June 13, 1933. C. M. F. FRIDEN 1,913,630

CALCULATING MACHINE

Original Filed April 13, 1926 4 Sheets-Sheet 1

FIG. 1.

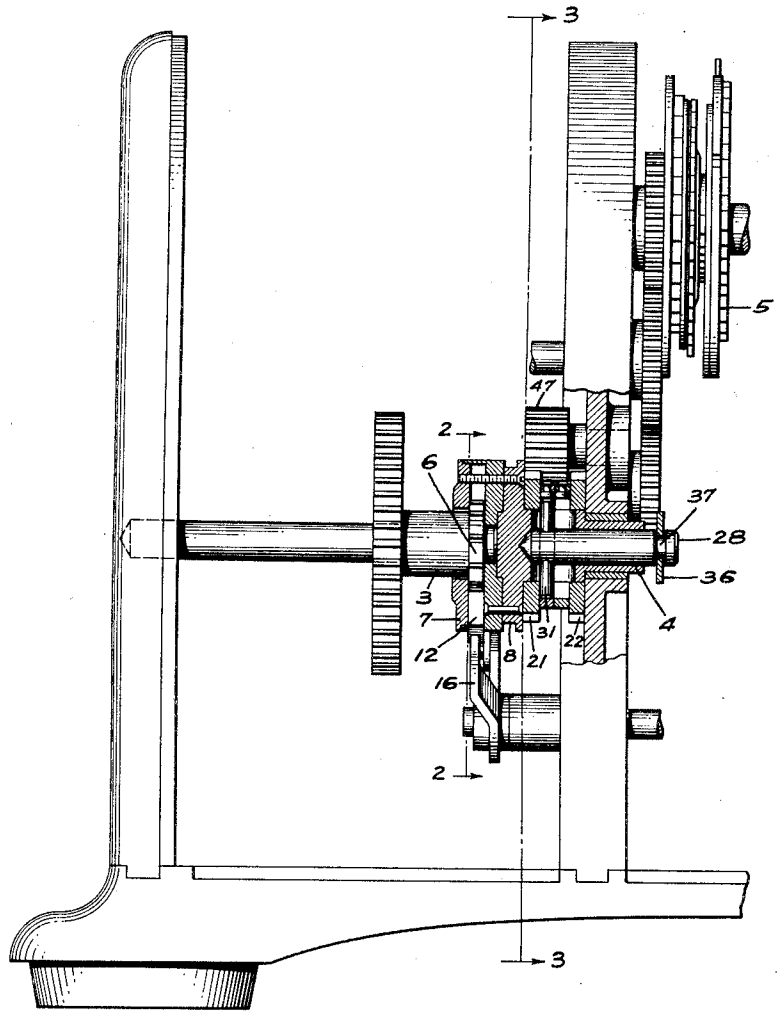
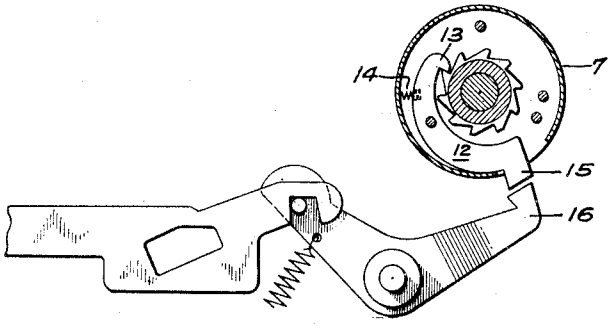


FIG. 2.



INVENTOR
Carl M. F. Friden
BY White & Frost
his ATTORNEYS

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CALCULATING MACHINE

Original Filed April 13, 1926 4 Sheets-Sheet 2

FIG. 3.

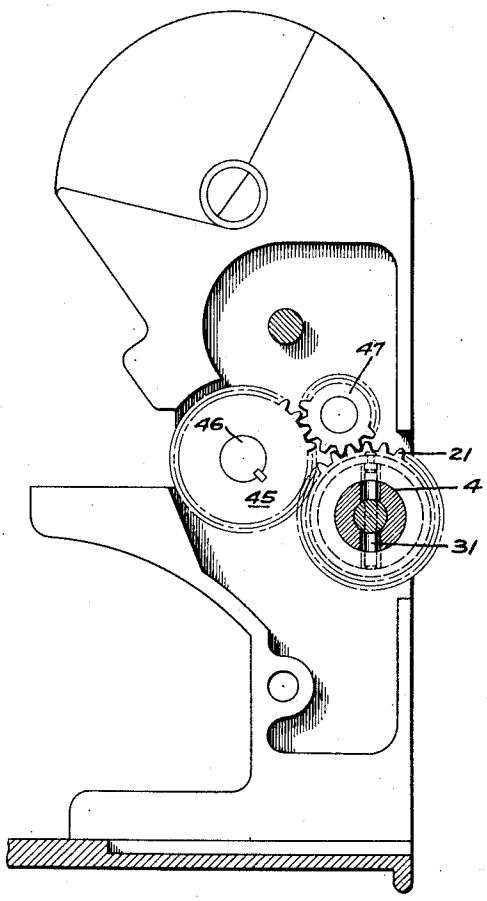


FIG. 4.

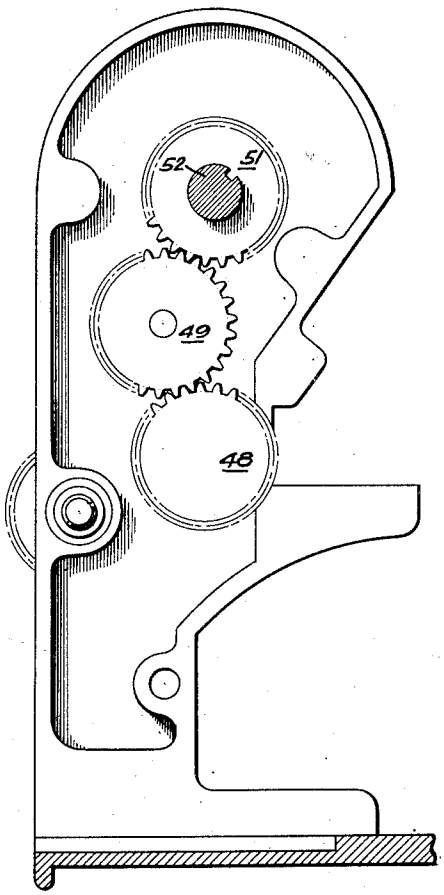


FIG. 5.

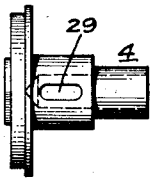


FIG. 6.

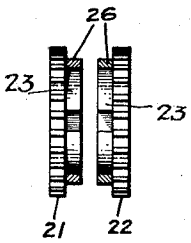
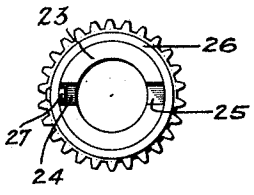


FIG. 7.



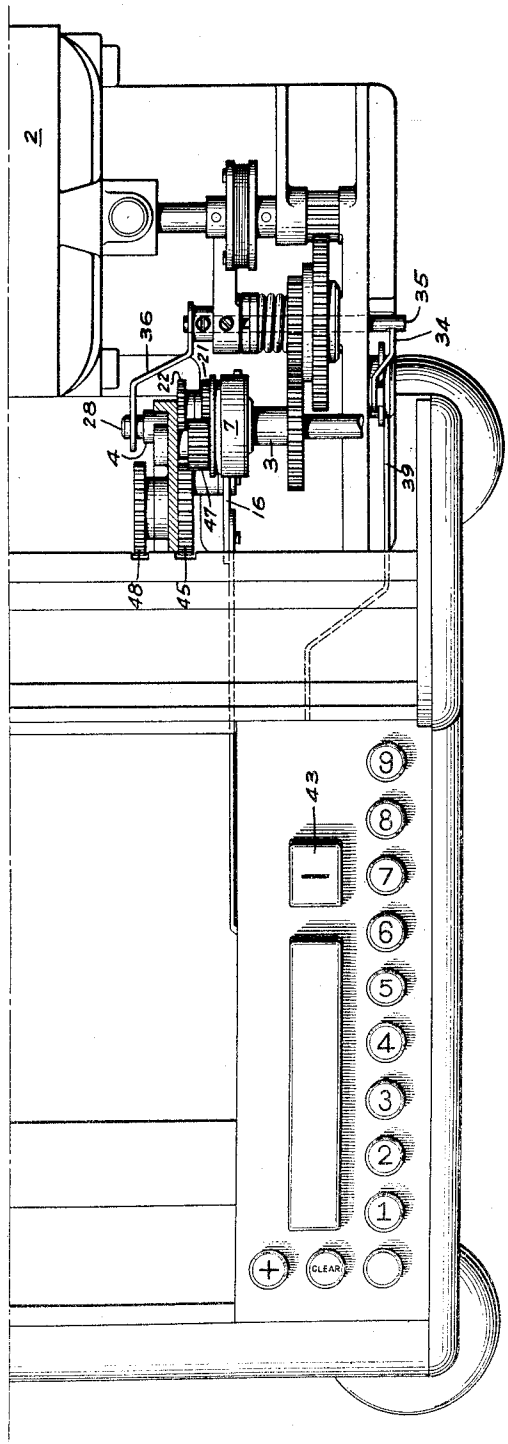
INVENTOR
Carl M. F. Friden
BY White & Post
his ATTORNEYS

June 13, 1933. C. M. F. FRIDEN 1,913,630

CALCULATING MACHINE

Original Filed April 13, 1926 4 Sheets-Sheet 3

FIG. 3.



INVENTOR
Carl M. F. Friden
BY White & Prat
his ATTORNEYS

June 13, 1933. C. M. F. FRIDEN 1,913,630

CALCULATING MACHINE

Original Filed April 13, 1926 4 Sheets-Sheet 4

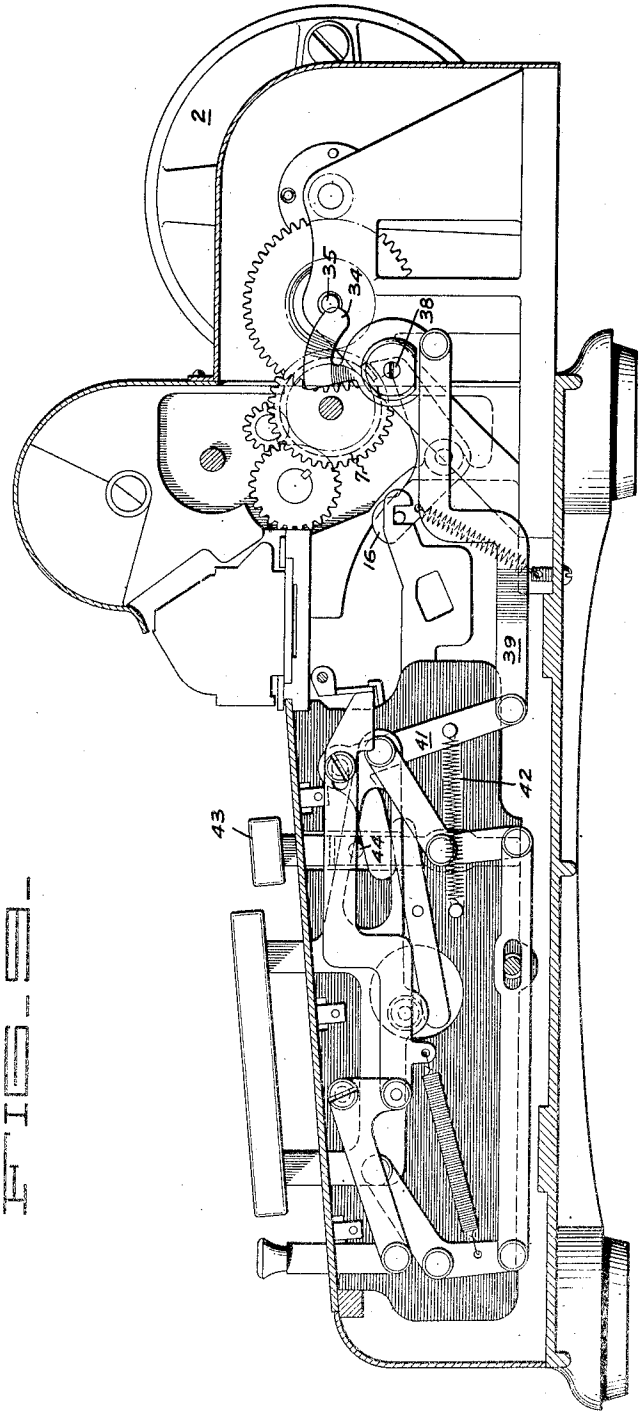


FIG. 5.

INVENTOR
Carl M. F. Friden
BY White & First
his ATTORNEYS

Patented June 13, 1933 1,913,630

UNITED STATES PATENT OFFICE

CARL M. F. FRIDEN, OF PIEDMONT, CALIFORNIA, ASSIGNOR TO MARCHANT CALCULATING MACHINE COMPANY, OF EMERYVILLE, CALIFORNIA, A CORPORATION OF CALIFORNIA

CALCULATING MACHINE

Original application filed April 13, 1926, Serial No. 101,658. Divided and this application filed August 31, 1926, Serial No. 132,698. Renewed August 30, 1929.

This application is a division of my copending application Serial No. 101,658, filed April 13, 1926, which has resulted in Patent No. 1,682,901.

An object of the invention is to provide a calculating machine having a reversible rotary actuator with a reversing gearing which is arranged to cause stopping of the actuator to occur at full cycle position only, and which can be engaged while parts are in motion.

Another object of the invention is to provide an improved reversing mechanism that cannot be operated to disturb the timing of the reversible element.

A further object of the invention is to provide a reversing mechanism including a number of gears which are always maintained in engagement, so that timing of the reversible element is not disturbed, and which can be engaged without disengaging the driving means of the machine.

The invention possesses other advantageous features, some of which with the foregoing will be set forth at length in the following description, where I shall outline in full that form of the invention which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown a calculating machine of the rotary type provided with a reversing mechanism, but it is to be understood that the invention as set forth in the claims, may be embodied in a plurality of forms.

Referring to said drawings:

Figure 1 is an elevation of a portion of a calculating machine employing the reversing mechanism, the reversing mechanism being shown in section.

Figure 2 is a vertical section of the clutch with which the reversing mechanism is associated, taken on the line 2—2, Figure 1.

Figure 3 is a section of the calculating machine taken on the line 3—3 Figure 1.

Figure 4 is an elevation of a portion of the calculating machine showing the opposite side of the standard shown in Figure 3.

Figure 5 is an elevation of the driving shaft on which the reversing gears are journalled.

Figure 6 is an end elevation of the pair of reversing gears, the rings surrounding the shoulders on the gears being shown in section.

Figure 7 is a side elevation of one of the gears.

Figure 8 is a top or plan view of a portion of a calculating machine showing the reversing gear.

Figure 9 is a vertical longitudinal section through a calculating machine showing the means for actuating the reversing gear.

The reversing mechanism is particularly adapted for use in calculating machines of the rotary type, having a reversible rotary actuator which has a single full cycle stop position. In calculating machines of this type it is essential that the actuator always be brought to a stop in full cycle position and therefore it is essential that a reversing mechanism be employed which will prevent the reversal of the actuator at any time other than that which will result in the actuator being brought to a stop at full cycle position. Ordinarily in the present machine, the reversing mechanism is actuated to reverse the direction of rotation of the actuator, only when the actuator is stopped in full cycle position. However, in practical operation, the reversing control may be actuated while the actuator is in rotation. Under such a condition either of two things may occur. If the control is actuated before the actuator reaches half cycle position, the reversal will occur in half cycle position and the timing of the actuator with respect to the driving shaft will be undisturbed. If the control is actuated after the actuator passes half cycle position and before it reaches full cycle position, the reversal will occur in full cycle position and the timing will be likewise undisturbed. Under either condition, the clutch will be maintained engaged and the actuator will not be locked at any time during the reversal.

Calculating machines of this type comprise a driving motor 2, which is connected through suitable gearing with an operating shaft 3, which is rotated continuously with the motor. Interposed between the operating shaft 3 and the driving shaft 4 is a clutch and

stop mechanism, having a single full cycle position. Interposed between the driving shaft 4 and the rotatable actuator 5, rotation of which serves to introduce values entered into the actuator, into the counting mechanism, is a reversing gear whereby the direction of rotation of the actuator may be reversed. The actuator has a single full cycle position, corresponding to the single full cycle position of the clutch, and the reversing mechanism is so constructed that the timing relation of the clutch and the actuator is not disturbed by the operation of the reversing mechanism.

Secured to the operating shaft 3 is a clutch ratchet 6 which is disposed within the clutch housing 7 which is secured to the flange 8 on the end of the hollow driving shaft 4. Pivoted in the end of the housing 7 is a clutch dog 12 having a tooth 13 on one end adapted to engage the ratchet 6. The dog 12 is urged in a direction to cause engagement of the tooth with the ratchet by the spring 14. The clutch dog 12 is provided on its other end with a projection 15 which when the tooth is in engagement with the ratchet, extends outward through an aperture in the clutch housing 7. Means, such as the lever 16, are provided for engaging the projection 15 and depressing it into the housing, thereby disconnecting the lever 12 from the ratchet 6. The end of the lever 16 extends into the aperture in the wall of the housing, thereby bringing the housing to rest in full cycle position. In the operation of the calculating machine, the lever 16 is normally in engagement with the housing and operation of the lever 16 to remove it from engagement with the housing, causes engagement of the clutch and the operation of the calculating machine until the lever 16 subsequently disengages the clutch.

Journaled on the hollow shaft 4 are two contiguous gears 21 and 22, each gear being provided on one side with an annular shoulder 23, the shoulders of the two gears being arranged contiguously. Each shoulder 23 is provided with two diametrically opposed slots or seats 24 and 25, the two seats being of different lengths radially, for reasons which will hereafter appear. For purposes of production it is advantageous to cut the two seats at one operation and to make them both of the same length radially, and one of the seats 24 is subsequently shortened to make it of different length radially than the seat 25. The shortening of the seat 24 is preferably accomplished by the use of a ring 26, engaging the annular shoulder 23 and being provided with a projection 27 which extends into the seat 24. The extension 27 may comprise a stud or screw seated in the ring 26. It is understood that there are two rings 26, one for each of the gears 21 and 22, so that each gear is provided with two sets of seats of different lengths radially.

Disposed in the hollow shaft 4 and arranged for longitudinal movement therein, is a stub-shaft 28 (Figure 1) carrying a transverse pin 31 in its portion underlying the seats of the gears 21 and 22, either end of which is disposed in opposite radial slots 29 in the hollow shaft 4 and extends a sufficient distance beyond the periphery of shaft 4 to permit their seating in the radial slots 24 and 25 provided in the contiguous annular shoulders 23 of the gears 21 and 22. The two ends of the pin 31 are of different length, one end being adapted to seat in either of the short slots 24 and the other being adapted to seat in either of the long slots 25. The pin is of such diameter that it will seat in the slots in one gear and be out of engagement with the slots in the contiguous gear. The stub-shaft 28 is movable longitudinally to move the pin 31 from engagement with the seats in one gear into engagement with the seats in the other gear. The gears 21 and 22 are rotated in opposite directions, as will hereinafter appear, and due to the difference in the length of the slots 24 and 25 and the length of the two ends of the pin 31, the pin may be shifted only after the gears 21 and 22 have made a half or a whole revolution, or a multiple of a half or a whole revolution. In other words, it is impossible to shift the pin 31 at any point other than the half cycle or full cycle position of the gears 21—22. When the gears 21—22 are in full cycle position, as indicated in Figure 1, the clutch housing is in full cycle position and the actuator is in full cycle position. Normally the pin is shiftable only when the actuator is in full cycle position, but, in the event it is shifted when the actuator is in half cycle position, the clutch housing will simultaneously be in half cycle position, so that the relationship of the actuator to the clutch housing is not disturbed. The clutch housing can be stopped only in full cycle position and consequently with this reversing gear, regardless of the time of reversal, the actuator will always stop in full cycle position.

The stub-shaft 28 is moved longitudinally by means of the rocking cam 34 which engages a slot in the end of the longitudinally movable rod 35. Secured to the other end of the rod 35 is a yoke 36, which engages an annular groove 37 in the end of the stub-shaft 28. The rocking cam 34 is rocked on its pivot 38 by the link 39 which is connected to the bell crank lever 41, suitably fulcrumed within the calculating machine. The lever 41 is normally held in one position by the spring 42 and in Figure 9 is shown as being displaced against the tension of the spring, by the depression of the control key 43, which key is provided with a pin 44 which engages the bell crank lever 41. Therefore, depression of

the key 43 operates to shift the reversing gear to reverse the direction of rotation of the actuator, and release of the key 43 permits the spring 42 to return the shifting mechanism to normal position.

In Figures 3 and 4, only a few of the teeth on each of the gears are shown, but it is to be understood that the gears are complete gears being provided on their peripheries with regularly spaced teeth. Meshing with the reversing gear 22 is a gear 45 of equal pitch diameter, which is secured to the shaft 46, suitably journaled in the machine. Meshing with the gear 45 and with the other reversing gear 21 is an idler gear 47. Secured to the shaft 46 is a gear 48 of the same pitch diameter which meshes with a similar gear 49, which in turn meshes with a similar gear 51, secured to the shaft 52 of the actuator 5. By longitudinally shifting the pin 31, the direction of rotation of the gears 21 and 22 is reversed and consequently the direction of rotation of the gear 45 and consequently the direction of rotation of the gear 51, is reversed, thereby causing reversal of the direction of rotation of the actuator 5. The gears 21 and 22 are rotated at a fairly high speed, so that the accidental shifting of the pin 31 while the gears are in rotation is substantially precluded, but, should such accidental shifting occur, the timing of the actuator with respect to the stop mechanism will not be disturbed, so that the actuator will always be brought to rest in full cycle position. The devices for actuating the clutch lever 16 to cause engagement and disengagement of the clutch are shown in my Patent No. 1,643,710, issued September 27, 1927, to which reference is hereby made for a more complete disclosure of the calculating machine.

I claim:

1. In a calculating machine, a calculating mechanism normally locked against operation, means for controlling operation of said calculating mechanism including a plurality of gears constantly enmeshed and a selectively operable engaging means therefor, means for unlocking said calculating mechanism and selectively operating said engaging means to initiate an operation, and means for maintaining said calculating mechanism unlocked and operating said engaging means to terminate the initial operation and initiate a different operation.

2. In a calculating machine, a calculating mechanism having a cyclic mode of operation, means for positioning said calculating mechanism in full cycle position comprising an obstructing means adapted to be maintained in obstructing position as long as said calculating mechanism is at rest in full cycle position, means for continuing the cyclic movement of the calculating mechanism in a direction opposite to the original direction and to restrain said obstructing means from obstructing position.

3. In a calculating machine, a calculating mechanism having a cyclic mode of operation, means operable in full cycle position of said calculating mechanism for reversing said calculating mechanism, means operable in full cycle position of said calculating mechanism for locking said calculating mechanism against cyclic movement, means for disabling said locking means to permit continued cyclic movement of said calculating mechanism, and means for automatically operating said reversing means during cyclic movement of said calculating mechanism rendered effective as an incident to the operation of said disabling means.

4. In a calculating machine, a calculating mechanism having a cyclic movement, means for locking said calculating mechanism against cyclic movement, means for initiating subtractive operation of said calculating mechanism, means for disabling said locking means to permit continued cyclic movement of said calculating mechanism, and automatically operating means enabled by said disabling means for terminating subtractive operation and initiating additive operation.

5. In a calculating machine, a calculating mechanism, means for reversing said calculating mechanism, means for locking said calculating mechanism, and means for operating said reversing means when said locking means is operative or inoperative upon said calculating mechanism.

6. In a calculating machine, calculating mechanism, driving means and reversing means therefor, means for locking said calculating mechanism, and means to disable said locking means and to operate said reversing means while said calculating mechanism is in driving engagement with said driving means.

7. In a calculating machine, calculating mechanism, a driving control and transmission mechanism for initiating, maintaining, and terminating the operation of said calculating mechanism and for determining the direction of operation of said calculating mechanism, in combination with means normally operating to lock said calculating mechanism in stopping position, rendered inoperative by said driving control and transmission mechanism when said mechanism operates to reverse and maintain the operation of the calculating mechanism.

8. In a calculating machine, a reversible actuator, means for controlling the actuator for continuous operation through a plurality of cycles including a reversal means normally operative in full cycle position to lock the actuator against cyclic movement, and means operated as an incident to the operation of

said controlling means for retaining said locking means in inoperative position.

9. In a calculating machine, a plurality of drive initiating and direction controlling means for controlling the operation of a calculating element, locking means for said calculating element, reversing means interposed between said driving means and the calculating element, said reversing means being operable by the controlling means during locked or unlocked positions of the locking means.

10. In a calculating machine, a reversible rotary actuator, a drive shaft for said actuator, a clutching and reversing transmission mechanism interposed between said drive shaft and actuator, including a pivoted member having a shoulder thereon adapted to hold the actuator against cyclic movement when said shoulder abuts a second shoulder or abutment, control means for all of said mechanism including reversing means operable to reverse direction of the actuator and means operable by said control means to hold the locking means ineffective during reversing operation.

11. The combination with an element rotatable substantially 360 degrees from full cycle position back to full cycle position, of a driving shaft, a clutch arranged to stop the driving shaft in full cycle position, and reversing gearing interposed between the element and the driving shaft, said reversing gearing being constructed to permit reversal of the element only at such time that stopping of the driving shaft in full cycle position by the clutch will stop the element in full cycle position.

12. In a calculating machine, a reversible rotary actuator having a single full cycle position, a driving shaft rotatable in one direction, and reversing gearing interposed between the actuator and the driving shaft, said gearing being constructed to permit reversal of the actuator without disengagement of the drive, only at such times that the actuator will invariably stop in full cycle position on stoppage of the driving shaft.

13. In a calculating machine, a reversible rotary actuator, a driving shaft rotatable in one direction, reversing gearing interposed between the actuator and the driving shaft including a member shiftable during rotation of the actuator to cause reversal of the direction of rotation of the actuator, a spring normally holding said member in position to determine the direction of rotation of the actuator and a key depressible to shift said member against the tension of said spring.

14. In a calculating machine, a reversible rotary actuator, a driving motor rotatable in a single direction, a driving shaft, a clutch interposed between the motor and the driving shaft, a reversing gearing interposed between the driving shaft and the actuator and means operative while the clutch is maintained in engagement for operating the reversing gearing to reverse the direction of rotation of the actuator.

In testimony whereof, I have hereunto set my hand.

CARL M. F. FRIDEN.