CALCULATING MACHINE

Original Filed Dec. 18, 1933 2 Sheets-Sheet 1

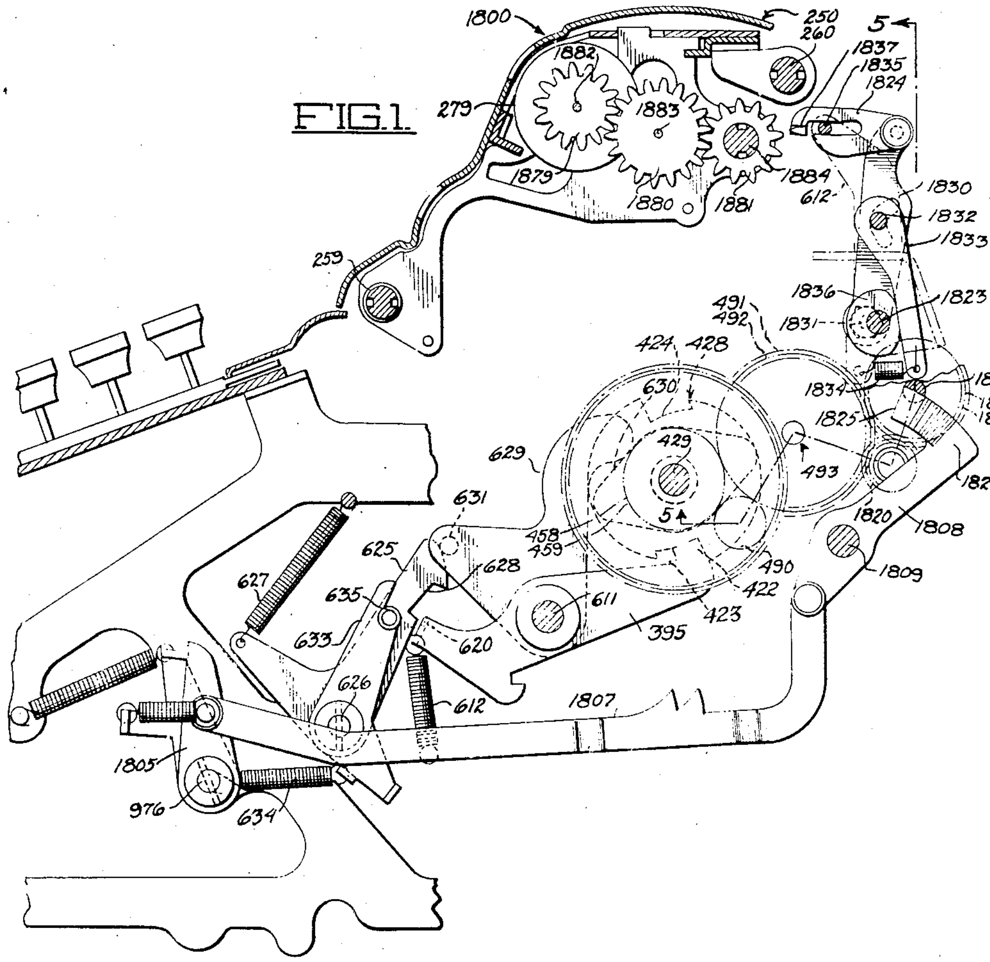

FIG. 1.

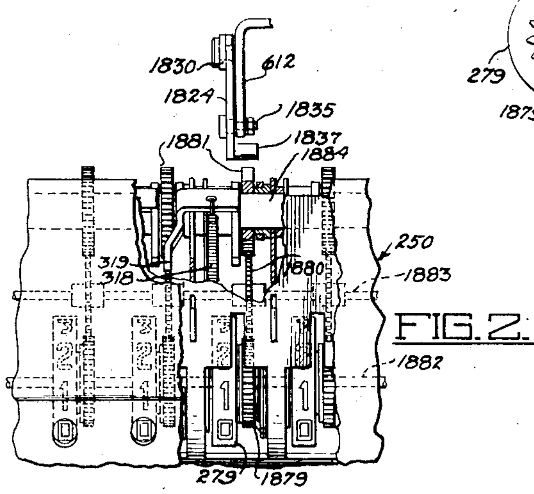

FIG. 2.

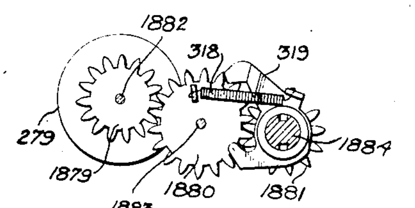

FIG. 3.

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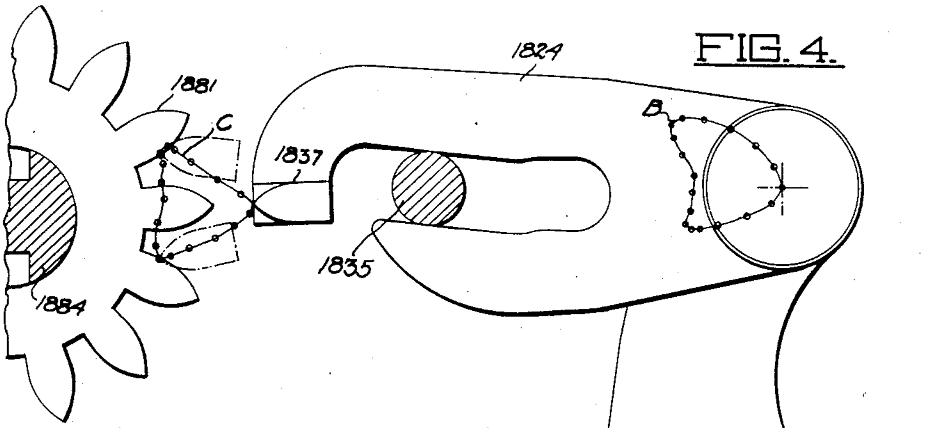
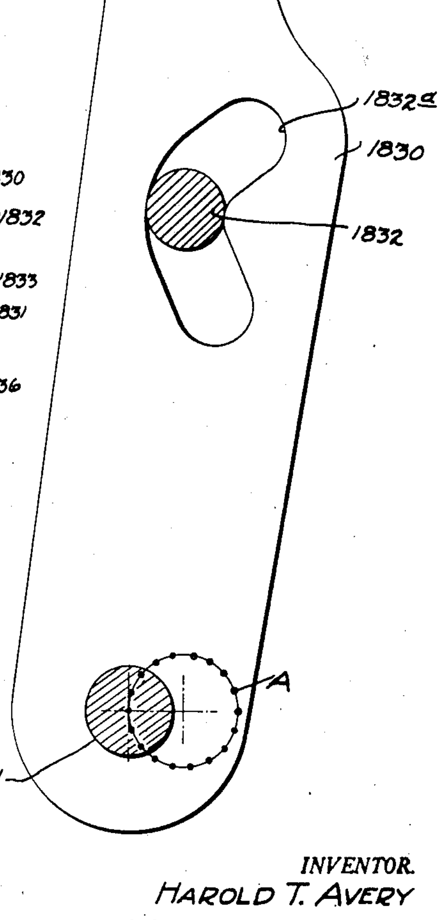
Original Filed Dec. 18, 1933 2 Sheets-Sheet 2

FIG. 4.

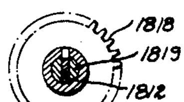


FIG. 6.

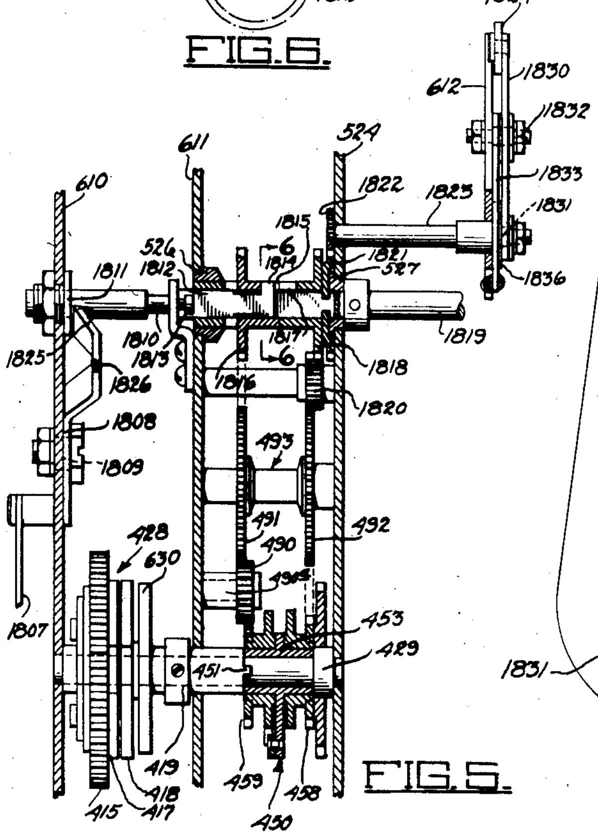


FIG. 5.

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2,267,890

UNITED STATES PATENT OFFICE

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CALCULATING MACHINE

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Original application December 18, 1933, Serial No. 702,949, now Patent No. 2,211,736, dated August 13, 1940. Divided and this application November 20, 1939, Serial No. 305,311

7 Claims. (Cl. 74—118)

The present invention relates to calculating machines and the like and has particular reference to counter actuating mechanisms and controls therefor.

In high speed calculating machines, the intermittently actuated registering mechanisms, such as those used to additively or subtractively register the machine cycles in terms of multiplier, quotient, etc., tend to overthrow due to momentum. In attempting to overcome this tendency, spring pressed pawling mechanisms have been incorporated. If these pawling mechanisms are relied on, in themselves, to prevent overthrow, strong springs must be used which introduce considerable noise and vibration, as well as wear. Furthermore, the force required to actuate such registering mechanisms against the action of these springs is much greater than that required to actuate the registering mechanisms alone.

Bearing in mind the above defects, the general object of the present invention is to provide counter actuating mechanism which will positively prevent overthrow of the counter registering mechanism when operated at high speeds.

Another object is to provide a counter actuating mechanism of this character which is reversible.

Another object is to provide a counter actuating mechanism of this character which remains out of engagement with the counter mechanism while at rest, in order to permit transverse movement between the counter and its actuator.

A still further object is to generally simplify and improve counter actuating mechanism of the class described.

The manner in which the above and other objects of the invention are accomplished will be readily understood on reference to the following specification when read in conjunction with the accompanying drawings wherein:

Figure 1 is a transverse sectional view, partly deleted, of a calculating machine and illustrating a counter actuating mechanism embodying the present invention.

Figure 2 is a top plan view of a part of the carriage with parts broken away to show the counter registering mechanism.

Figure 3 is a transverse sectional view through the counter registering mechanism.

Figure 4 is an enlarged detail view of the counter operating mechanism, illustrating its movement diagrammatically.

Figure 5 is a sectional view through the driving and reversing unit for the counter actuating mechanism, as well as the control therefor, and is taken substantially along the line **5—5** of Figure 1.

Figure 6 is a transverse sectional view through the counter reversing unit and is taken along the line **6—6** of Figure 5.

The machine embodying the present invention is of the type disclosed and claimed in the applications of Avery, entitled Calculating machines, Serial Number 653,207, filed January 23, 1933 (now Patent Number 2,229,630, issued January 28, 1941), of which the present application is a continuation in part, and Serial Number 702,949, filed December 18, 1933 (now Patent Number 2,211,736, issued August 13, 1940), of which the present application is a division, and to which patents reference is made for a disclosure of a complete calculating machine. It is to be understood, however, that although this invention is shown applied to the type of machine disclosed in the above mentioned patents, the invention is not limited to use therewith, but may be utilized advantageously even in simple revolution counters.

Referring to Figures 1 and 2, a counter, generally indicated at **1800**, is shown as being provided in the upper portion of a carriage **250** transversely shiftable along support shafts **259** and **260**, for the purpose of counting the number of machine cycles and thereby registering the number of operations in addition or subtraction, as well as serving as a multiplier register in multiplication operations and a quotient register in division operations.

The counter proper comprises an ordinal series of dials **279** connected together by suitable tens-carrying mechanism (not shown). Each dial is provided with digit numerals from "0" to "9," equally spaced therearound, and is adapted to be driven through a train of gears **1879**, **1880**, and **1881** rotatably mounted on shafts **1882**, **1883**, and **1884**, respectively. Each dial is connected to its respective gear **1879** by a planetary gear system (not shown) whereby the dial is normally advanced one-tenth of a revolution for each one tooth advancement of gear **1879**. One of the gears **1881**, depending on the position of the carriage **250** along the pair of parallel carriage supporting shafts **259** and **260**, is intermittently advanced an increment of one tooth at a time by a counting finger **1824** which is moved through a roughly triangular path on each cycle of operation (one-half revolution) of a main clutch **428** through a train of gears and a counter actuator to be described later. The ratios of the various gears **1879**, **1880**, and **1881** are such that for each advancement of a gear **1881** by the counting finger **1824**, the corresponding dial will be advanced from one numeral thereon to the next.

The clutch 428 is engaged to initiate one or more machine cycles by rocking clutch dog 395 clockwise against the tension of spring 612, in a manner described in the above mentioned applications, and it is to be noted that the clutch, the construction of which is described in detail in the aforesaid application Serial Number 702,949, has a normal cycle consisting of half a revolution so that if clutch dog 395 is rocked, even for an instant, and then released, the clutch and the elements it drives will make half a revolution before the nose 422 can again engage one of the opposite notches 423 and 424 to open the clutch, stop and lock the mechanism.

To insure proper engagement of the main clutch, temporary retaining means are provided for locking the clutch dog out of engagement with the clutch during the first portion of the first cycle of its operation. This means comprises a bell crank 625 (Figure 1) rockably mounted on shaft 626 and urged by spring 627 to engage lateral projection 620 on the main clutch dog 395. The bell crank 625 includes a notch 628 which engages lateral projection 620 and retains the clutch dog 395 out of engagement with the clutch. During the first part of the rotation of the main clutch, a cam follower 629 is rocked about shaft 611 by cam 630 which is driven by the main clutch, so that a pin 631 on the cam follower rocks the bell crank 625 counter-clockwise and releases the main clutch dog allowing the same to be moved into engagement with the notches 423 and 424 by the tension spring 612.

An additional latch is provided, however, whereby the main clutch may be latched free of the clutch for any selected number of cycles and comprises a bell crank 633 pinned on shaft 626 and having a roller 635 thereon, which may be moved into latching engagement with lateral projection 620 on the main clutch dog 395 by controls described in the above identified applications, whenever it is desired to cause continuous operation of the clutch 428 for several cycles.

The roller 635 permits the main clutch dog to slide off it easily and quickly when the end of the clutch operation has been determined, and holds the main clutch dog slightly lower than does notch 628 so that after lever 625 is once released it cannot reengage the main clutch dog and the dog is thus left free to drop home as soon as bell crank 633 is moved counter-clockwise. If the bell crank 633 has not moved into position to engage the under part of lateral extension 620, then the clutch dog can move to engage the clutch and stop it after a single cycle of operation.

As shown particularly in Figure 5, a main reverse unit 450 is provided to selectively transmit rotation from the main clutch 428 to an idler unit 493 in opposite directions. The main reverse unit 450 includes a pair of gear members 458 and 459 independently journaled on an integral clutch plate and sleeve 453 which, in turn, is journaled on the shaft 429. The member 453 is keyed at 451 to a sleeve 419 which is suitably secured to the disc 418 and which forms part of the driven side of the clutch 428. The gear members 458 and 459 are adapted to be selectively and alternatively secured to the clutch plate 453 in the manner disclosed in detail in the copending applications above referred to. Gear member 458 meshes directly with the gear 492 on the integral double idler unit 493, while the gear member 459 is entrained with the other gear 491 on the idler unit 493 through an idler 490, rotatably mounted upon a stud 490*a* extending from a stationary supporting plate 611.

As explained in detail in the copending applications above referred to, the setting of the main reverse unit 450 determines the direction of operation of the main actuating mechanism of the calculating machine. The counter actuating mechanism, since it is designed to count the net number of cycles of operation of this main actuating mechanism, is driven by the main reverse unit 450; but since it is desirable to render it possible to reverse the direction of operation of the counter actuating mechanism with respect to that of the main actuating mechanism, so that either net additive or net subtractive cycles of operation of the latter may be counted, a counter reversing unit is interposed between the main reversing unit and the counter actuating mechanism.

This counter reversing unit comprises gears 1816 and 1818 (Figure 5) rotatably mounted on a shaft 1819 and driven in opposite directions by the idler unit 493, gear 491 of the latter meshing directly with gear 1816 while gear 492 drives gear 1818 through an idler 1820.

A slide 1812 is supported in a slotted end of shaft 1819 which is journaled in bearings 526 and 527 formed in the plates 611 and 524, respectively, and said slide includes a projection 1814 which can be selectively engaged with slot 1815 provided in gear 1816 and slot 1817 in gear 1818, so that shaft 1819 may be driven in either direction, selectively, while the idler unit is driven in the same direction, thus selectively driving gear 1821, keyed to shaft 1819, in either direction. Gear 1822 fixed on a shaft 1823 meshes with gear 1821 and is thus reversed in its direction of rotation to rotate said shaft 1823 in either a clockwise or a counter-clockwise direction. The ratio between the gears is such that, for each half revolution made by the main clutch, the gear 1822 will rotate one revolution and a finger 1824 (Figures 1, 4 and 5), driven by shaft 1823 as hereinafter disclosed, will describe a complete cycle. This arrangement results in the counter dial 279 in register 1800 being advanced one full increment, for each main clutch cycle, although this main clutch cycle is completed in only a half revolution of the clutch itself.

The setting of the counter reverse unit is under control of a radial cam on a lever 1808 (Figure 5), pivotally mounted on a bearing bolt 1809 secured to the plate 610. This cam operates in a notch in a slidable shaft 1810 which is supported by a sleeve 1811 in plate 610. One end of shaft 1810 is keyed into the flat slide 1812 by enlarged portion 1813, whereby lateral movement of the shaft 1810 moves slide 1812. Cam lever 1808 has an extending offset end 1825 (see also Figure 1) which, when moved into engagement with the slot in shaft 1810, shifts shaft 1810 in one direction and another portion 1826 whereby the shaft 1810 may be shifted in the opposite direction. A link 1807 (Figure 1) is pivotally connected between lever 1808 and another lever 1805 mounted on a rockable shaft 976. Movement of link 1807 lengthwise into one position by means disclosed in the aforesaid copending applications, therefore, causes gear 1816 to be keyed to shaft 1819 while movement of link 1807 into another position causes the gear 1818 to be keyed to shaft 1819.

The counter finger 1824 (Figures 1, 4 and 5) is pivotally mounted at the rear thereof on the upper end of a lever 1830 which is oscillated by an eccentric 1831 on shaft 1823. The finger is supported intermediately by pin 1835 extending from a stationary vertical supporting member 612, while the lever 1830 is supported by pin 1832 also extending from the supporting member 612. The gear 1881 is selectively reversed by reversing the direction of rotation of the eccentric 1831. In one case, the finger is moved toward the gear, then up and back to drag the gear around. In the other, the finger is moved forward and down, to push the gear around in the opposite direction, and then out of engagement, and back. The finger is retracted from the gear 1881 after each single actuation so that the counter dial, having its train of gears 1879, 1880, and 1881 aligned with the finger 1824, is moved one step at a time. A lever 1833 is pivoted at its upper end to pin 1832 and is biased by spring 1834 against a centralizing cam formation 1836 on the eccentric shaft 1823 to tend to centralize the eccentric, and thereby the finger 1824, in a position wherein the driving tooth 1837 on finger 1824 lies out of engagement with the gear 1881 at the apex of the triangular path of movement described thereby. Of course, this centralizing action occurs only when the main clutch 428 becomes disengaged.

On reference to Figure 4, the theoretical considerations on which the structure is based will be apparent. The eccentric mounting 1831 causes the point of attachment of lever 1830 to shaft 1823 to be revolved through the path indicated by the "stations" indicated diagrammatically at A. Fulcrum 1832 would, were the slot 1832a straight and the lever arms equal, transform this circular movement into movement at the upper end of lever 1830 which might be described as a circle slightly flattened on top and oppositely deformed at the bottom side, such modification being caused by vertical shifting of the lever with respect to the fulcrum.

The first modeling of this transmitted movement toward that desired is effected by curving the slot 1832a substantially as shown so as to function as a cam-way serving as a rocking slide bearing for pin 1832, so as to cause the vertical center line of the geometrical figure described by the upper end of the lever to be deformed in a manner determined by the conformation of the cam-way, causing said end to describe a roughly triangular path as indicated diagrammatically at B in the figure.

Further modeling of the pattern of movement of the actuating tooth is accomplished by transmitting the above described movement of the upper end of lever 1830 through a second lever or finger 1824 which carries the actuating tooth 1837 and which has a rocking slide bearing on 1835. When the lever 1824 is in its leftmost position, the left lever arm is longer than the right and vertical movement of lever 1830 is thus increased as it is transmitted to the tooth. The actuating tooth 1837 is thereby given sufficient movement to carry it distinctly beyond its next position of rest, thus insuring that any back lash in the gearing connecting the driven gear 1881 with the numeral wheel 279 will be taken up. As lever 1824 is moved to the right, however, the relation of the lengths of its arms progressively reverses, causing the tooth to describe the path indicated at C on the diagram.

If the tooth path pattern is found to be too asymmetrical because of the vertical shifting of lever 1830 with respect to its fulcrum, as hereinbefore mentioned, this condition can be compensated for by making the slot of lever 1824 in the form of a slightly angular cam-way, as indicated. The ideal tooth path is one in which the actuating tooth upon passing out of contact with the driven tooth sweeps away from the driven gear 1881 along a path retrograding slightly toward the following gear tooth so as to meet and check it if it is overthrowing past the position in which it should be centralized. In a type of counter in which the actuating tooth is not reversible, no compensation for asymmetry of its path is necessary. In a reversible actuator structure such compensation may or may not be necessary, depending upon the centers originally chosen.

By these means an actuator is provided which, first, sweeps into engagement between two teeth of a gear in a direction which definitely precludes it from picking up more than one tooth, second, overdrives the picked up tooth to insure full advancing of the driven mechanism, and lastly, sweeps out of engagement with the driven gear in a path and at a relative speed which insures interception and complete checking of the next advancing gear tooth so as to prevent overthrow by momentum.

Pawls 319 (Figures 2 and 3) may be provided to engage the gear 1880 to hold the counter registering mechanism after advancement thereof by the finger 1824. Each of these pawls 319 is pivoted on shaft 1884 and is spring urged in a counter-clockwise direction by a tension spring 318 into engagement with the teeth on the adjacent gear 1880. Since these pawls are employed merely for the purpose of registering or holding the counter gear train in correct alignment and not for the purpose of preventing overthrow, it will be seen that the tension in springs 318 may be relatively weak.

I claim:

1. A counting mechanism comprising a rotatable member, a lever, means for moving said lever at one end thereof in a predetermined path, means for guiding the other end of said lever in a different path, a driving finger adapted at one end thereof to engage and drive said member, said finger being pivotally connected at the other end thereof to said other end of said lever, and means intermediate the ends of said finger for guiding said driving end thereof, first along an engaging path from a starting point exteriorly of the outer periphery of said member to a position within said periphery and into engagement with said member, second along a driving path in engagement with said member, and finally, along a withdrawing path while retrograding before withdrawing from said outer periphery of said member.

2. A counting mechanism comprising, a rotatable member having a plurality of teeth thereon, means for advancing said member intermittently comprising a lever, means for moving said lever at one end thereof in a circular path, a fulcrum, means on said lever forming a cam-way in sliding engagement with said fulcrum to guide the other end of said lever, a driving finger pivotally connected at one end thereof to said lever and adapted at the other end thereof to engage and drive the teeth on said member, a second stationary fulcrum, and means on said finger forming a second cam-way in sliding engagement with said second fulcrum to guide said driving end of said finger, said cam-ways coacting to cause said driving end of said finger to move, first along an engaging path from a starting

point into engagement with one of said teeth, second along a driving path in engagement with one of said teeth, and third along a path withdrawing to said starting point while retrograding to intercept movement of a succeeding overthrown tooth of said member, said first and third paths extending subsantially symmetrical about a line between said starting point and the center of rotation of said member.

3. A counting mechanism comprising, a toothed member, and means for advancing said member step by step comprising a lever and a driving finger, each pivotally connected at one end thereof to the other, means on said finger forming a driving tooth adapted to engage and drive the teeth on said member, means for cyclically moving said lever over a substantially triangular path at said pivoted end thereof, and a rocking slide bearing support for said finger intermediate said pivoted end thereof and said driving tooth for guiding said driving tooth in a substantially triangular path and in driving engagement with said teeth on said member during traverse of said driving tooth along the base of said last mentioned triangular path, and means for arresting the movement of said lever at the end of one or more cycles with said driving tooth positioned substantially at the apex of said last mentioned triangular path and out of engagement with said member.

4. Counting mechanism comprising a toothed element and means for advancing said element step by step, comprising a pair of levers, each pivotally connected to the other, means forming a driving tooth on one of said levers for engaging and driving said element, means for imparting a circular motion to the other of said levers at one end thereof, and rocking slide bearing supports for guiding said levers to move said driving tooth first into engagement with a tooth on said element, second along a driving path, and finally along a path retrograding to intercept movement of an overthrown tooth of said element.

5. A counting mechanism comprising a rotatable toothed element and means for advancing said element step by step comprising a driving tooth, driving means for cyclically advancing said tooth, and guiding means for constraining said tooth to move, first into engagement with a tooth of said element, second along a driving path, and finally out of engagement with the driven tooth of said element, in a retrograde direction to impart reverse movement to the next adjacent tooth of said element in the event of overthrow of said element.

6. A counting mechanism comprising a toothed element rotatable to a plurality of registering positions, means for driving said element step by step comprising a driving tooth, cyclically operable driving means for said tooth, means for reversing the direction of movement of said tooth by said driving means, and guiding means for constraining said tooth to move along a driving path in engagement with said element during movement of said element from one of said registering positions to a second position in a direction determined by said reversing means, and both into and out of engagement with said element at angles to said driving path sufficiently acute to cause slight retrograde movement to be imparted to the driven element in the event of displacement thereof beyond said second position.

7. A counting mechanism comprising a rotatable toothed element and means for advancing said element step by step comprising a lever and a driving finger, each pivotally connected to the other, means on said finger forming a driving tooth adapted to engage and drive the teeth on said element, drive means pivotally connected to said lever and operable to impart a circular motion to said lever at the point of said last mentioned pivotal connection, a fulcrum upon which said lever is compoundly movable by said drive means for guiding said lever, and a fulcrum upon which said finger is compoundly movable by said lever for guiding said finger, said fulcrums coacting to constrain said tooth to move, first into engagement with said element, second along a driving path, and finally in a path withdrawing from said element.

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