwardly extending arm of said bell crank is a shoulder stud 378 which is embraced by the bifurcated forward end of a clutch control lever 379 rockable on a stationary shaft 600. A clutch control dog 381 is made integral with the control lever 379 being connected thereto by a bail 379a (Figure 13), and is normally held in the position illustrated in Figure 12, to lock clutch 360 against rotation, by a spring 382. Thus, the clear clutch 360 is not effective to transmit power from the motor 640 until the dog 381 is moved rearwardly to cause clutch engagement.

The clutch used in this form of clearance is preferably of the irreversible type, in which a ratchet wheel 370 (Figure 15) is keyed to the shaft 649 and constitutes the driving member for the clutch. To the clutch housing 394 is secured a stud 396 on which is pivoted a dog 371 to form the connection between the ratchet wheel and the clutch housing, and effect disengagement of the clutch by contact of its tip 372 with the clutch control dog 381 (Figure 12). The dog 371 is urged toward engagement with the ratchet wheel 370 by a torsion spring 369, and a stud 395 is located on the clutch housing to serve as a limit stop for the dog 371 when rocked by the control dog 381. The design of the ratchet wheel 370 differs from the one disclosed in the Friden Patent Number 1,643,710, referred to in the above Avery application Serial Number 84,927, in that each of the notches provided to receive the clutch dog 371 (Figure 15) has two faces, instead of one, so that when the dog 371 is rocked about its pivot 396 and seats in one of the notches, it cannot be backed out, as for instance, when a cam follower 364 (Figures 12) under pressure of the spring clearance would otherwise force cam 363 (connected intermediate the clear clutch 360 and the linkage for rocking shaft 320) to rock from a high point of contact to a low point of contact, and thus cause the cam to overrun the clutch. This clutch construction thereby provides a positive control of the movement of the cam 363 and the mechanism actuated thereby.

Motor operation is instituted by closing a pair of switch contacts 391 (Figure 12) located in the motor circuit. To close these contacts, a depending projection 383 is formed on the lever 378 which, when the lever is rocked downwardly to retract dog 381 to engage the clutch 360, engages an extension 384 formed on a bell crank 385 to rock the bell crank about a shaft 386 in a clockwise direction from the position shown in Figure 12. The lower arm of bell crank 385 is connected to a lever 388 by a pin and slot connection 387 whereby to rock the lever 388 about a stud 389 and remove a tip 390 thereon away from the rearmost switch contact 391, thus allowing the contacts to close. On return of the clearing linkage and key 373 to normal inoperative position by spring 382, the switch contacts 391 are again allowed to open by the action of a spring 392 which then rocks the bell crank 385 and parts connected thereto, back to the position indicated in Figure 12.

It will be seen from the foregoing that upon depression of key 373, the clutch control dog 381 will be rocked rearwardly against the action of spring 382 to cause clutch engagement, the effect of which will rotate a cam 363 (Figures 12 and 13) keyed on a sleeve 1364 integral with the driven side of the clutch 360 and adapted to impart clockwise rocking movement to a cam follower 364, pivoted at 365 and held against the cam by a spring 366. A link 367 is connected between the upper end of cam follower 364 and a lever 368, splined to a shaft 259.

Shaft 259 supports the forward part of the carriage 250, being journaled in the carriage end plates 251 and held against endwise movement relative thereto by retainers 258 (Figure 3) at either end of the shaft. Shaft 259 is slidably and

rockably supported in spaced bearings 149 and 150 provided at the upper ends of stationary plates 151 and 152, respectively, (Figures 2 and 4) suitably supported at opposite sides of the main machine body or frame 153 in a manner not shown in detail. Shaft 259 is, therefore, first rocked counter-clockwise by operation of the clutch 360 and thereafter rocked clockwise no matter what the transverse position of the carriage may be at the time.

As shown in Figure 3, the rocking movement of shaft 259 is transmitted to the clear shaft 320 by means of an arrangement comprising identical levers 370 fixed on opposite ends of the shaft 259, and carrying rollers 371 adapted to cooperate with cam surfaces on levers 372 fixed on opposite ends of the shaft 320. The camming surface on each lever 372 is so designed as to cause the shaft 320 to rock at a rate substantially equal to that of shaft 259 at the beginning of a clearing stroke, but to gradually decelerate the shaft 320 to substantially no movement at the end of said stroke. A greater deceleration of shaft 320 is, however, accomplished by forming the cam 363 with the contour shown in Figure 12, in which it rises, at a rapid rate, through approximately one-half its total radial camming range or rise in the first one-eighth of rotation thereof in the direction of the arrow A, while the other half of the rise is distributed over an additional one-half of the periphery, to its maximum rise, at a diminishing rate. Approximately the first one-eighth revolution of cam 363 is effective merely to take up all loose connections between the cam and the shaft 320, to raise the pawls 319, and to lower stop lever 353, which operation is performed mostly at an accelerated rate. Therefore, during the clearance, the dials are returned to zero by the mechanism described hereinbefore at such a diminishing rate that no appreciable jar or noise results therefrom. Furthermore, due to the greater leverage obtained during the latter portion of the stroke, the increased resistance of the tension springs 317 and possibly of the torsion springs 343 may be easily overcome. Also, the particular interaction between the levers 370 and 372 reduces the tendency of the cam follower 364 to drive the cam 363 ahead of it on its return stroke due to the comparatively large amount of tension applied by the various springs 317, 359, 366, et cetera, especially at the beginning of such return stroke, to rock the shaft 320 back to its starting position. The shaft 259 and a like shaft 260 support the weight of the entire carriage and in order to minimize frictional resistance to the movement of the shafts in their bearings, and resultant wear, the keyways 259*a* and 260*a* (Figure 4) are normally disposed horizontally so that they do not lie in the lower or bearing portions of the shafts and bearings. Further, the angle through which the shafts are capable of being rocked during the zeroizing operation is reduced to such an extent that the keyways do not move entirely through the pressure region or area of the bearing and, therefore, the edges of the keyways do not tend to cut the main portion of the supporting film of lubricating oil between the bearings and the shaft as would be the case if the shafts were completely rotated. A further advantage obtained by the application of a rocking motion, instead of a rotation, to the supporting shafts 259 and 260 is that a simple camming mechanism as provided by the levers 370 and 372 (Figure 3) may be utilized to vary the rates of movement and torques applied to the clearing shafts at different points in the clearing movement, as desired, whereas the gearing connections necessary to rotate such shafts will not provide similar flexibility in varying ratios and torques.

Power clearance of the counter register

In a machine of this general class, it is necessary to provide means to zeroize the counter register, as well as the product or accumulator register; therefor, an "upper dial" clear key 1910 (Figures 1 and 12) is juxtaposed the "middle dial" clear key 373 to set into operation mechanism similar to that described in connection with the automatic clearance of the dials 279, for selectively clearing the counter register dials 1875. A clear clutch 1911 (Figures 12 and 13) similar to that illustrated in Figure 15 is controlled by a clutch dog 1912 carried by a lever 1913 rockable about the shaft 600. Lever 1913 is connected to key 1910 by linkage identical to that connecting the lever 379 to its associated key 373.

Clutch 1911, when engaged, serves to rotate a cam 1915 to rock a cam follower 1916. This cam follower is also pivoted at 365 and is pivotally connected at the upper end thereof to an arm 1917, which is splined to a shaft 260. Shaft 260 supports the rear part of the carriage 250 in the same manner that shaft 259 supports the forward part. For this purpose, shaft 260 is journaled in the end plates 251 of the carriage and is slidably and rockably supported in bearings formed in stationary plates, one of which is shown at 154 (Figure 4) extending from opposite sides of the machine body or frame 153. The rocking of the shaft 260 rocks a lever 1918 (Figure 3), keyed thereto, to move an associated cam lever 1920 pinned to a shaft 1921 in the same decelerating manner described in connection with levers 370 and 372. Levers 1922, similar to levers 350, are mounted on and yieldably connected to shaft 1921 (Figure 7) and each includes a projection 1923 lying in a notch 1924 of a rocking lever 1925 supported on the shaft 1878. The rocking of lever 1922 brings a latch 1926, pivotally mounted on the lever 1925, into the path of a zero stop projection 1927 on each dial assembly, and also positions a projection 1928 on lever 1925 into the path of one of the four projections 1929 of each dial unit, as well as projection 1927. Rocking of lever 1922 also results in an ear 1930 thereon engaging a projection 1931 on a pawl 1932 (Figure 5) to lift the pawl free of a gear 1877 provided in the counter drive gear train for the respective dial wheel. Further movement of lever 1922 brings a projection 1933 (Figure 9) on the pawl 1932 into engagement with an ear 1934 of the lever 1884. This lever rocks a planetary gear carrier 1885 about a supporting shaft 1867 to return the respective dial 1875 to zero position where it is engaged by the latch 1926 (Figure 7) to prevent rebound from said zero position. This latter zeroizing movement is carried out in a manner identical with that described in connection with the dial wheels 279 of the product register.

Although I have described and illustrated my invention in a preferred form as embodied in a commercially known Marchant calculating machine, it is to be understood that the present disclosure has been made only by way of example and that numerous changes in construction may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage and bearings on said frame supporting said shaft for longitudinal movement thereon; means for rocking said shaft comprising a keyway on said shaft, a member slidably keyed thereon for transmitting rocking movement to said shaft in different shifted positions of said carriage, and mechanism mounted on said frame for rocking said member; said keyway normally extending substantially at right angles to the direction of bearing pressure of said shaft and said rocking movement thereof being insufficient to move said keyway completely through the pressure areas of said bearings; means comprising a second shaft carried by said carriage for zeroizing said register, and a pair of members each connected to one of said shafts and forming coacting cam surfaces, said members coacting to operate said second shaft at a rate of speed varying from that of said first mentioned shaft.

2. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage, and bearings on said frame supporting said shaft for longitudinal movement therealong; means for rocking said shaft comprising a keyway on said shaft, a member slidably keyed thereon for transmitting said rocking movement to said shaft in different shifted positions of said carriage, and mechanism mounted on said frame for rocking said member; said keyway normally extending substantially at right angles to the direction of bearing pressure of said shaft and said rocking movement thereof being insufficient to move said keyway completely through the pressure areas of said bearings; means comprising a second shaft carried by said carriage for zeroizing said register, and means for transmitting movement from said first mentioned shaft to said second shaft at a rate of speed varying from that of said first mentioned shaft.

3. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage; bearings on said frame supporting said shaft for longitudinal movement therealong, actuating means on said frame for rocking said shaft in one direction; means comprising a keyway on said shaft and a member slidably keyed thereon for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; said keyway normally extending substantially at right angles to the direction of bearing pressure of said shaft and said rocking movement thereof being insufficient to move said keyway completely through the pressure areas of said bearings; means comprising a second shaft carried by said carriage for zeroizing said register, a pair of members each connected to one of said shafts and forming coacting cam surfaces; said members coacting to operate said second shaft at a rate of speed varying from that of said first mentioned shaft, and yieldable means for returning said first mentioned shaft to normal position.

4. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage; bearings on said frame supporting said shaft for longitudinal movement therealong; actuating means on said frame for rocking said shaft in one direction; means comprising a keyway on said shaft and a member slidably keyed thereon for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; said keyway normally extending substantially at right angles to the direction of bearing pressure of said shaft and said rocking movement thereof being insufficient to move said keyway completely through the pressure areas of said bearings; means comprising a second shaft carried by said carriage for zeroizing said register; means transmitting movement from said first mentioned shaft to said second shaft at a rate of speed varying from that of said first mentioned shaft, and yieldable means for returning said first mentioned shaft to normal position.

5. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage, and bearings on said frame supporting said shaft for longitudinal movement therealong; means for rocking said shaft comprising actuating mechanism mounted on said frame and a keyed connection between said shaft and said actuating means for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; a second shaft carried by said carriage and rockable from one position to a second position for zeroizing said register, and a pair of members each connected to one of said shafts and forming coacting cam surfaces; said members coacting to rock said second shaft at a rate of speed varying from that of said first mentioned shaft.

6. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage; bearings on said frame supporting said shaft for longitudinal movement therealong; means for rocking said shaft, comprising actuating mechanism mounted on said frame and a keyed connection between said shaft and said actuating means for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; a second shaft carried by said carriage and rockable from one position to a second position for zeroizing said register; and means for transmitting rocking movement from said first mentioned shaft to said second shaft.

7. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage; bearings on said frame supporting said shaft for longitudinal movement therealong; actuating means on said frame for rocking said shaft; means comprising a keyed connection between said shaft and said actuating means for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; a second shaft carried by said carriage and rockable from one position to a second position for zeroizing said register; means for transmitting rocking movement from said first mentioned shaft to said second shaft at a rate of speed varying from that of

said first mentioned shaft, and yieldable means for returning the said first mentioned shaft to the position from which it has been rocked by operation of said actuating means.

8. In a calculating machine having a frame, and a shiftable carriage having a register thereon; the combination of carriage supporting means comprising a shaft rockably mounted in said carriage; bearings on said frame supporting said shaft for longitudinal movement therealong; actuating means on said frame for rocking said shaft; means comprising a keyed connection between said shaft and said actuating means for transmitting said rocking movement from said actuating means to said shaft in different shifted positions of said carriage; a zeroizing device for said register; means operable by said shaft upon said rocking movement thereof for actuating said zeroizing device, and yieldable means for returning said shaft to the position from which it has been rocked by operation of said actuating means.

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