July 2, 1968 H. L. SEIDEN 3,390,834

REVERSIBLE COUNTER

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Fig. 1.

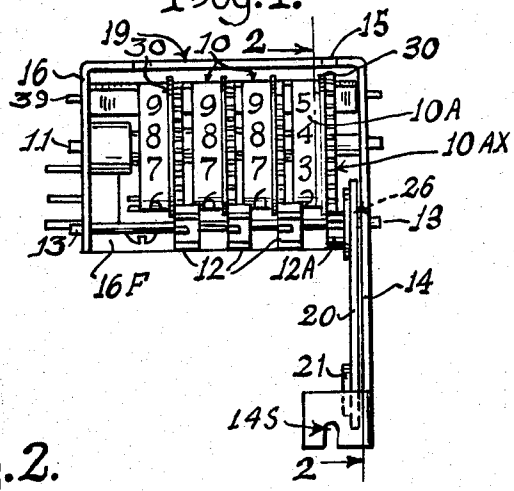


Fig. 2.

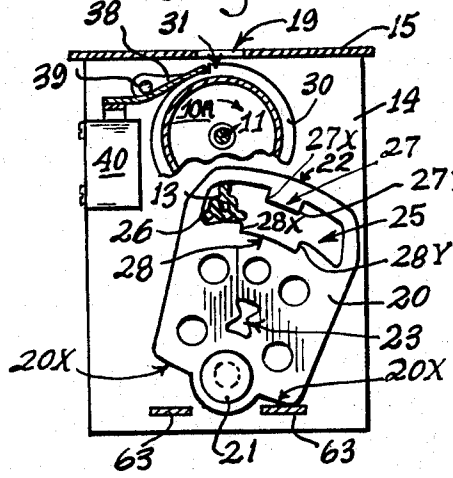


Fig. 3.

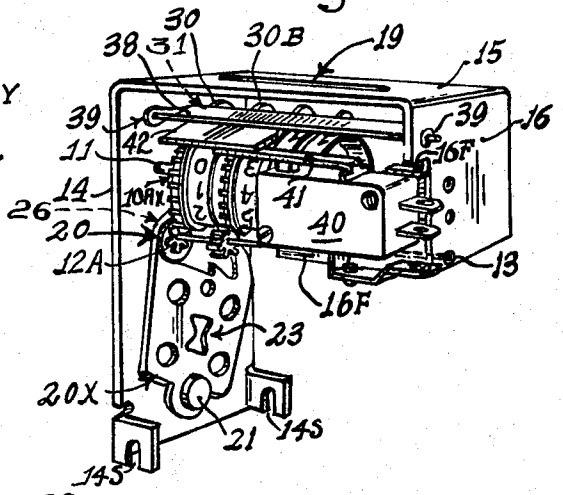
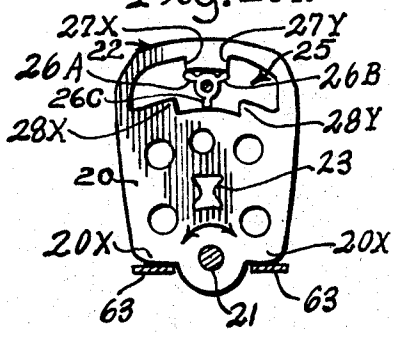


Fig. 2-A.



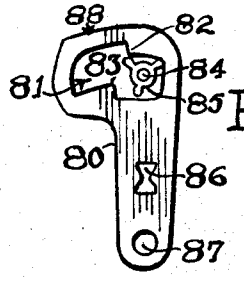


Fig. 2-B.

INVENTOR.
Herman L. Seiden
BY
ATTORNEY.

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Fig. 4.

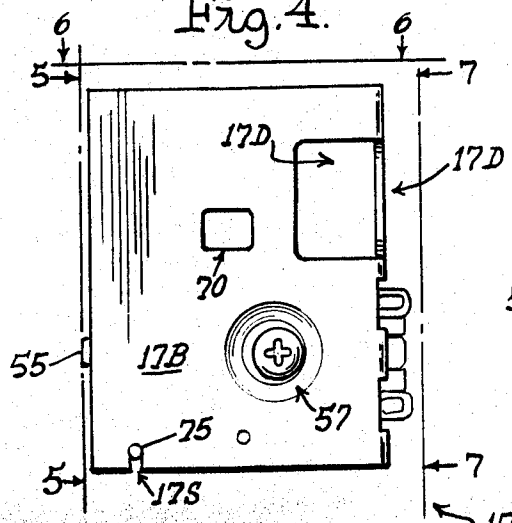


Fig. 5.

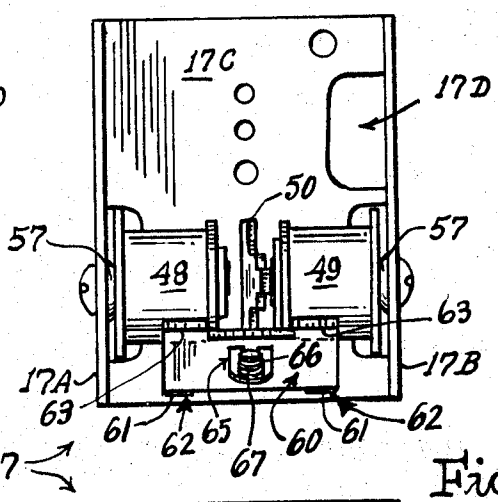


Fig. 6.

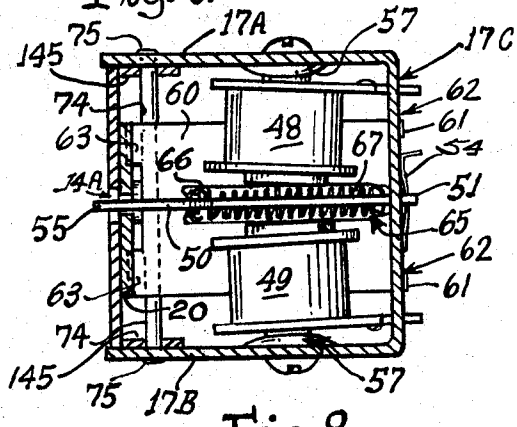


Fig. 7.

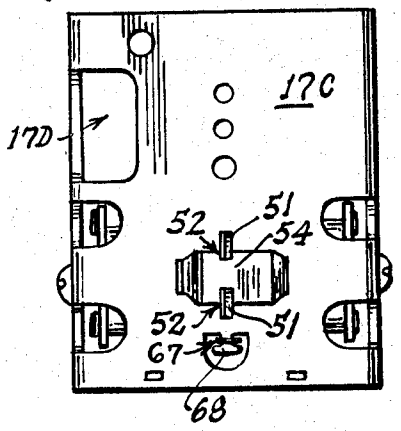


Fig. 8.

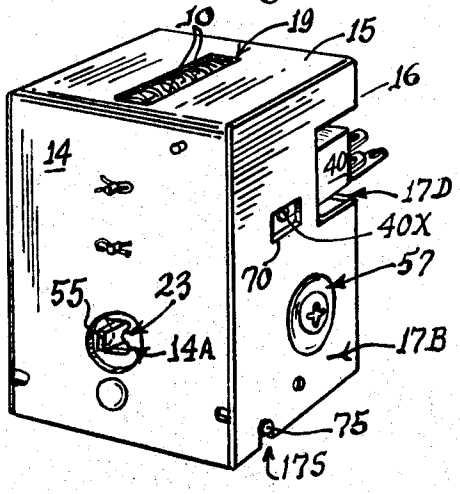
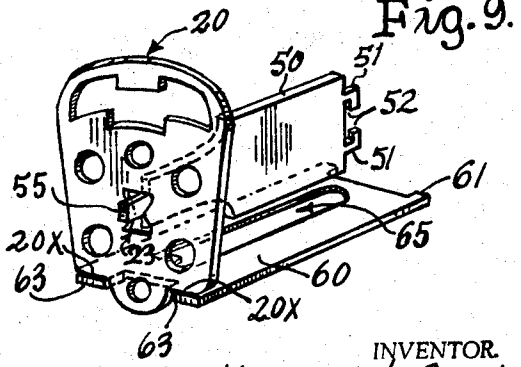


Fig. 9.



INVENTOR.
Herman L. Seiden
BY
ATTORNEY.

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3,390,834
REVERSIBLE COUNTER

Herman L. Seiden, Chicago, Ill., assignor to Lion Manufacturing Corporation, Chicago, Ill., a corporation of Illinois

Filed Apr. 4, 1966, Ser. No. 539,919
10 Claims. (Cl. 235—91)

The invention relates to counting mechanism of the known type having a series of coaxial, side-by-side number wheels each bearing digits numbering from zero to nine for counting units, tens, hundreds and so-on, with tens-transfer mechanism between successive wheels for consecutive counting from zero up to the capacity of the particular wheel assembly involved. Such counters are commonly actuated by a pawl and ratchet drive which may be driven mechanically or electromagnetically from any source of counting pulses, the disclosed counter being reversely driven by a pair of electromagnets, respectively energizable for additive or subtractive stepping of the counting wheels in consequence of correspondingly reverse oscillations of a stepping pawl of an especially contrived configuration cooperatively with certain novel armature constructions.

Among the features of novelty and utility inhering in the construction described hereinafter are: the provision of a single lightweight, one-piece reverse-acting drive pawl, and an armature means for oscillating the same to impart add and subtract movements to the counting wheels; the provision of simplified means for pivotally and removably mounting the armature on a flat casing wall; the provision of a single, spring-urged rockable means for centering the armature and imparting a snap-action thereto without loading the same unduly, in order to hold the armature in its oppositely-attracted positions relative to the electromagnets; the provision of a simple off-zero switch-actuating mechanism cooperable with all counting wheels and effective to actuate a signal switch in one condition when the wheels are all in the zero position, and in another condition whenever the wheels indicate a count other than zero.

Still further aspects of novelty and utility characterizing the counter mechanism relate to details of the construction and assembly of the component parts and the encasement for the mechanism as separable subassemblies; a manual actuating means, and other features of construction and operation all of which will appear more particularly hereinafter in view of the annexed drawings, in which:

FIGURE 1 is an elevational view of the counting wheel and pawl subassembly;

FIGURE 2 is an inside elevational view of the driving pawl and wheel index means as seen along lines 2—2 of FIGURE 1;

FIGURE 2A is a change-position detail showing the pawl of FIGURE 2 in neutral position;

FIGURE 2B depicts a modified form of drive pawl for unidirectional drive of the counting wheels;

FIGURE 3 is a perspective view showing parts seen in FIGURES 1 and 2;

FIGURE 4 is a side elevation of the drive magnet casing and subassembly;

FIGURE 5 is a view looking inwardly of the drive magnet casing along lines 5—5 of FIGURE 4;

FIGURE 6 is a view of the magnet subassembly looking downwardly along lines 6—6 of FIGURE 4;

FIGURE 7 is a rear elevation of the casing structure seen in FIGURES 4 to 6;

FIGURE 8 is a perspective view of the assembled counting unit;

FIGURE 9 is a perspective detail of the drive pawl, driving armature, and centering blade.

Referring to FIGURE 1, the counter includes as a part of a wheel subassembly, a set of counting wheels **10** of known construction (except as modified for purposes hereinafter set out) for cumulative or additive counting of units, tens, hundreds and thousands, according to the embodiment shown for illustrative purposes, in digital increments, as a result of stepping or driving pulses applied to the first or units-counting wheel indicated at **10A**, and the action, as necessary, of the usual intercoupling tens-transfer gear teeth (not seen) located on the sides of the wheels in such manner that following the ninth advance of a preceding counting wheel, the next higher value wheel will be automatically coupled for one step or digital movement, all in a manner well-understood in the art and not of itself forming a part of the present improvements.

The counting wheels are mounted on a common shaft **11** seated between opposite wall portions **14** and **16** of a formed plate serving as the chassis for the counting wheel subassembly (see FIGURE 3 also) which interfits with a complementary subassembly chassis generally indicated at **17** in FIGURES 4 to 7 and completes a closed housing such as seen in FIGURE 8.

The numbers on the several counting wheels are visible through an elongated sight-opening **19** in the top wall **15** of the wheel subassembly chassis, FIGURES 1 to 3.

Both the counting advance and subtractive or retrogressive movements of the wheel **10** are achieved by an oscillable stepping pawl **20** of novel configuration, which is pivoted at **21** on the wall portion **14** of the wheel chassis, FIGURES 2 and 3.

The pawl **20** is desirably formed of a light material such as aluminum having a plurality of holes formed therein to further reduce the mass, along with a coupling **23** of hour-glass shape, and an especially-contrived arcuate gear slot **25** which freely fits over a trident drive gear **26** forming a part of the first idler tens-transfer gear **12A** which is one of a set of such gears on the shaft **13** and having driving engagement with the sidewise gear teeth **10AX** on the first or "units" counting wheel, FIGURE 1.

A centralized salient tooth formation **27** and an oppositely-recessed tooth formation **28** in the arcuate gear slot **25** provide two sets of oppositely offset drive teeth **27X** and **28X**, and **27Y** and **28Y** located on opposite sides (right and left, FIGURES 2, 2A) of the central salient tooth.

The offset upper and lower pawl teeth in each said set are so spaced radially and angularly relative to each other as to engage one of the trio of teeth **26A**, **26B**, **26C** on the tri-dent drive gear whenever the pawl rocks one way or the other from its normally centralized or neutral position of rest, as from the position of FIGURE 2A to that of FIGURE 2, whereby the drive gear makes nearly one-third of a revolution to impart one counting step equivalent to one-tenth of a revolution to the "units" wheel **10A**, which step will be completed upon return of the pawl to the centralized or neutral position aforesaid, the relative spacing of the offset pawl teeth in each set being such that when the pawl returns to the central position after advancing the drive gear **26** almost, but not quite, a complete step as aforesaid, another one of the trident teeth thereof on the opposite side of the axis of shaft **13** will be slightly and transiently pushed on return of the pawl to central position to complete such advancing step and cause the appropriate number on the wheel to be properly centered in the window **19**. This kind of action occurs identically whether the pawl moves to the right or

the left of its central position, the direction of movement of the pawl from such position simply determining whether the counting wheels move additively or subtractively, that is, clockwise or counterclockwise, FIGURES 2, 2A.

The foregoing action of the tri-dent gear **26** when displaced by some form of stepping pawl is known in the art, but the special configuration of the pawl **20** in effecting the reverse movements of gear **26** is novel. Moreover, while the counting wheels **10**, in general, and their cumulative counting advance responsive to stepping of a tri-dent drive gear **26**, in general, constitute known art, the counting wheels herein disclosed are modified to provide means for signalling a zero-count or starting condition, while permitting the individual wheels to continue through revolution after revolution, such means including a control ring **30** on each of the counting wheels, FIGURES 1 to 3, the radial depth of each such ring being uniform about its circumference except for a zero-notch **31** in each such ring, the depth of such notch being such that a rockable zero-sensitive plate **38** pivoted on pin **39**, FIGURES 2 and 3, will drop into the aligned series of control ring notches **31** when all of the appertaining number wheels are at zero or starting position.

As seen in FIGURES 2 and 3, the signalling means includes a small snap-switch **40** having an actuating lever **41** pivoted thereon and projecting beneath an extension piece or wing **42** welded on the zero rocker plate such that when the latter is rocked upwardly or counterclockwise, as viewed in FIGURE 2, the eccentric wing portion **42** thereof will bear down upon the switch lever **41** and actuate said switch to signal the off-zero condition of the counter. A single step of the first or units wheel will actuate the switch and the control rings of the successive wheels will maintain this condition while the lower-value wheels rotate continuously until the count is reached or the zero condition restored.

The control switch **40** is mounted on an inwardly-turned flange portion **16F** of the casing wall **16**, while the complementary casing has a corner portion **17D**, FIGURES 4, 5, 7 and 8, cut out to expose two sides (those of FIGURES 2 and 3) to view in the assembled condition of the two subassembly chassis or casing sections.

Means for driving the pawl **20** reversely comprises a pair of electromagnets **48** and **49** and an armature **50**, FIGURES 5, 6, 7, carried by the casing subassembly **17**.

On oppositely-facing casing walls **17A**, **17B** are identically aligned inwardly struck bosses **57** each pitched to afford an angular seat for one of said electromagnets such that when the armature **50** is attracted by either, as in FIGURE 5, the plane of the armature and the plane of the magnet pole face will be substantially parallel to afford maximum armature displacement and magnetic efficiency, and to reduce chattering in the case of alternating current coils having the phase-splitting slugs on the pole face for this purpose.

The armature **50** has a pair of closely-spaced lugs **51**, FIGURES 6, 7 and 9, which seat rockably in corresponding punches in the back wall **17C** of the subassembly casing member, and the confronting edges of the lugs have aligned slots **52**, FIGURE 9, exposed at the outer surface of the casing wall to receive (FIGURE 7) a bowed flat retaining spring **54** which holds the armature in assembly with the casing wall while permitting spring-buffered movement of the lugs for the full arcuate swing of the armature, the opposite end of which has a reduced tongue **55**, FIGURES 6, 8, 9, fitting freely but closely into the hour-glass coupling slot **23** in the manner shown particularly in FIGURES 8 and 9, so that when the armature is attracted by one or the other of the two electromagnets from a central idle position corresponding to the centralized idle position of the oscillable pawl **20**, the latter will be rocked correspondingly to effect a clockwise or counterclockwise movement of the pawl and an additive or subtractive stepping of the units wheel **10A**, as previously explained. The reduced tongue **55** on the armature is exposed, FIGURE 8, through a hole **14A** in the wall of the wheel chassis for manual enagement to actuate the counter additively or subtractively.

The armature **50** and coupled pawl **20** are returned and maintained in the central idle position by a spring rocker means comprising a wide rocker plate **60**, FIGURES 5, 6 and 9, having spaced rocker lugs **61**, FIGURES 6, 9, rockably seating in matching slots **62** in casing wall **17C**; another pair of wider endwise lugs **63** at the opposite end of the rocker plate, FIGURES 5, 6 and 9, are spaced and disposed to underlie and press upon shoulders **20X**, FIGURES 2, 2A, and 9, of the oscillable pawl on opposite sides of the pivotal axis and mounting **21** thereof.

As seen in FIGURES 5, 6 and 9, the neutralizing presser plate **60** has a lengthwise slot **65** punched therein at one end of which is a spring lug **66** upon which is anchored one end of a traction spring **67**, the opposite end of which is anchored on lug means **68** in the casing wall, FIGURE 7, in a position such that the rocker plate is constantly biased upwardly to thrust its two lugs **63** against the shoulders **20X** on pawl **20** with the result that the latter is yieldingly held and forced to return to its centralized idle position when free to do so.

The spring **67** is of a diameter, and is so disposed relative to the slot **65**, FIGURE 6, as to expose a large number of its coils to engagement by the confronting edge of the armature **50** in the centralized mid-position of the latter, in consequence of which the spring exerts a moderate pressure effect responsive to energization of either of the electromagnets. This action effects positive displacements of the armature in moving off-center and tends to aid reduction of chatter in A.C. operation. While the pawl-centering presser plate **60** exerts sufficient force always to return the armature (through the pawl) to normal mid-position when the electromagnet is deenergized, the additional pressure of the spring coils against the edge of the armature in mid-position effects a moderate snap-action off center and assists in stabilizing the maintenance of the centralized position of the armature and the pawl, slight movements of which off-center can cause the units counter wheel **10A** to move more or less out of proper register and reading position relative to the sight opening or window **19**.

As a result, the foregoing configuration and action of the driving pawl **20**, the armature means **50**, pitched mounting **57** of the electromagnets, and the positive centering and snap-throw action of the spring presser plate means **60**, **65**, **67**, effects consistently accurate and rapid reverse stepping of the counting wheels with moderate driving power in a subassembly construction which is economical to assemble and readily disassembled for servicing as by replacement of the coils or the switch or for the purpose of adjusting the sensitivity of the switch in respect to the slight off-zero signalling movements of the zero-sensing rocker bar **38**. A small window **70**, FIGURE 8, adjacent the switch **40** affords access to an adjusting screw **40X** on the switch, which usually suffices for initial alignment.

The two subassembly chassis interfit, as in FIGURE 8, the opposite sidewalls **17A**, **17B** of one being joined by a tie rod **74**, FIGURES 6 and 8, having a groove and head formation **75** at opposite ends, FIGURES 4 and 8, which snap into edgewise slots **17S**, in the opposite chassis walls **17A**, **17B**, this tie rod also engaging in another pair of aligned slots **14S**, FIGURE 1, formed in a pair of wings offset from wall **14** of the wheel chassis. If desired, a bottom closure plate (not illustrated) may be added, for which purpose sidewall screw holes **74**, FIGURES 4 and 8, are provided.

For rapid counting in small counters measuring perhaps 2 x 2 x 3 inches, the drive pawls must be as small and light as possible; and for continuous duty they must have maximum strength.

These requirements are met by the constructions shown

in FIGURES 2, 2A and 2B, one of the important characteristics of which is the shaping of the arcuate slot as a closed loop in order to provide a reinforcing arch **22** of the body metal as a base for the salient tooth **27** in a configuration which reduces the amount of the metal along the top of the arc in order that the pawl may fit about the tri-dent drive gear **26** and very close to the "units" wheel **10A**.

Another advantage of the pawl structure also deriving from the arcuate slot and its salient teeth resides in the fact that such an arrangement makes it possible to minimize the amplitude of the right or left swing of the armature to achieve the required advance of the "units" wheel in a given available space which is inherently confining.

Another feature of the construction of pawl **20** is the provision of centering thrust shoulders **20X** on opposite sides of its pivotal axis and the coaction thereof with opposite presser lugs **63** on the centering plate **60**.

The several advantages of the pawl configuration in strength in minimal mass and displacement, may be availed of in the uni-directional or non-resetting or non-subtracting type of counter, for which purposes the modified pawl **80** depicted in FIGURE 2B also employs a closed arcuate opening **81**, which on comparison with the reverse-driving pawl of FIGURE 2A, will be seen to constitute approximately one-half of the symmetrical configuration of the pawl **20** on opposite sides of a vertical center line through the pivotal axis and the hour-glass shaped coupling notch.

Thus, the uni-directional pawl **80** has only one pair of salient teeth **82, 83**, both located at one side of a line connecting the center of the shaft **84** for a tri-dent gear **85**, the coupling notch **86** and the pivot **87**, which line defines the neutral or starting position for this pawl, each oscillatory excursion from and back to this position effecting one fractional revolution of the gear **85** and the associated counting wheels (not shown but operatively identical to wheels **10**) the lower salient pawl tooth **83** first starting the gear on the outbound (clockwise) stroke, and the upper tooth **82** completing the advance of the gear on return to the starting position.

The unidirectional pawl **80** has a reinforcing arch **88** similar to the longer arch **22** of the pawl **120**.

I claim:

1. In a counting mechanism of the type having a set of number wheels moved from a normal zero starting position in counting action by a trident gear revolved by an oscillatory pawl, the combination with said gear of a pivoted pawl for driving the same one revolution per oscillation of the pawl; an armature mounted at one end thereof for oscillation with respect to a normal central position; and drivingly engaging said pawl at an opposite end thereof; spring-urged means acting on said pawl to dispose the same in a corresponding normal central position; electromagnetic means for oscillating the armature to and from said central position; spring means engaging the armature at one side thereof in a normal central position of the armature to impart thereto a form of snap action in moving from said central position to terminal positions outward therefrom; said pawl having formed therein an opening for the trident gear remote from the pivotal axis of the pawl and extending in an arcuate sense concentrically of said axis, and further means formed on opposite sides of said opening and lying on opposite sides of a radius of said axis and located on opposite sides of said radius defining opposite gear teeth cooperable with said trident gear to advance the latter one revolution for each excursion of the pawl from and back to said central position responsive to actuation of said electromagnetic means; together with off-zero control means comprising a movable control member engaging peripheral means on each number wheel and positioned thereby in a first control condition when the wheels are all in zero starting position, and positioned thereby in a second control condition so long as at least one of said wheels is in off-zero position.

2. Apparatus according to claim **1** wherein said pawl is in the form of a flat plate and said opening therein is arcuate and lies wholly within the body of the plate and affords a reinforcing arch constituting one angular side of the opening, said trident gear fitting within said opening.

3. The construction of claim **2** wherein said further means defining gear teeth comprises a salient tooth portion projecting inwardly in a radial sense of the arc toward the pivotal axis of the pawl and located on one side of said radius, and another salient tooth portion projecting outwardly in a radial sense but on the opposite side of said radius and on the near side of the arc toward said axis.

4. A construction according to claim **2** wherein said further means defining gear teeth comprises a salient tooth located centrally of said arc on the radially far side thereof from said axis and on said radius, and said tooth has opposite sides each located on a side of said radius opposite from the other and each constituting a gear-engaging margin drivingly engageable with the trident gear, the near side of the arc proximate to the pivotal axis of the pawl having a centrally located notch on said radius and inwardly toward said axis with opposite marginal portions at opposite ends thereof each constituting a gear-engaging portion also respectively drivingly cooperable with said trident gear such that the pawl in oscillatory excursions from and back to said central position thereof can rotate the trident gear correspondingly through the action of a pair of said gear-engaging portions each pair disposed on opposite sides of the arcuate opening on one or the other side of said radius.

5. Mechanism according to claim **1** wherein said off-zero control means comprises a ring means projecting radially beyond the periphery of each number wheel circumambiently thereof and each said ring means is provided with a detent means disposed relative to the zero position of the appertaining wheel, and said control member comprises an elongated member rockably mounted adjacent said wheels and urged against the said ring means thereof for engagement with the said detent means thereof such that when all wheels are in the zero starting position said member will rock into the first said condition, and when any wheel is off-zero the said control member will thereby be rocked and maintained in the second condition by peripheral portions of the appertaining ring means moved relative to said control member by displacement of such wheel from zero position.

6. Mechanism according to claim **1** wherein said pawl is in the form of a flat plate member and said opening is of elongated arcuate character concentric with the pivotal axis of the pawl, and said plate has formed thereon a pair of shoulders each situated adjacent to and respectively on a side of said axis opposite from the other, and said presser means comprises a rockable plate mounted at one end and having spaced apart projections at an opposite end thereof and each pressed against one of said shoulders by action of said spring means to move the pawl yieldingly into the central position aforesaid.

7. Counting mechanism as set forth in claim **1** wherein said mechanism is mounted on a chassis member having opposite wall portions each confronting an opposite side of said armature, and said electromagnetic means comprises a pair of electromagnets each mounted on one of said wall portions to confront a side of the armature opposite from the side confronted by the other, and each said wall portion is provided with a boss projecting toward the appertaining side of the armature and each said boss affords an angularly pitched seat for one of said electromagnets disposing a pole face thereof in angular relation to the juxtaposed side of the armature to procure a predetermined magnetic relation with the armature.

8. Counting mechanism according to claim **1** wherein said spring-urged means acting on said pawl comprises an elongated plate means rockably mounted at one end and

having pawl-engaging portions engaging the pawl on diametrically opposite sides of the pivotal axis of the pawl with spring means acting on said plate to cause the same to apply equal forces to the pawl on opposite sides of said axis whereby to urge the pawl into said central position.

9. Mechanism according to claim **8** wherein the said spring means acting on the plate is the same spring means engaging the armature to impart snap action as aforesaid.

10. Mechanism according to claim **9** wherein said plate has a long slot therein, said spring means acting thereon is an elongated coil spring having coil portions exposed

through said slot in a position across the path of oscillation of a long edge portion of the armature and the said coil portions tend to act against said edge portion to snap the armature in either direction from said central position.

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