April 29, 1947. E. F. BRITTEN, JR 2,419,760

OPERATION CONTROL MEANS FOR CALCULATING MACHINES

Filed July 13, 1945 3 Sheets-Sheet 1

Fig. 1

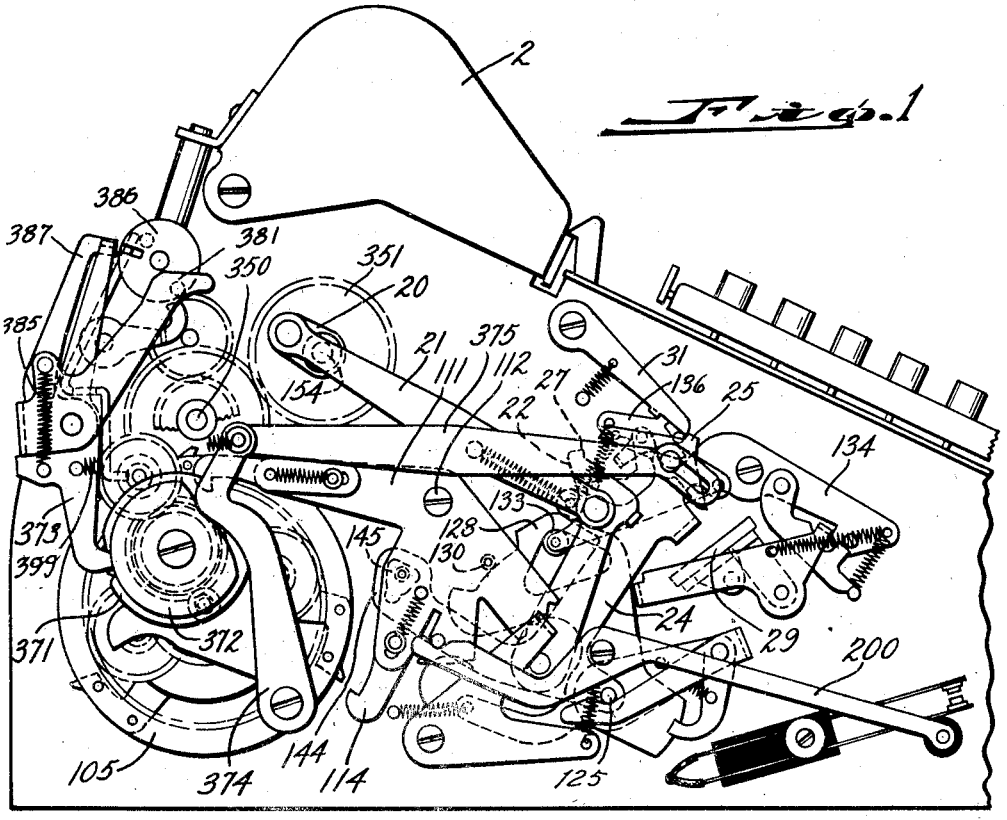
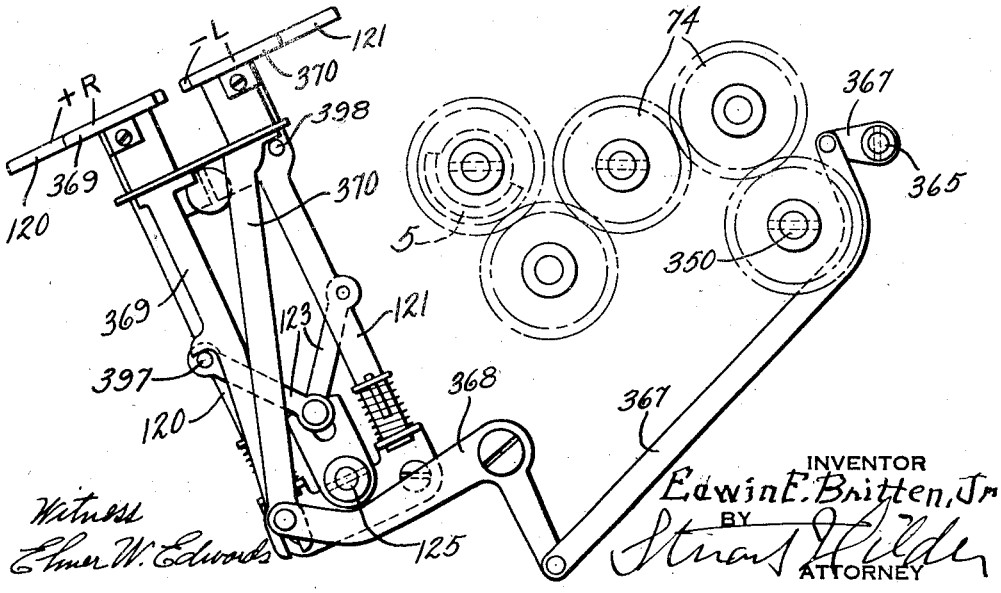


Fig. 2



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Filed July 13, 1945 3 Sheets-Sheet 2

Fig. 4

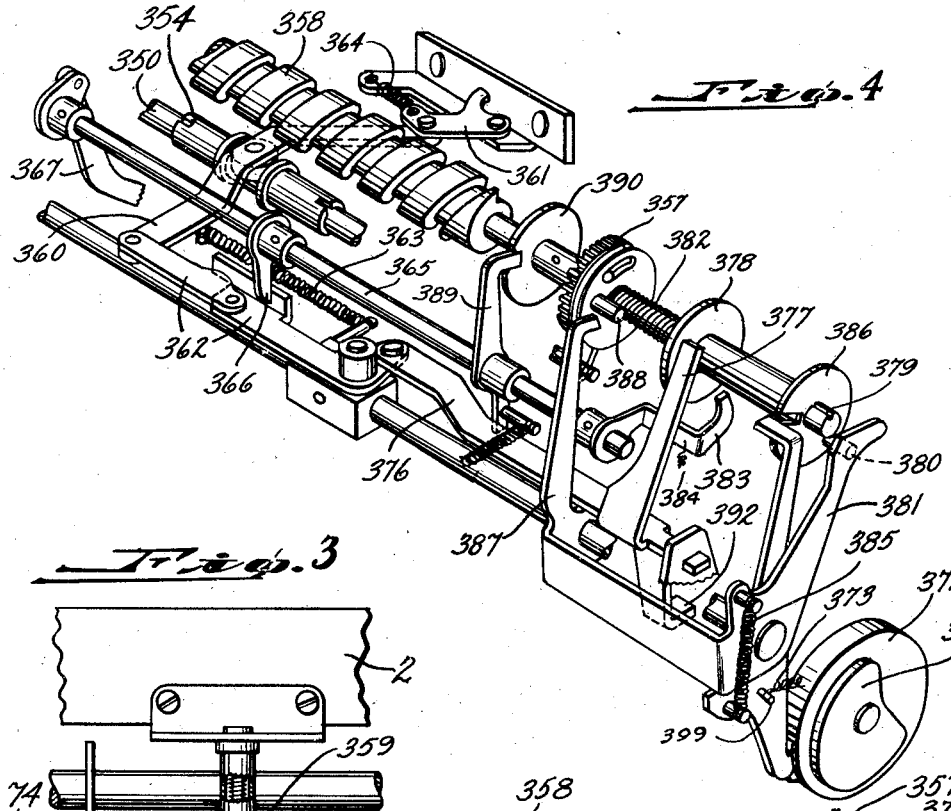
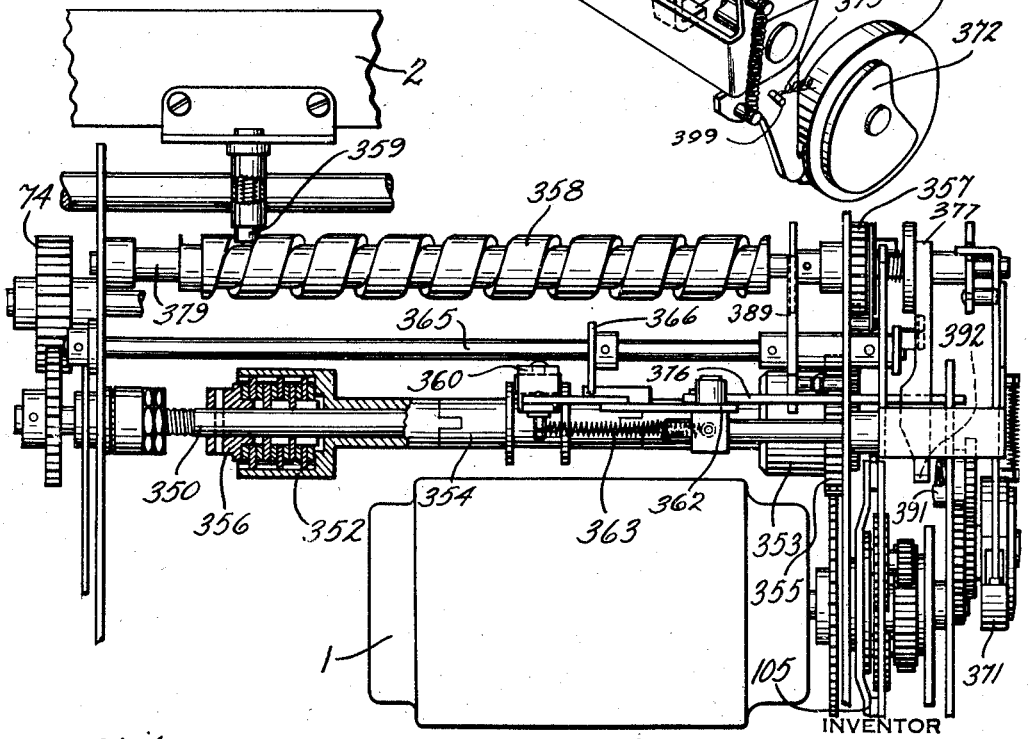


Fig. 3



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OPERATION CONTROL MEANS FOR CALCULATING MACHINES

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Fig. 5

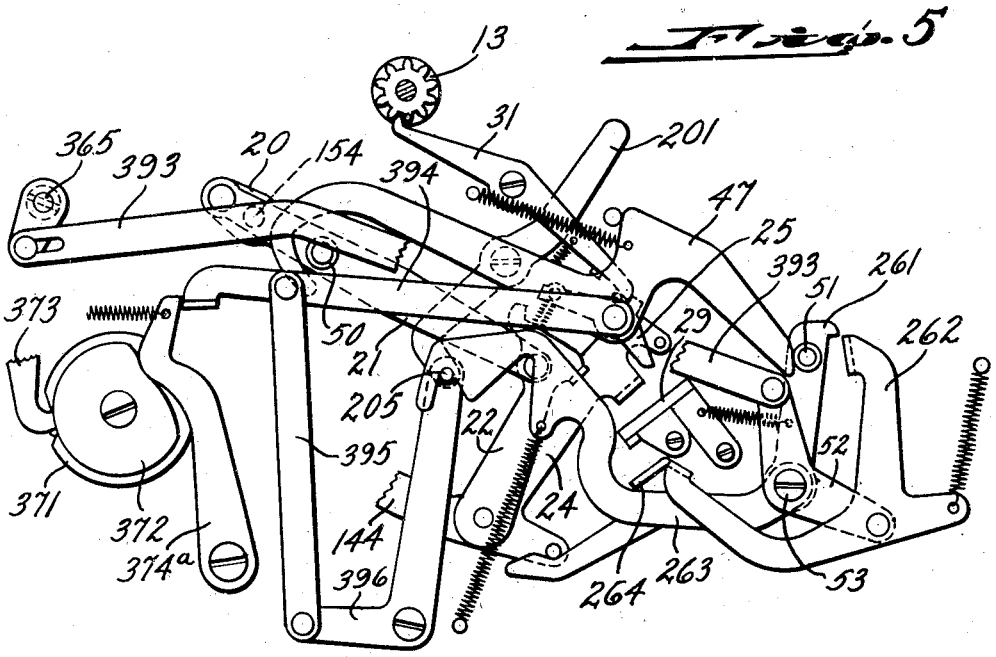
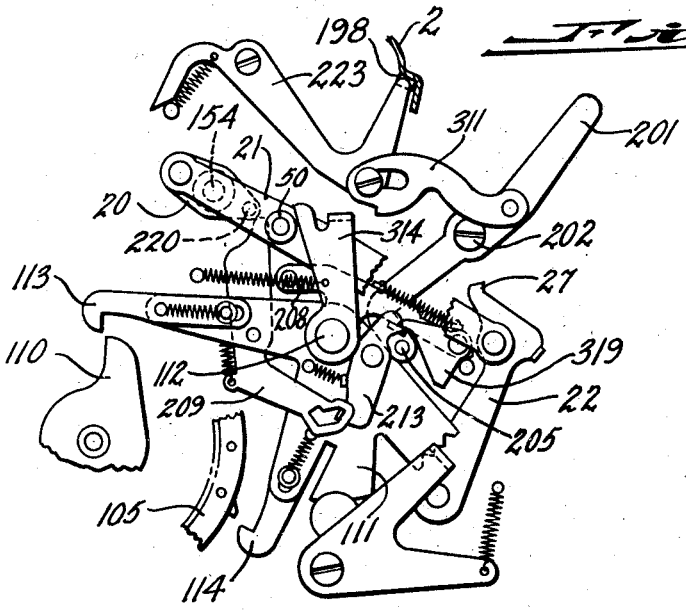


Fig. 6



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UNITED STATES PATENT OFFICE

2,419,760

OPERATION CONTROL MEANS FOR CALCULATING MACHINES

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Application July 13, 1945, Serial No. 604,852

4 Claims. (Cl. 235—63)

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The invention has relation to calculating machines and more particularly to means for controlling additive and subtractive registrations and shifting of the numeral wheel carriage toward the right or left, respectively.

The invention consists in the novel construction and combination of parts, as set forth in the appended claims.

In the accompanying drawings, illustrating the invention,

Fig. 1 is a left side elevation of the rear portion of a calculating machine, with the casing removed.

Fig. 2 is a right side elevation of certain operation controlling keys and associated parts.

Fig. 3 is a rear elevation of the motor drive and carriage shifting mechanism.

Fig. 4 is a perspective view of the carriage shifting mechanism and certain operation controls.

Fig. 5 is a left side elevation showing a modified structure of certain parts illustrated in Fig. 1 and of certain additional parts used in automatic division calculations.

Fig. 6 is a similar view of other automatic division parts.

The invention is shown as applied to a Monroe calculating machine, constructed in accordance with the disclosures of United States Patents No. 1,566,650, entitled "Operating means for calculators," and issued to George C. Chase on December 22, 1925; and No. 1,888,161, entitled "Automatic control for calculating machines," and issued to the same inventor on November 15, 1932. The devices of these patents are shown as redesigned in accordance with the disclosure of United States Patent No. 1,964,211, entitled "Calculating machines," and issued to Austin A. Overbury on June 26, 1934.

In accordance with these disclosures numeral wheels 13 (Fig. 5) of a product-dividend register are mounted in a transversely shiftable carriage 2 (Fig. 1), and are rotated additively or subtractively upon operation of forwardly or reversely driven differential actuators 5 (Fig. 2), connected with the numeral wheels by intermediate gearing (not shown). Differential actuators 5 are driven from an electric motor 1 (Fig. 3), through the medium of a differential gear clutching and reversing mechanism, having driving connection with a shaft 350, connected in turn to the differential actuators through gearing 14 (Figs. 2 and 3).

Registrations not involving automatic shifting of the carriage 2 are controlled by a plus bar 120 and minus bar 121 (Fig. 2), having link connections 123 with a rock shaft 125 extending across the machine and provided with a setting plate 128 (Fig. 1) having spaced shoulders adapted to engage a pin 130 in reversing clutch lever 111, fulcrumed on the frame at 112. Depression of plus bar 120 will rock shaft 125 in a clockwise direction as viewed in Fig. 2, setting the lever 111 from neutral position into adding position, in which a hook arm 114 of said lever will engage with a lug upon gear 105, forming one leg of the differential drive. Normally the gearing comprising both working legs of the differential will rotate idly, as described in Patent No. 1,566,650, interruption of the movement of one leg causing the planet gears to move in their orbit in one direction and interruption of the movement of the other leg causing a movement in the opposite direction. Depression of the minus bar 121 will effect opposite rocking movement of the members 125, 128 and 111, to bring a hook arm 113 (Fig. 6) of lever 111 into engagement with a stop 110 for the other leg of the differential, whereby the drive of the differential actuators 5 will be effected in the reverse direction.

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Upon manual release of plus bar 120 or minus bar 121 the parts will be brought to rest in full cycle position as follows:

Setting plate 128 is provided with opposed cam faces, operating in the depression of either bar, through a roller 133 to depress the rear end of a lever 134. This movement of lever 134 carries a pawl 136, mounted upon said lever into position beneath a trigger 31 normally engaging a pawl 25 mounted upon a stop arm 24, and serving to hold said pawl inactive. Upon release of the key, suitable springs will return lever 134 to normal position, causing pawl 136 to raise trigger 31 and release pawl 25, the latter dropping into position behind a shoulder 27 of rock arm 22, connected to shaft 154 by crank 20 and link 21. Shaft 154 is driven in one-to-one ratio with actuators 5, by means of gearing 351, shaft 350, etc. Engagement of pawl 25 with shoulder 27 connects the arms 22 and 24 to operate in unison, the latter arm being carried against a fixed stop 29, to prevent further rotation of the parts in the original direction. Upon the rebound of the parts from stop 29, a lug of pawl 25 will engage with the end of trigger 31 and lift said pawl out of engagement with shoulder 27.

In the movement of arm 24 against stop 29 a rearward extension 144 of said arm will engage a pin 145 of reversing clutch lever 111, and through the action of one or the other of two opposed cam faces of said extension, will move said lever to its

central or neutral position. Lever 111, in moving to either of its active positions, is adapted to close the contacts of a circuit breaker, interposed in the motor circuit, by means of an arm 200.

All of the mechanism follows the disclosures of the patents hereinbefore referred to.

According to the present invention, it is desired to simplify and otherwise improve the operation controls of the machine by utilizing the means which control the extent and direction of actuator movement to control the extent and direction of shift of the carriage 2. For this purpose two friction clutches 352, 353 are provided, as shown in Fig. 3, the driving elements of these clutches being connected for rotation as a unit by a sleeve 354. The driving elements of clutches 352 and 353 are connected to the output gear of the differential gear drive by means of a gear 355 secured to the driving member of clutch 353. The driven member of clutch 352 consists of a collar 356, fast upon shaft 350, a series of friction disks being interposed between the driving member of the clutch and the driven member 356. Normally clutch 352 is held under spring tension, connecting shaft 350 with the electric motor.

Clutch 353, which is normally disengaged, has a driven member similar to member 356 of clutch 352 except that it is freely supported on shaft 350 and is provided with gearing connection 357 with the shaft of the carriage shift worm 358. Worm 358 is engaged by a spring plunger 359 depending from carriage 2, the carriage thus being shifted to the right or to the left upon rotation of the worm 358 in one or the other direction.

Sleeve 354 is moved to the right or to the left, and is held under spring tension in either shifted position, to engage clutch 352 or clutch 353 by means of a toggle arrangement shown best in Fig. 4. A shifting arm 360 is provided with an anti-friction roller engaging between flanges of sleeve 354, and is pivoted at one end to a link 361, having pivotal connection to the machine framing, and at the other end has connection with one link of a toggle 362, the far end of this toggle being also pivotally secured to the machine frame. In the normal position of the parts toggle 362 is fully extended, holding arm 360 against the tension of a spring 363 in position to engage clutch 352, the clutch being yieldingly held engaged under the tension of a spring 364, connected to link 361. In order to disengage clutch 352 and engage clutch 353 means are provided for breaking the toggles 362, thereby allowing spring 363 to move sleeve 354 to the right as viewed in Fig. 3, clutch 353 being now held in engaged position under the tension of spring 363. For breaking the toggle a shaft 365 is provided with a finger 366, said shaft having crank and link connection 367 with a bell crank levers 368 (Fig. 2) pivoted to the right hand machine framing.

Bell crank 368 is operated by a right shift key 369 or by a left shift key 370, these keys being mounted in the machine frame closely adjacent to the plus bar 120 and minus bar 121. Right shift key 369 has a shoulder overlying a stud 397 carried by the stem of the plus bar 120, and left shift key 370 has a shoulder overlying a stud 398 in the shank of minus bar 121, both keys being extended downward and provided with slot and pin connection with the bell crank 368. Therefore, depression of key 369 will effect the depression of plus bar 120, effecting additive rotation of clutch 352 and rotation of clutch 353 in a similar direction, and at the same time shaft 365 will be rocked, breaking the toggle and engaging the carriage shift clutch 353. Depression of key 370 will effect the depression of minus bar 121, giving an opposite rotation of the clutches 352 and 353, and also throwing clutch 353 into driving engagement.

Upon release of shift key 369 or 370, it will be necessary, at the end of the cycle of operation, to disengage clutch lever 111 and to restore toggle 362 to latching position, and power means has been provided for this purpose. In this connection it may be noted that, although the plus or minus bar is depressed and released with the shift key, arm 22 will not rock during a shifting operation, and therefore the tripping of trigger 31, as the plus or minus bar is released, will be ineffective. Furthermore, it is desired that the carriage be stopped without overrunning its registering position. A one cycle clutch 371 (Figs. 1, 3 and 4) has driving connection with the shaft of motor 1, and is provided with a cam 372, fast upon the driven member thereof. The clutch is of well known construction, wherein a detent 373 normally holds a spring pawl, mounted on the driven member of the clutch, out of engagement with a ratchet mounted on the driving member. Cam 372 is provided with a spring biased follower 374, to which is pivoted a link 375 (Fig. 1) having pin and slot connection at its forward end with the cycle stopping arm 24.

Upon engagement of clutch 371, cam 372 will operate follower 374 and link 375, to rock the arm 24 clockwise about its pivot, raising the cam extension 144 into contact with the pin 145 of clutch lever 111 and thereby centralizing said clutch lever.

Clutch 371 is tripped as follows:

When toggle 362 is broken upon depression of the right or left shift key a link 376 (Fig. 4), connected to a crank extension of one of the toggle links, will be moved to the right, as seen in that figure, carrying an extension 377 thereof out of restraining engagement with a disk 378, fixed upon a sleeve which is keyed to the shaft 379 of the shifting worm 358. A disk 386 secured to the opposite end of this sleeve is provided with a pin 380, normally lying to the left of a tripping arm 381, secured upon the pivot of clutch detent 373 and having shouldered engagement therewith. A spring 382 urges disk 378 and the associated parts toward the right, but the disk is restrained, after the removal of the restraint of member 377 by engagement with a crank arm 383, secured upon shift initiating shaft 365, which arm is rocked into the path of movement of said disk upon depression of the shift key. Thus arm 383 provides for continuous shifting through a number of places, in case the shift key is held depressed. Upon release of the key, shaft 365 will be restored, under the influence of a spring 384 and disk 378 and pin 380 will be free to slide to the right, bringing the pin into the plane of tripping arm 381. As shaft 379 completes its cycle of operation, pin 380 will contact one of two opposed cam faces of tripping arm 381, putting detent 373 under the tension of a spring 385, which acts to release the detent and effect engagement of clutch 371. The upper end of clutch detent 373 will at this time enter a notch in disk 386, the peripheral surface of disk 386 providing that the clutch shall not be engaged until shaft 379 arrives in full cycle position. In order to prevent the overrun of shaft 379, tripping arm 381 is provided with an extension 387, which is moved

by engagement of pin 380 into the path of movement of a pin 388, which is fixed in a disk rotating with shaft 379, thereby preventing movement of the shaft beyond full cycle position. Because the shaft may be rotating in either direction, pin 388 may engage extension 387 upon one or the other side thereof, for which reason the disk to which pin 388 is fixed has pin and slot lost motion driving connection with gear 357, fast to shaft 379.

It will be apparent that upon release of the key the worm 358 will complete the shift into the next operating position of carriage 2, whereupon pin 380 will release clutch 371, this clutch effecting the release of clutch lever 111, and thereafter completing its cycle and being released by engagement with the detent 373.

During this cycle of clutch 371 a cam 391 (Fig. 3) will be rotated. this cam engaging an extension 392 of link 376 and moving the toggle links 362 back into latching position.

Restoration of toggle 362 will move link 376 to the left, thus restoring disks 378 and 386 to their left-hand position and releasing arm 381 from pin 380. Detent 373 will now be held by a spring 399 in contact with the peripheral flange of clutch 371, ready to drop into clutch disengaging position at the end of the restore cycle. It may be noted that spring 385 is stronger than spring 399. Upon disengagement of clutch 371 the upper end of detent 373 will be removed from the notch of disk 396, and in order to provide a locator which will hold the carriage shift parts in position while they are standing still, a spring biased detent 389, loosely mounted upon shaft 365, normally engages the notch of a disk 390, fast upon shaft 379. Upon breaking of toggle 362, a cam edge of link 376 will engage a lower extension of detent 389 and remove the same from the notch of disk 390, holding the detent disengaged until toggle 362 is restored.

In normalizing the shift control mechanism, release of the main clutch is not effected until clutch 371 starts to operate, and shift shaft 379 must be locked before clutch 371 can be engaged. This condition illustrates the utility of employing clutches (352, 353) of the friction type, since shift clutch 353 may slip briefly during the normalizing cycle, so that the driving element thereof may rotate while engaged with the driven element, after the latter is locked against rotation.

Automatic division

Division is performed in well known manner, by subtracting the divisor from the higher orders of the dividend until the remainder becomes negative, thereupon making a corrective additive cycle, shifting the register carriage to the left and repeating the operations, whereupon the quotient will appear upon a cycle counting register (not shown).

This is all effected automatically, upon setting of a division key or lever 201 into active position. As shown, the lever is rotated counterclockwise from the normal position illustrated in Fig. 5.

Lever 201, which is fulcrumed to the frame at 202 (Fig. 6), in moving to rearward position, will bring pin 205 into engagement with a click pawl 319, mounted upon the forward end of an arm 208, which arm is pivoted upon the fulcrum 112 of reversing clutch lever 111. In this movement, pin 205 will rock the arm 208, a projection in the rearward end of said arm acting upon lever 111 to bring the hook arm 113 of said lever into

engagement with the subtractive member 110 of the differential gear train, thus setting the machine in operation subtractively. Pin 205 passes entirely beyond pawl 319, in this movement, leaving lever 111 free to be adjusted from one to another of its three positions.

The setting of lever 201 has adjusted certain control devices into position to effect the reclutching of lever 111 in its reverse operating position.

For this purpose a finger 209 (Fig. 6) is pivotally connected to the reversing clutch lever 111, being normally held in inactive position by a suitable spring. As lever 201 is moved to active position, arm 208 will contact with finger 209 and will rock the same counter-clockwise about its pivot, as seen in Fig. 6, until it is caught and held in active position by latch 213. In this position finger 209 is so adjusted that whenever lever 111 is brought into its neutral position, the upper end of said finger will lie in the path of movement of a crank pin 220 carried by the shaft 154, pin 220 thus acting to throw the lever 111 into additive or into subtractive position according to the direction of rotation of shaft 154.

Upon the completion of the quotient figure registration in each denominational order, the registration in this order is terminated, register carriage 2 is shifted to the left and the registration in the next lower order is initiated by means of the full cycle stopping devices above described and additional devices for modifying the action of the stopping devices, all of these means, having been set into active position, being controlled in their operation through the trigger 31.

Push rod 47 (Fig. 5) is intermediately pivoted upon arm 24, the rear end of said rod being adapted for engagement by a stud 50 of the link 21. At the end of an additive operation, crank arm 20, rotating counter-clockwise, as seen in Figs. 5 and 6, will be carried downwardly, through its dead center position, before the arm 24 engages stop 29, this movement bringing stud 50 against the end of push rod 47 and acting to hold the forward end of this rod upward, in contact with a stud 51 of a hook arm 261. At the same time the forward movement of arm 24 will carry arm 261 forwardly about its pivot 53. It will be noted that where the movement of arm 24 follows a subtractive operation, the crank 20 will sweep upwardly through dead center position, and push rod 47 will be free to pass under stud 51. Automatic shifting is controlled by a member 262 carried by a lever 52 and adapted to engage beneath the hook of arm 261 when lever 201 is set to active position. For this purpose a plate 263 is pivoted at 53, normally held in raised position by engagement of the pin 205 of lever 201 with a rearward seat of the plate as seen in Fig. 5, movement of lever 201 to active position bringing pin 205 into contact with a forward seat of said plate, adapted to permit the plate to drop into its lower position. The member 262 has a lug 264 engaging plate 263, so that as said plate drops to its lower position, member 262 is rocked rearwardly by a suitable spring, into contact with the hook of arm 261.

A link 393 connects lever 52 with a crank arm of shift initiating shaft 365, this crank arm not being shown in Figs. 3 and 4, since it is not employed unless the machine is equipped for the performance of automatic division. It will be apparent that when arm 24 is moved forwardly at the end of an additive cycle of the parts, push rod 47 will operate members 261 and 262, rock-

ing lever 52 and shaft 365, to disengage clutch 352 and engage clutch 353, to start a shift of register carriage 2 in the manner previously described. Of course, arm 24 and the parts connecting that arm with shaft 365 will be displaced only momentarily, so that at the end of a single cycle of shifting movement the carriage will be brought to rest.

At the end of the shifting operation, clutch lever 111 will not be centralized, as in the operations previously described, since it is necessary in division calculations that the machine should continue with the computation of the next quotient, or in other words that a subtractive operation should be initiated when the shift is completed. It will be recalled that at the end of the corrective additive cycle clutch lever 111 is thrown into subtracting position, and since the reverse gearing controls a shift to the left in the same manner that it controls subtraction, the carriage was shifted accordingly. Therefore, at the end of the shifting movement, clutch lever 111 is properly set for continuing the operation, and the previously described change from engagement of clutch 353 to engagement of clutch 352 is all that is necessary in order to continue division operations. Therefore, in the form of mechanism illustrated in Fig. 5 means are provided for disabling the link connection between cam follower 374*a* and arm 24. Thus, in this form of the mechanism a link 394 is pivotally connected with arm 24, and its rearward end has a lug lying normally in the path of movement of follower 374*a*. The rearward end of link 394 is connected through a link 395 with a bell crank lever 396, fulcrumed upon the machine frame and connected at its upper end with the pin 205 of division lever 201. In the normal position of the parts, illustrated in Fig. 5, bell crank lever 396 will support the rearward end of link 394 in the position described. However, upon setting of division lever 201 to active position, bell crank lever 396 will be rocked clockwise, and the rearward lug of link 394 will be lifted and held out of the path of movement of follower 374*a*.

Division operations are concluded as follows:

A lug 198 (Fig. 6) is provided on the carriage 2, said lug being adapted as the carriage is seated in last place position to depress a lever 223, having pin and slot connection with a link 311, pivoted upon the division lever 201, this movement carrying a shoulder of said link into the path of movement of an arm 314 pivoted upon the stud 112 and engaged by the roller 50 of link 21. When the carriage arrives in the last place position, the parts are in rotation in a subtractive direction, shaft 154 being rotated clockwise as seen in Fig. 6 until the arm 24 is carried against the stop 29. During this movement of shaft 154 stud 50 will, through arm 314 and link 311, restore lever 201 to inactive position.

After the contact of arm 24 with stop 29 the parts will rebound and the clutch will be thrown into additive position. This movement of the clutch will bring the latch 213 of the reversing finger 209 against the pin 205 of the retracted division lever 201, and will trip the latch and allow the reversing finger to be restored to inactive position, so that the parts will operate to stop the machine in full cycle position, as described above in connection with single order operation.

I claim:

1. In a calculating machine having a transversely shiftable carriage and numeral wheels mounted thereon, reversible rotary differential actuators for said numeral wheels and reversible rotary carriage shifting devices; cyclically operable drive means common to said actuators and shifting devices including clutch and reversing elements adjustable to effect forward or alternatively reverse rotation thereof, means adjustable to engage the drive means alternatively with the actuators or with the shifting devices, and adjusting and clutch control means including power elements operable at the conclusion of a shifting operation to disengage the clutch elements and to readjust the engaging means.

2. In a calculating machine having a transversely shiftable carriage and numeral wheels mounted thereon, reversible rotary differential actuators for said numeral wheels and reversible rotary carriage shifting devices; cyclically operable drive means common to said actuators and shifting devices including elements adjustable to control forward or alternatively reverse rotation thereof, a friction clutch between the drive means and the differential actuators, a friction clutch between the drive means and the shifting devices, and means adjustable to engage one or alternatively the other of said clutches.

3. In a calculating machine having a transversely shiftable carriage and numeral wheels mounted thereon, reversible rotary differential actuators for said numeral wheels and reversible rotary carriage shifting devices; cyclically operable drive means common to said actuators and shifting devices including elements adjustable to control forward or alternatively reverse rotation thereof, a friction clutch between the drive means and the differential actuators, a friction clutch between the drive means and the shifting devices, means adjustable to engage one or alternatively the other of said clutches, a toggle latch normally holding the engaging means in actuator clutching position, means manipulable to break the toggle, and power means for restoring the toggle to latching position.

4. In a calculating machine having a transversely shiftable carriage and numeral wheels mounted thereon, reversible rotary differential actuators for said numeral wheels, reversible rotary carriage shifting devices, and means including a key for controlling division calculations; cyclically operable drive means common to said actuators and shifting devices including clutch and reversing elements adjustable to forward or alternatively reverse rotation thereof, means adjustable to engage the drive means alternatively with the actuators or with the shifting devices, power means operable at the conclusion of a shifting operation and including elements for readjusting the engaging means and elements normally acting to disengage the clutch elements, and means settable by the division key to disable the clutch disengaging elements.

EDWIN F. BRITTEN, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,292,513	Rechnitzer	Jan. 28, 1919
1,964,211	Overbury	June 26, 1934
2,009,010	Friden	July 23, 1935

Certificate of Correction

Patent No. 2,419,760. April 29, 1947.

EDWIN F. BRITTEN, JR.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Column 3, line 5, for "the" before "mechanism" read *this*; column 7, line 14, after the syllable "tient" and before the comma insert the word *figure*; column 8, line 53, claim 4, before "forward" insert *effect*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of September, A. D. 1947.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.