

Feb. 20, 1968

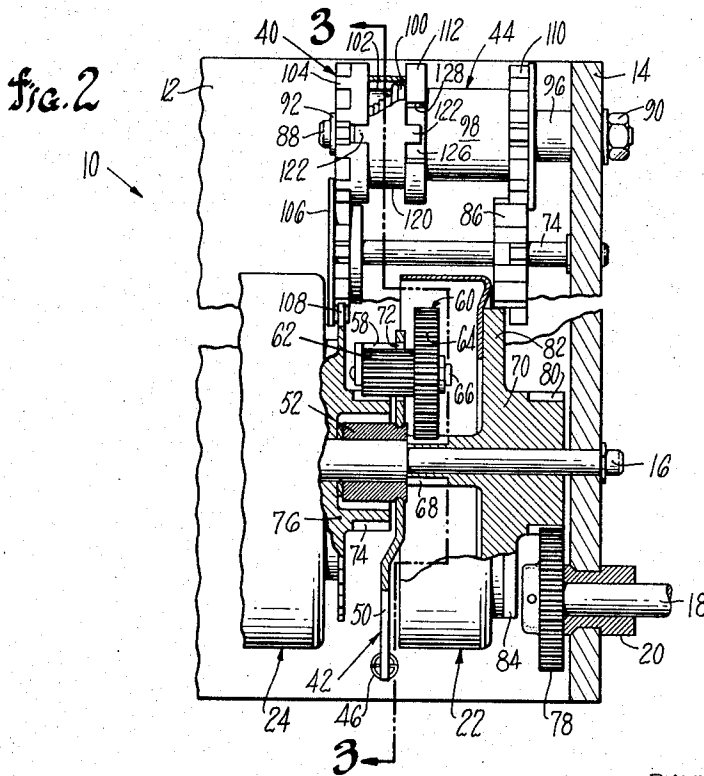
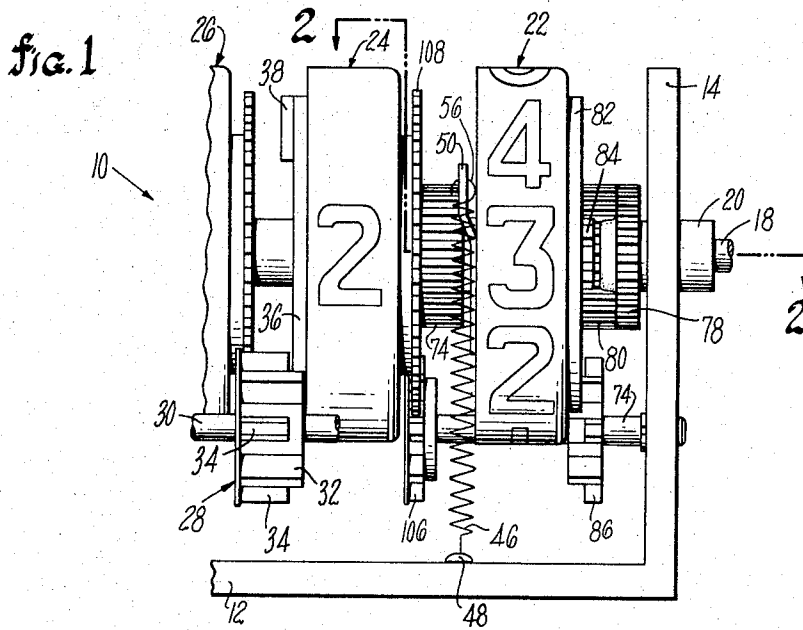
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3,369,747

COUNT TRANSFER MECHANISM

Filed March 14, 1967

2 Sheets-Sheet 1



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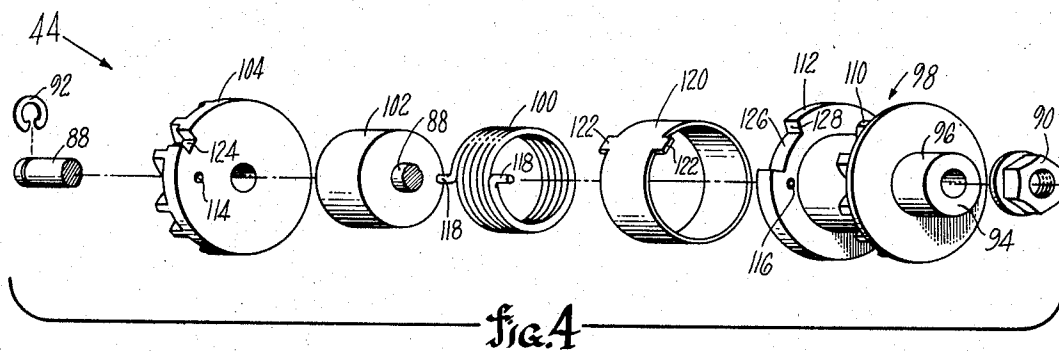
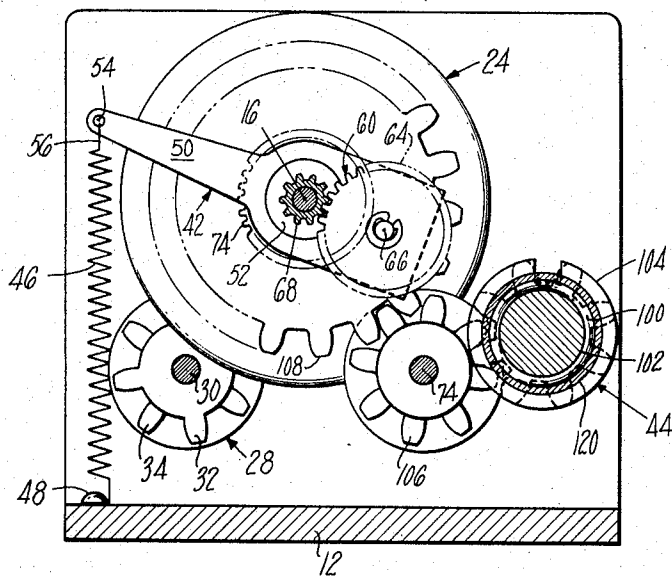
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2 Sheets-Sheet 2

fig. 3



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COUNT TRANSFER MECHANISM

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ABSTRACT OF THE DISCLOSURE

A transfer mechanism for assisting the count transfer operation of a counter is positioned between the lowest order number wheel and the next higher order number wheel of the counter. The transfer mechanism is provided with a planetary drive subassembly loaded during $\frac{9}{10}$ of each revolution of the lowest order number wheel. A clutch subassembly connected to the drive is restrained by the lowest order wheel and intermittently released during the remaining $\frac{1}{10}$ movement of the lowest order wheel to permit controlled advancement of the higher order wheel by the drive subassembly. The clutch subassembly additionally includes a lost motion driving connection which assures advancement of the higher order number wheel.

The present invention relates generally to high speed counters. More particularly it is directed to a new and improved count transfer mechanism for assisting the count transfer operation between successive order number wheels of a counter.

A primary object of the present invention is to provide a count transfer assisting mechanism for a counter which enables a fluid, efficient and effective count transfer from the lower order number wheels to the higher order number wheels of a counter while at the same time relieving the counter input of undesirable load conditions which might cause fluctuation in the accuracy and reliability of the counter.

Another object of the present invention is to provide a count transfer assist mechanism for a counter wherein the higher order number wheels must be rapidly activated from a stationary position and then abruptly stopped to effectuate the desired count advancement in a transfer operation, the assist mechanism providing a controlled, shock-absorbing advance of the higher order number wheels and a delayed follow-through of the transfer in the event the higher order number wheels do not fully respond to the transfer operation.

A further object of the present invention is to provide a count transfer assisting mechanism which effectuates a smooth, controlled and reliable advancement of the higher order number wheels of a counter while eliminating the difficulties heretofore associated with the brief, rapid acceleration and deceleration thereof during the count transfer operation, the assisting mechanism being especially advantageous in counters where a plurality of transfers occur simultaneously.

A still further object of the present invention is the provision of a high speed counter having a count transfer assisting mechanism controllably geared to the counter wheels for preventing both the undesirable overadvancement of higher order number wheels and the undesirable retardance of the lowest order number wheel during the count transfer operation, a portion of the assisting mechanism being adapted for oscillatory, planetary movement capable of driving the higher order number wheels.

Still another object of the present invention is to provide a transfer assist mechanism of the type described which prevents excessive wear on the counter yet provides efficient, effective and practical operation coupled with sturdy and economical construction.

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Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application which will be indicated in the appended claims.

In the drawings:

FIG. 1 is a side view of the lower order number wheel portion of a counter incorporating an embodiment of the transfer assist mechanism of the present invention;

FIG. 2 is a top sectional view taken along the line 2-2 of FIG. 1, partially broken away and partially in section for clarity of illustration and ease of understanding;

FIG. 3 is an end sectional view taken along the line 3-3 of FIG. 2; and

FIG. 4 is an exploded isometric view of a control portion of the transfer assist mechanism of the present invention.

Referring now to the drawings in greater detail wherein like reference characters indicate like parts throughout the several figures, the counter, generally designated 10, is shown as having a frame including a base portion 12 and an integral upright end wall member 14 which supports the number wheel shaft 16 (FIG. 2) as well as the drive shaft 18, the latter being rotatably journaled in the bushing 20 fixedly positioned within the end wall 14. A bank of coaxially aligned counter wheels including a lowest order number wheel, such as a units wheel 22, and a plurality of higher order number wheels, such as a tens wheel 24 and a hundreds wheel 26, are journaled on the shaft 16 for independent relative rotation therebetween. As illustrated in FIG. 1, each of the number wheels carries on its outer peripheral surface suitable read-out indicia such as the numerals "0" to "9" inclusive and the wheel bank is preferably adapted for consecutive advancement, i.e., for each revolution of a lower order number wheel an immediately adjacent higher order number wheel is indexed or advanced a single unit or increment.

The count transfer operation between each of the number wheels of the counter 10, with the exception of the transfer between the lowest order number wheel 22 and its immediately adjacent higher order number wheel 24, is accomplished through an independently rotatable transfer pinion 28 mounted intermediate the number wheels on a supporting shaft 30. In a manner well-known to the art, the pinion 28 is provided with alternating full and mutilated gear teeth 32, 34, respectively, which cooperate with the locking ring 36 on the number wheel 24 to prevent movement of both the pinion 28 and the adjacent higher order wheel 26 during the rotation of the number wheel 24. As the wheel 24 completes all but one increment of a full revolution, a two-toothed driving gear or sector 38 carried by the wheel 24 adjacent the locking ring 36 reaches the pinion 28 and upon further rotation of the wheel 24 cooperates with a full tooth 32 of the pinion 28 to incrementally advance the pinion 28 as well as the higher order wheel 26 thereby effectuating a count transfer operation. It will be appreciated that this "in series" arrangement for advancement of the number wheels places a substantial load on the lowest order number wheel and the drive of the counter, especially where a simultaneous count transfer is required between all of the wheels of a multi-wheel counter.

Because of the load effects of the multi-transfer operation on a continuously rotating, constant speed counter drive, it is desirable to incorporate into the counter a transfer assist mechanism which will relieve the drive of this load. An embodiment of the count transfer assist mechanism provided in accordance with the present in-

vention is perhaps best illustrated in FIG. 2. The count transfer assist mechanism, designated generally by the numeral 40, is positioned intermediate the lowest order number wheel 22 and its immediately adjacent higher order number wheel 24 so that the lowest order number wheel 22 as well as the drive shaft 18 are relieved of the load caused by a multi-transfer operation. The count transfer assist mechanism 40 comprises a transfer drive subassembly 42 generally characterized as a "load and fire" type mechanism and an operatively interconnected spring clutch subassembly 44 for controlling the transfer drive, both subassemblies of the assist mechanism being interconnected with the lowest order number wheel 22 and the higher order number wheel 24.

The transfer drive subassembly 42 includes an energy accumulating drive spring 46 having one end fixedly secured to the base 12 of the counter by a suitable fastener 48 and a drive armature 50 rotatably mounted on the wheel shaft 16 between the wheels 22, 24 through a bushing 52 to which it is fixedly secured. As clearly shown in FIG. 3, the forwardmost end of the armature 50 is provided with a small aperture 54 for receiving the hook end 56 of the extensible drive spring 46. Accordingly, as the armature 50 rotates about the shaft 16 in a clockwise direction as viewed in FIG. 3, the helical drive spring 46 is elongated to load the spring and thereby accumulate driving energy for a count transfer operation.

The rearwardmost end of armature 50 is disposed on the opposite side of bushing 52 from the drive spring 46 and is provided with an integral L-shaped flange 58 for mounting a rotatable gear assembly 60 adapted for planetary movement about the shaft 16. The gear assembly 60, comprising a first generally cylindrical gear 62 and a second radially enlarged gear 64 rotatable with the first gear 62, is rotatably supported by a shaft 66 mounted on the flange 58. As illustrated in FIGS. 2 and 3, the larger disk-like planetary gear 64 meshes with the driving gear teeth 68 provided on the hub 70 of the lowest order number wheel 22 while the smaller planetary gear 62 extends through an aperture 72 in armature 50 and meshes with the driven gear teeth 74 located on the hub 76 of the higher order number wheel 24.

In the preferred embodiment the effective gear ratio between gears 68 and 74 through the planetary gear assembly 60 is 10:1, that is, one full revolution or ten-count movement of the lower order number wheel 22 will effectuate rotation of wheel 24 by $\frac{1}{10}$ of a revolution, e.g., a one-count advance. However, during normal operation of the counter 10, the higher order number wheel 24 is locked against movement by the spring clutch subassembly 44 as the lower order number wheel 22 rotates through $\frac{9}{10}$ of its revolution. Accordingly, the rotation of driving gear teeth 68 and the accompanying rotation of planetary gear assembly 60 causes gear 62 to walk around the hub 76 of the higher order number wheel 24 on the gear teeth 74. The planetary movement of assembly 60 results in a movement of the forwardmost end of armature 50 away from base 12 against the bias of drive spring 46 thereby loading or accumulating energy within the drive spring for the transfer operation. During the count transferring advance of the lowest order number wheel 22 the higher order wheel 24 is released to advance $\frac{1}{10}$ of a revolution as the drive spring 46 pulls the armature 50 toward the base 12, the planetary assembly 60 thereby returning to its original position to initiate another operating cycle. Thus, it can be seen that during operation of the counter the transfer drive subassembly 42 oscillates through a limited planetary arc or sector about the shaft 16, the subassembly being initially driven in a clockwise direction, as viewed in FIG. 3, by the lowest order number wheel 24 and then in a counterclockwise direction by the drive spring 46 during a count transfer operation.

As mentioned hereinbefore it is an advantage of the present invention that the advancement of the higher

order number wheels is controlled to prevent over-advancement thereof during the count transfer operation. This control is provided in the illustrated counter by the spring clutch subassembly 44 of the transfer assist mechanism 40 interconnecting the lowest order number wheel 22 and the higher order number wheel 24. The lowest order number wheel 22 is rotatably driven by the shaft 18 through the operative interengagement of the driving gear 78 affixed to shaft 18 and the peripheral driven gear teeth 80 located on the hub 70 of wheel 22. Integrally formed as part of the geared hub 70 is a locking ring 82 and a two-toothed driving gear 84 similar to the corresponding locking ring and driving gear 36, 38, respectively, carried by the wheel 24. The ring 82 and gear 84 cooperate with the mutilated transfer pinion 86, mounted for rotation on the shaft 74, to lock the pinion 86 against movement except during the 1/10 count transfer motion of each revolution of wheel 22, whereupon the two-toothed driving gear 84 coacts with the pinion 86 to effectuate controlled release of the higher order number wheel 24 through the clutch subassembly 44.

The subassembly 44 is mounted on shaft 88 which, as shown in FIG. 2, is fixedly secured to wall member 14 rearwardly of the wheel bank of the counter by the nut 90 and stabilized thereagainst through the cooperative interengagement of the wall with the flat end surface 94 of an integral hub 96 protruding from one end of the spindle 98. The shaft 88 is provided with an enlarged integral drum 102 of generally cylindrical configuration over which operates the concentrically wound torsion spring 100 of the subassembly 44 in response to the rotation of the spindle 98 to releasably hold the higher order number wheel 24 against count advancement. The subassembly 44 further includes a geared disk 104 mounted coaxially with the spindle 98 for rotation on the shaft 88 in response to the rotation of spring 100, the disk 104 being retained on the shaft by the snap ring 92. The geared disk 104 meshes with a transfer pinion 106 which in turn drivingly engages the gear 108 formed as an integral portion of the hub 76 of the higher order number wheel 24. The spindle 98 is provided with a first integral geared disk portion 110 interconnected with the lowest order number wheel 22 through the mutilated pinion 86 to receive the incremental count transfer motion from wheel 22 and a second integral disk portion 112 located on the end of spindle 98 abutting the generally cylindrical drum 102 of the subassembly. The drum-abutting disks 104 and 112 are provided with radially displaced apertures 114 and 116, respectively, for receiving the end tab portions 118 of the concentrically wound torsion spring 100. It will be appreciated that the direction of the concentric windings of the spring 100 is such that counterclockwise movement of the disk 104, as viewed in FIG. 3, will tighten the torsion spring 100 on the drum 102.

Circumscribing the spring 100 is a tubular, spring-enclosure sleeve 120 provided with a pair of projecting side tabs 122 which fit within peripheral slots on the drum-abutting disks 104, 112 and provide a lost motion driving connection therebetween. Although the slot 124 in disk 104 is approximately the same size as tab 122 positioned therein, the slot 126 within the disk 112 of the spindle 98 is of substantially greater length than the width of tab 122 to permit nondriving rotation of the spindle as it rotates in response to the count transfer motion of the wheel 22. The elongated peripheral slot 126 is, however, sufficiently short to prevent excessive or undue rotational movement of the spindle 98 without cooperative interaction between the tab 122 and the radial surface 128 of the slot 126 thereby assuring follow-through of the count transfer motion even though this follow-through may be delayed for one full revolution of the lowest order number wheel.

As assembled prior to operation, the drive spring 46 is slightly tensioned thereby placing the geared disk 104 of the clutch subassembly 44 under a constant counterclockwise bias. The spindle 98 is, of course, locked in place by

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the locking ring 82 of the lowest order number wheel 22 and the torsion spring 100 firmly engages the drum 102 as a result of the bias on the disk 104. Consequently, the wheel 24 is locked against advancement so long as the spring 100 clutches against the stationary drum 102.

In operation the lowest order number wheel 22 of the counter 10 is driven in a counterclockwise direction, as viewed from the right side of FIGS. 1 and 2, by the drive shaft 18 to advance the read-out indicia on its arcuate peripheral surface. Since the hub 76 of the higher order number wheel 24 is locked against advancement by the action of the spring 100 on the drum 102, the drive sub-assembly 42 is forced by the counterclockwise rotation of the gear teeth 68 to rotate clockwise about the shaft 16 with the gear 62 of the planetary gear mechanism 60 walking along the gear teeth 74 of the hub 76. The planetary movement of gear assembly 60 and its interconnected armature 50 causes extension of the drive spring 46 and continuous accumulation of driving energy during the rotation of the lowest order number wheel 22. As the two-toothed driving gear 84 is rotated into driving engagement with the mutilated pinion 86, it causes a limited counterclockwise rotation of the spindle 98. The rotational movement of the spindle 98 tends to loosen the torsion spring 100 on the fixed drum 102 and permits rotation of the disk 104 but does not directly drive the higher order number wheel 24 due to the lost motion connection between the spindle 98 and the disk 104. Since disk 104 no longer firmly locks wheel 24 against count advancement and accordingly no longer holds the subassembly 42 in an energy accumulating condition, the driving force accumulated within the driving spring 46 is smoothly and controllably released permitting counterclockwise rotation of the armature 50 causing the planetary gear assembly 60 to move back toward its original position as it drives the higher order number wheel 24 in a counterclockwise direction to advance the count thereon. The spindle 98 is, of course, rotated by the pinion 86 through an arc sufficient only to advance the higher order number wheel 24 by a single count or indicia and is thereafter immediately held stationary by the ring 82 as the lowest order number wheel 22 continues its advance and the clutch spring 100 re-engages drum 102. Thus, it will be appreciated that the wheel 24 is prevented from jumping ahead or overcounting during the transfer and the wheel 22 is substantially uninterrupted by the transfer, the driving force of the transfer being directed principally to the frame through the clutch drum 102 affixed thereto by the integral shaft 88.

It is an advantage of the present invention that the higher order number wheel need not respond immediately to the count transfer motion of the lowest order number wheel 22 but may, due to its independent drive source, catch up with the count without placing excessive strain or load on either the lowest order number wheel 22 or the counter input 18. It will, of course, be appreciated that in that event at least a portion of the backward reaction from the loaded drive spring 46 will pass through the planetary assembly to the input shaft 18. However, in the event advancement of the higher order number wheel is not accomplished in the normal manner the transfer assist mechanism further provides surface 128 which will follow-through to contact tab 122 thereby effectuating the transfer operation and assuring accurate and reliable operation of the counter. If desired, this follow-through effect may even be delayed for one full revolution of the lowest order number wheel 22.

As will be appreciated from the foregoing detailed description, the present invention provides a transfer assist mechanism for a counter which effectuates a rapid, accurate and reliable count transfer between successive order number wheels even during a multi-transfer operation. The transfer is accomplished in such a manner as to relieve the drive and lowest order number wheel of the counter of any undesirable load which might other-

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wise result. Thus, excessive wear is avoided and the service life of the counter is substantially lengthened.

As will be apparent to persons skilled in the art, various modifications and adaptations of the structure above-described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a counter comprising a first rotatable member, a rotatable counter wheel, and count advancing means interconnecting the first member and the counter wheel for advancing the counter wheel, the combination wherein the count advancing means includes a drive mechanism for biasing the counter wheel in a count advancing direction and a control assembly for controlling the count advance of the counter wheel by the drive mechanism, said drive mechanism having driving means responsive to the rotation of the first rotatable member for accumulating driving energy for assisting the count advance of the counter wheel, said control assembly having clutch means operative against the bias of the drive mechanism for restricting count advance of the counter wheel during the accumulation of driving energy and being responsive to the operation of said first rotatable member to controllably release the accumulated driving energy and advance the count of the counter wheel.

2. The counter of claim 1 wherein the drive mechanism includes a rotatable assembly interconnected with the driving means and being continuously driven by the first rotatable member during the energy accumulating operation, and wherein the clutch means includes a rotatable element intermittently driven in the direction of bias to controllably release the accumulated driving energy and permit a count advance of the counter wheel.

3. The counter of claim 1 wherein the clutch means includes a first clutch element locked against count advancing movement by the first rotatable member and intermittently rotated in response to the rotation of the first rotatable member for advancing the counter wheel, a second clutch element interconnected with the counter wheel and biased in a count advancing direction by the drive mechanism; and interconnecting means between said first and second elements permitting limited movement therebetween in response to the intermittent rotation of the first clutch element.

4. The counter of claim 3 wherein the first clutch element is a spindle responsive to the rotation of the first rotatable member and the second clutch element is a disk interconnected with the counter wheel, said control assembly including a lost motion driving connection between said spindle and said disk to follow-through and assure a count advancing operation.

5. The counter of claim 1 wherein the clutch means includes a first driven element interconnected with the first rotatable member for locking the clutch means against count advancing movement during the accumulation of driving energy by the drive mechanism, said first clutch element being operative by the first rotatable member for intermittent rotational movement in the direction of bias by the drive mechanism to permit a count advance of the counter wheel, a second driven element mounted for coaxial rotation with the first driven element under the bias of the drive mechanism in response to the intermittent rotational movement of the first driven element, a clutch drum mounted independently of the first and second elements and a torsion spring connected to said first and second elements operative over the drum for permitting limited movement therebetween.

6. The counter of claim 1 wherein the drive mechanism includes a planetary assembly responsive to the rotation of the first rotatable member for moving the driving means to an energy accumulated condition, the planetary assembly being interconnected with the counter

wheel to drive the wheel in a count advancing direction upon controllable release of accumulated energy by the driving means.

7. The counter of claim 1 wherein the driving means is an extensible biasing member, the drive mechanism is mounted for planetary rotational movement intermediate the first rotatable member and the counter wheel and mounts the biasing member to effect energy accumulating extension thereof in response to the rotation of the first rotatable member, the drive mechanism being interconnected with the counter wheel and control assembly for driving the counter wheel in a count advancing direction during the driving return of the biasing member to a rest position upon controllable release thereof by the control assembly.

8. The counter of claim 1 wherein the driving means is a drive spring movable between a rest position and an energy accumulated position, the drive mechanism includes a rotatable planetary assembly in driving engagement with the first rotatable member and interconnected with the drive spring for driving the spring to an extended energy accumulated position, the planetary assembly being in driving engagement with the counter wheel to drive the wheel in a count advancing direction in response to the driving action of the drive spring upon its return to a rest position.

9. The counter of claim 1 wherein the means for accumulating driving energy is an extensible biasing member, the drive mechanism includes a rotatable armature mounted intermediate the first rotatable member and the counter wheel and connected to the extensible biasing member, said armature carrying a planetary gear assembly operatively interconnected with both the first rotatable member for driving the biasing member to an extended energy accumulated condition and the counter wheel to drive the wheel in a count advancing direction as the first rotatable member moves the clutch means in the direction of bias and releases the accumulated driving energy in the extensible biasing member.

10. The counter of claim 1 wherein the drive mechanism includes a planetary gear assembly responsive to the rotation of the first rotatable member for driving the driving means to an energy accumulated condition, the planetary assembly being interconnected with the counter wheel to drive the wheel in a count advancing direction upon controllable release of accumulated energy; the clutch means including a first driven element interconnected with the first rotatable member for locking the clutch means against count advancing movement during the accumulation of driving energy by the driving means, said first driven element being operative by the first rotatable member for intermittent rotational movement in the direction of bias of the drive mechanism to permit a count advance of the counter wheel, a second driven element mounted for coaxial rotation with the first driven element under the bias of the drive mechanism in response to the intermittent rotational movement of the first driven element and interconnecting means between said first and second elements permitting limited independent movement therebetween.

11. The counter of claim 1 wherein the driving means is a drive spring movable between a rest position and an energy accumulated position; the drive mechanism includes a rotatable planetary gear assembly in driving engagement with the first rotatable member and interconnected with the drive spring for driving the spring to the energy accumulated position, the planetary gear assembly being in driving engagement with the counter wheel to drive the wheel in a count advancing direction in response to the driving action of the drive spring upon its return to a rest position; the clutch means including a first clutch element locked against count advancing movement by the first rotatable member and intermittently rotated in response to the rotation of the first rotatable member for advancing the counter wheel, a second clutch element interconnected with the counter wheel and biased in a count advancing direction by the drive spring, and clutch means associated with said second element for directing away from the first rotatable member the force resulting from the driving action of the drive spring.

12. The counter of claim 1 wherein the first rotatable member includes control assembly retaining means and control assembly advancing means, the driving means is an extensible biasing member; the drive mechanism includes a rotatable armature mounted intermediate the first rotatable member and the counter wheel, said armature being connected to the extensible biasing member and carrying a planetary gear assembly operatively interconnected with both the first rotatable member for driving the biasing member to an extended energy accumulated condition and the counter wheel to drive the wheel in a count advancing direction; the clutch means including a first driven element interconnected with the retaining means of the first rotatable member for holding the control assembly against count advancing movement during the accumulation of driving energy by the biasing member and being responsive to the advancing means of the first rotatable member for intermittent rotational movement in the direction of bias to permit a count advance of the counter wheel, a second driven element mounted for coaxial rotation with the first driven element under the bias of the biasing member in response to the intermittent rotational movement of the first driven element, a fixed drum and a torsion spring operative over the drum and connected to said first and second elements for permitting limited movement therebetween.

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