Jan. 14, 1969 F. P. KNOX 3,421,690

COUNTER WITH NOVEL DRIVE MECHANISM

Filed July 21, 1967

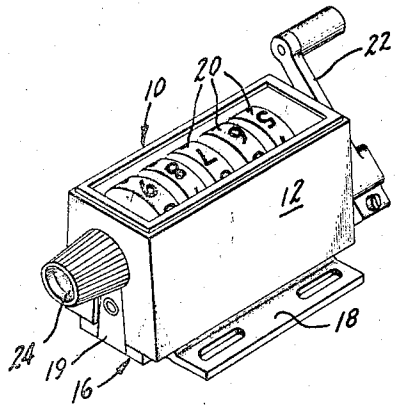


FIG. 1

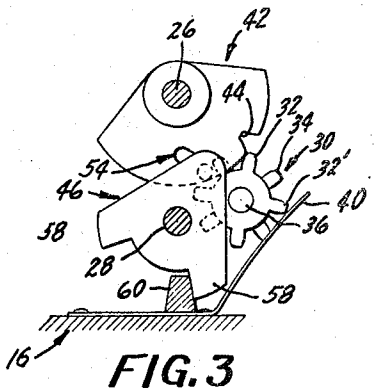


FIG. 3

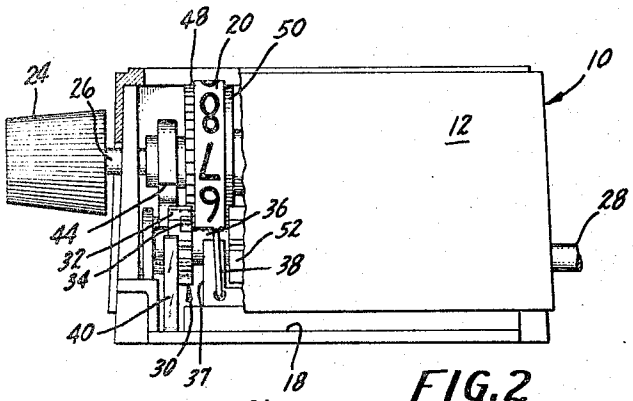


FIG. 2

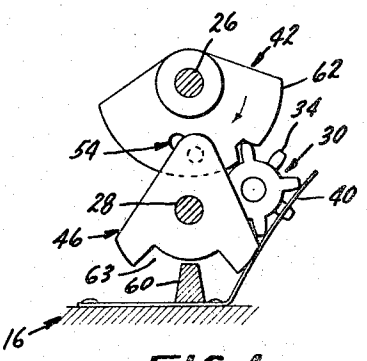


FIG. 4

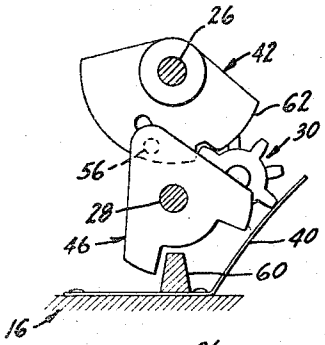


FIG. 5

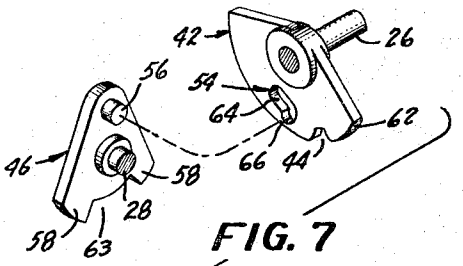


FIG. 7

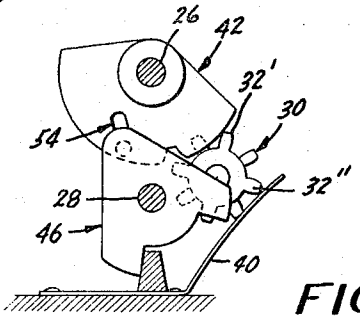


FIG. 6

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United States Patent Office 3,421,690
Patented Jan. 14, 1969

3,421,690

COUNTER WITH NOVEL DRIVE MECHANISM

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Filed July 21, 1967, Ser. No. 655,083
U.S. Cl. 235—117 11 Claims
Int. Cl. G06c 27/00; G06m 1/00

ABSTRACT OF THE DISCLOSURE

There is provided a counter with a novel drive assembly comprising a combination including a pinion member cooperating both with a number wheel and with an oscillatable ratchet. The pinion member has two axial portions each with teeth spaced equidistantly about its circumference, the first portion having twice the number of teeth as the second. The first number wheel is in meshing engagement with the first portion of the pinion member and the ratchet is mounted for oscillation adjacent to the second portion of the pinion member. Biasing means urges the pinion member into driving engagement with the ratchet during oscillation thereof in a forward direction and urges the pinion member from driving engagement with the ratchet during oscillation thereof in the opposite direction. Means are also provided for controlling the motion input to the ratchet to minimize likelihood of injury to parts.

BACKGROUND OF THE INVENTION

Counters are widely employed in industry and elsewhere for recording various items of numerical significance including the operation of presses, attendees, etc. The input to the counting mechanism may be mechanical through oscillation of a suitable pivot arm or electrical or a combination of both electrical and mechanical actions. It is customary to employ a pinion which drives the first number wheel through meshing engagement with a tooth portion thereof and for this number wheel in turn to drive the remaining number wheels in a predetermined sequence.

One of the major sources of wear and tear in counters is the abruptness with which motion is imparted to the drive pinion through the drive mechanism and, over extended periods of time, breakdown in the drive mechanism may occur. In addition, sometimes complicated arrangements have been employed as a means of overcoming the tendency for the drive pinion to rotate in the reverse direction and thus nullify the count just recorded.

It is a object of the present invention to provide a novel counter with a simple but highly effective drive mechanism capable of producing a relatively high degree of efficiency and accuracy in operation.

It is also an object to provide such a counter which utilizes parts which may be produced relatively simply and inexpensively and may be assembled conveniently and quickly.

Another object is to provide such a counter which will permit both pretravel and overtravel of components for ease of count stroke adjustment.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects can be readily obtained in a counter utilizing a drive mechanism which includes a rotatably mounted pinion member having a pair of axially adjacent portions each with a multiplicity of axially-extending teeth spaced equidistantly about the periphery thereof. One portion has twice the number of teeth as the second and the teeth of the second portion are aligned with alternate teeth of the first portion. A number wheel is rotatably mounted in meshing engagement with the first portion of the pinion

member and a ratchet is oscillatably mounted adjacent to the pinion member with its axis of oscillation parallel to the axis of rotation thereof. The ratchet has a generally curvilinear edge surface which is slidable upon the teeth of the second portion of the pinion member, and the curvilinear edge surface is configured to engage the teeth thereof to cause rotation of the pinion member in the forward direction counter to the direction of oscillation of the ratchet.

Biasing means bears upon the pinion member to urge it against the curvilinear edge surface of the ratchet and also to urge its rotation in a direction counter to the forward direction of oscillation of the ratchet. This is accomplished by positioning the biasing means so that it bears against a following edge of one of the teeth of the pinion member at all times when another of the teeth is not in driving engagement with the ratchet curvilinear edge surface. The positioning of the biasing means also allows it to bear against a following edge of one of the teeth for a period of time prior to disengagement of another tooth from the edge surface. The ratchet is designed to rotate the pinion member at least to a point where the biasing means bears against a following edge of a tooth of the pinion member. Means for oscillating the ratchet are also provided in the combination, and the drive assembly preferably includes means for controlling the input motion.

In accordance with a preferred embodiment of the invention, the ratchet is drivingly engaged by a driving member which is oscillatably mounted for oscillation about an axis parallel to the axis of the ratchet and is oscillated by an input which may be mechanical or electrical. Conveniently, the input effects direct oscillation of the shaft upon which the driving member is mounted. To provide a constant motion input, the drive connection comprises a pin and slot arrangement. One member, preferably the ratchet, is provided with a slot which has two portions, an elongated portion extending secantally outwardly and a relatively short portion which extends in a substantially radial direction from the outer edge of the elongated portion. The other member, preferably the driving member, has a stud or pin or boss which extends laterally therefrom at a point spaced from its axis into sliding engagement within the slot.

With such a drive arrangement, initially the stud is seated in the radial portion of the slot which is offset from a line drawn between the axes of the two members. As the driving member starts to oscillate, the stud moves radially toward the center of the ratchet because of the difference in radii with little motion, if any, of the ratchet to permit relatively free pretravel of the driving member. As the continued oscillatory motion of the driving member starts to move the ratchet, the stud enters the secantal portion of the slot which extends across the line between axes. By proper angular orientation and dimensioning of the secantal portion, the input motion can be rendered substantially constant by increasing the effective radial distance as the stud moves in the direction of the axis of the ratchet. The secantal slot portion can be of sufficient length to permit over travel of the stud therein and thus avoid abrupt motions.

Although the pinion member can be formed from two separate elements providing the two differently toothed portions thereof which are then engaged for simultaneous rotation, preferably it is integrally formed as a mutilated pinion by molding, casting or the like. The relative length of the short and long teeth in the two portions is not critical, but the peripheral spacing between teeth in the second portion should cooperate with the radius of the arc of the ratchet so as to provide a spacing therebetween through which the ratchet can pass unimpeded.

The teeth around the circumference of the pinion member need not be restricted to any particular number, but it should be appreciated that large numbers of teeth will tend to cause operation of the mechanism to be overly sensitive and subject to possible inaccuracy in the event of minor misalignment. The pinion member must have at least six teeth, i.e., three long and three short, because continuous rotation and proper relationships with the ratchet can not be established with fewer teeth. It has been found that a pinion having eight teeth operates very well because it provides efficient movement without unduly complicating alignment and sensitivity of the mechanism. For proper operation the number of teeth utilized, the configuration of the ratchet and placement of the biasing means must be consistent and such configuration and placement will usually depend upon the selected design of the pinion and ratchet.

The pinion member is mounted for rotation upon a shaft which provides an axis of rotation parallel to the axis of the number wheel, and also parallel to the axes of oscillation of both the drive member and the ratchet.

Although the ratchet may have any generally curvilinear edge surface which will provide a shoulder for driving engagement with the pinion in one direction and slippage in the other direction of oscillation, the preferred configuration utilizes a recess in the edge surface to receive the pinion teeth and rotate the pinion through a portion of a revolution, after which the tooth is disengaged from the recess. It is important that the ratchet have a smooth surface bordering at least one side of the recess to allow relative sliding movement of the ratchet and pinion teeth and thus to prevent excessive rotation of the pinion member. Although the ratchet design may be varied greatly, it is necessary in all instances that its edge surface enter into driving engagement with only the long teeth of the pinion in the second portion or zone.

The biasing means bearing upon the pinion member generally serves two functions: (1) it forces the pinion member against the arcuate edge surface of the ratchet and (2) it urges rotation of the pinion member in a direction counter to the direction oscillation of the ratchet member. A flat spring fixed at one end to the frame of the counter and having its other end bearing tangentially against the zone or portion of the pinion having the reduced number of teeth has been found to serve this dual function simply and economically. With regard to the first requirement, any spring placement which will tend to force the pinion against the ratchet will be satisfactory. As to the second requirement, however, spring placement is critical to ensure that rotation of the pinion is urged by the spring in only one direction. This necessitates placement of the spring tangentially against the zone or portion of the pinion having the reduced number of teeth so that it can bear against the following edge of one tooth without also bearing against the leading edge of the next adjacent tooth, and thus counteract effective rotation in the desired single direction. It will be appreciated that the spacing between teeth in the second zone or portion of the pinion member facilitates this action and that limiting the total number of teeth positioned about the circumference is desirable. It is necessary that the spring bear upon the following edge of teeth of the pinion member at all times when another tooth of the pinion is not within the recess in the ratchet and also for a period prior to disengagement of a tooth from the recess.

The number wheels employed in the counter are conveniently of the type commonly used in such devices, having the numerical indicia inscribed on the circumferential surface thereof. The number wheel is mounted adjacent the mutilated pinion and in meshing engagement for rotation in cooperation therewith. A pinion releasably engageable with the number wheel will most desirably be provided at one side thereof to mesh with the zone of

the mutilated pinion which has the larger number of effective teeth, so that rotation of the mutilated pinion will rotate the wheel. The wheel pinion should generally be disengageable from the number wheel to allow resetting of the counting device. The number wheel will generally have, on the side opposite to the side on which the wheel pinion is located, means such as a driving lug for engaging a transfer pinion which serves to rotate additional number wheels provided to increase the capacity of the counter. Limiting means is desirably provided to restrict the travel distance of the driving member so as to avoid overdrive and the consequent danger of injury to the parts of the mechanism. Such means can constitute a pair of wings on the driving member and a lug or boss projecting from the frame into the channel or recess between the wings. The travel distance is thereby restricted by the distance between the wings since the lug or boss will form an abutment limiting the oscillatory arc. Alternatively, a lug may be provided on the driving member which cooperates with a pair of projections on the frame to prevent overdrive in a similar fashion.

The counter mechanism components may be fabricated from metals, plastics, etc. The material used should, of course, be chosen to provide the maximum in efficiency and longevity to the device. From the standpoint of quietness and smoothness of operation, it is frequently found that plastics such as nylon and "Delrin" are well suited, and, of course, some portions of the device may be of metal and others of plastic depending upon the function of the particular element. It will be appreciated that the present invention is concerned primarily with the means by which oscillatory motion is converted into intermittent rotational motion and that the other portions of the counter mechanism may be conventional.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a perspective view of a counter embodying the present invention;

FIGURE 2 is a side elevational view thereof to an enlarged scale with a portion of the cover broken away to show a portion of the drive mechanism;

FIGURE 3 is a partially diagrammatical view to an enlarged scale of the drive mechanism of the invention in the initial rest position;

FIGURE 4 is a similar view of the mechanism in a position after initiation of the counting cycle;

FIGURE 5 is a similar view of the mechanism at a later stage in the counting cycle;

FIGURE 6 is a similar view of the mechanism at the completion of one-half of the counting cycle; and

FIGURE 7 is an exploded view of the drive member and the ratchet in the drive mechanism.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now to the drawing in detail, FIGURES 1 and 2 illustrate a mechanical counter embodying the present invention and having a cover generally desingated by the numeral **10** with an opaque body portion **12** and a transparent viewing window **14** supported in the top wall thereof. The cover **10** is mounted on a frame, generally designated by the numeral **16**, which has a flange **18** at the base thereof for mounting the assembly upon a supporting surface.

As seen in FIGURE 2, journalled in the end walls **19** of the frame **16** is a shaft **26** upon which are rotatably mounted a multiplicity of number wheels **20** bearing numerical indicia on the circumferential surface thereof and viewable through the window **14** as they rotate into position underlying. A pivot arm **22** is mounted at one end on the shaft **28** and is the means for actuating the counting mechanism. A knurled knob **24** is provided on shaft **26** outwardly of the cover **10** to aid in resetting the number wheels **20**.

As best seen in FIGURES 2 to 7, the counting mechanism includes a mutilated pinion generally designated by the numerical **30** which has alternating around the circumference thereof a plurality of teeth **32** extending through the axial length thereof and teeth **34** extending axially only along a portion of the length thereof. Since the short teeth **34** are in alignment along one end of the pinion **30**, they provide a first zone in which the number of teeth is twice that in the second zone provided at the other end solely by the long teeth **32**. The mutilated pinion **30** is rotably mounted at one end of a shaft **36** which is supported in brackets **37** adjacent the end of the frame **16** and held therein by spring clips **38**.

A ratchet generally designated by the numeral **42** is mounted for oscillation upon the shaft **26** upon which the number wheels **20** are also mounted. In its periphery, the ratchet **42** has a recess **44** which is designed to receive a portion of the long teeth **32** and thereby to turn pinion **30** as it oscillates upon the shaft **26**. A flat spring **40** affixed to the frame **16** is positioned so as to bear tangentially against the pinion **30** and bias it toward the ratchet **42**, the spring **40** bearing upon the second zone of the pinion **30** having the lesser number of teeth. A driving member generally designated by the numeral **46** is mounted for oscillation at the end of the shaft **28** adjacent the pinion **30** and ratchet **42** and serves to drive the ratchet **42** by engagement therewith as will be more fully pointed out hereinafter.

As seen in FIGURE 2, the wheel gear **48** is positioned adjacent the side of the number wheel **20** for rotation upon the shaft **26** by its meshing engagement with the mutilated pinion **34** on the side of the pinion **30** wherein the double number of teeth is located. The wheel gear **48** is disengageably connected to the number wheel **20** by conventional means (not shown) to allow resetting of the number wheels **20** by the resetting knob **24**. Rotation of the pinion **30** causes rotation of the wheel gear **48** which in turn revolves the wheel **20** to sequentially exhibit the indicia thereupon. Provided on the opposite side of the number wheel **20** is a transfer portion **50**, which has a drive lug (not shown) at one point about its circumference. As the wheel **20** rotates, the drive lug will engage the transfer pinion **52** to advance the adjacent number wheel through a wheel pinion (not shown) similar to **48**. Similar structure provides means for advancing the remaining several number wheels **20** in the desired sequence.

In FIGURES 3–6 there is diagrammatically illustrated the operation of the mechanism whereby the oscillatory motion of the pivot arm **22** and its actuating shaft **28** is converted into the rotary movement of the mutilated pinion **30** through the coupling of the driving member **46** to the ratchet **42**. FIGURE 3 shows the mechanism in the initial rest position with a tooth **32** on the verge of entering the recess **44** of the ratchet **42** and with the flat spring **40** bearing against the following edge of another of the wide teeth designated **32'**. This forces the pinion **30** against the arcuate edge surface **62** of the ratchet **42** and also urges rotation of the pinion **30**. As the ratchet **42** oscillates in a clockwise direction, the flat spring **40** urges the tooth **32** in a counter rotational direction and into the recess **44** provided in the arcuate edge surface **62**.

FIGURE 4 illustrates the mechanism shown in FIGURE 3 at a point in time after the oscillating ratchet **42** has turned in a forward direction through a small portion of a cycle. It will be seen that in this position the tooth **32** of the pinion **30** has been engaged in the recess **44** located in the arcuate edge surface **62** of the ratchet **42**.

The continuing oscillation of the ratchet **42** to the position depicted in FIGURE 5 rotates the pinion **30** to a position just prior to expulsion of the tooth **32** from the recess **44**. In this position another tooth **32''** has overridden spring **40** and is in a position with respect thereto wherein the spring **40** imparts no rotational motion to the pinion **30**. It will be apparent that continued oscillation of the ratchet **40** will position the other tooth **32''** in a relationship with the spring **40** wherein the spring bears against a following edge of the tooth. Thus, the combination of the spring **40** and the ratchet **42** urging rotation of the pinion **30** causes expulsion of the tooth **32** from the recess **44** during the continued rotation of the ratchet **40** in response to the oscillatory movement of the driving member **46**.

As the ratchet **42** completes the forward half of its cycle, the mechanism assumes the relationship depicted in FIGURE 6. Here, the tooth **32'** is forced against the arcuate edge surface **62** under the influence of the flat spring **40** bearing upon a following edge of the tooth **32''**, and tooth **32**, previously engaged with the recess **44**, is wholly expelled therefrom. At this point, the drive shaft **28** and driving member **46** start the ratchet **42** oscillating in a reverse direction. As the ratchet **42** oscillates backward, the leading edge of the tooth **32'** bears upon the arcuate edge surface **62** under the influence of a flat spring **40** bearing upon a following edge of the tooth **32''**. In this position, the ratchet **42** can return to the initial rest position depicted in FIGURE 3 without engaging the tooth **32** just expelled from the recess **44**. Accordingly, cancellation of the count just recorded is prevented.

Shown in FIGURES 3–6 is a preferred embodiment of the invention wherein there is provided means limiting the arc of oscillation of the driving member **46**. A pair of peripherally spaced wings **58** on the driving member **46** provide a channel **63** therebetween in which is received the abutment block **60** on the frame **16** so that oscillation of the driving member **46** is only through an arc until the block **60** abuts against the surface of one of the wings **58**. Such a relationship protects the mechanism by preventing overdrive and undue strain on the component parts.

In FIGURE 7 is illustrated the preferred embodiment of engagement between the driving member **46** and the ratchet **42**. As can be seen, the driving member **46** has a stud **56** projecting laterally therefrom at a point remote from axis of oscillation provided by the shaft **28**. The stud **56** rides in a slot in the ratchet **42** generally designated by the numeral **54** which has an elongated portion **64** extending secantally outwardly from the axis thereof. The slot **54** also includes short, substantially radially outwardly extending portion **66** at the outer end thereof. Utilization of such a design allows controlled acceleration of the ratchet and minimizes impact, which thereby improves the drive action and provides longer life to the entire mechanism.

Accordingly, it is seen that the present invention provides a counter drive mechanism which is relatively simple and inexpensive to produce and which provides a high level of efficiency and accuracy in operation. Moreover, the counter drive mechanism of the present invention consists of relatively few parts which are of relatively simple design and relatively simple to assemble. The simple but highly effective drive action permits a limited amount of overdrive to avoid injury to the parts and effectively prevents "milking" or falsifying the counts registered.

Having thus described the invention, I claim:

1. In a counter, the combination comprising a rotatably mounted pinion member having two axially adjacent portions each with a multiplicity of axially extending teeth spaced equidistantly about the periphery thereof, one of said portions having twice the number of teeth as the other portion with said teeth of said other portion being aligned with alternate teeth of said one portion; a number wheel member rotatably mounted with a toothed portion in meshing engagement with said one portion of said pinion member; a ratchet oscillatably mounted adjacent said pinion member with its axis of oscillation parallel to the axis of rotation of said pinion member, said ratchet having a generally curvilinear edge surface slidable upon the teeth of said other portion of said pinion member, said

edge surface being configured for engaging a tooth of said pinion member and for rotating said pinion member in a direction counter to the direction of oscillation of said ratchet; means for oscillating said ratchet; and biasing means bearing upon said pinion member to urge rotation of said pinion member in a direction counter to the forward direction of oscillation of said ratchet, said biasing means bearing against a following edge of one of the teeth of said pinion member at all times when another of the teeth is not engaged by said ratchet curvilinear edge surface and for an additional period of time prior to disengagement of a tooth from said surface, said ratchet being oscillatable about an arc sufficient to rotate said pinion member at least to a point where said biasing means bears against the following edge of a tooth of said pinion member, whereby said biasing means urges a tooth of said pinion member into engagement with said curvilinear edge surface as said ratchet oscillates in a forward direction, said ratchet rotates said pinion member in a counter direction and disengages from the first tooth, and reengagement of said first tooth with said ratchet surface during oscillation of the ratchet in the reverse direction is prevented by said biasing means urging rotation of said pinion member in the direction counter to forward oscillation of the ratchet.

2. The counter of claim 1 wherein said means for oscillating said ratchet includes a driving member mounted for oscillation about an axis parallel to said ratchet axis and wherein means interengaging said ratchet and said driving member includes a slot in one of said members which has an elongated portion extending secantally outwardly and a substantially radially extending portion at the outer end of said elongated portion, the other of said members having a stud extending laterally from a point on said member spaced from the axis thereof into sliding engagement within said slot.

3. The counter of claim 2 wherein said counter is provided with limiting means for restricting the arc of oscillation of said driving member to minimize the tendency for damage from overdrive.

4. The counter of claim 1 wherein said ratchet member curvilinear edge surface has a recess therein for receiving and engaging a tooth of said pinion member during a portion of its oscillatory motion.

5. The counter of claim 1 wherein said biasing means is a flat spring having one end fixedly mounted and its other end free and bearing tangentially against said other portion of said pinion member.

6. The counter of claim 1 wherein said number wheel member has a first element having the numerical indicia spaced about the circumference thereof, a second element with teeth spaced about the circumference thereof in meshing engagement with said one portion of said pinion member, and means disengageably connecting said first and second elements for driving said first element in the forward direction but preventing rotation in the other direction.

7. The counter of claim 1 wherein said means for oscillating said ratchet includes a driving member mounted for oscillation about an axis parallel to the axis of said ratchet and wherein means interengaging said ratchet and said driving member includes a slot in one of said members and a stud on the other of said members extending into sliding engagement within said slot, wherein said ratchet member curvilinear edge surface has a recess therein for receiving and engaging a tooth of said pinion member during a portion of its oscillatory motion, said biasing means urging an untoothed portion of said pinion member against the curvilinear edge surface of said ratchet during further oscillation of the driving member in the forward direction and during oscillation of the driving member in the reverse direction.

8. In a counter, the combination comprising a rotatably mounted pinion member having two axially adjacent portions each with a multiplicity of axially extending teeth spaced equidistantly about the periphery thereof, one of said portions having twice the number of teeth as the other portion with said teeth of said other portion being aligned with alternate teeth of said one portion; a number wheel member rotatably mounted with a toothed portion in meshing engagement with said one portion of said pinion member; a ratchet rotatably mounted adjacent said pinion member with its axis of oscillation parallel to the axis of rotation of said pinion member, said ratchet having a generally curvilinear edge surface slidable upon the teeth of said other portion of said pinion member with a recess therein for receiving and engaging a tooth of said pinion member during a portion of its oscillatory motion to impart rotation of said pinion member in a direction counter to the direction of oscillation of said ratchet; means for oscillating said ratchet including a driving member mounted for oscillation about an axis parallel to said ratchet axis and spaced therefrom and means interengaging said ratchet and driving member, said interengaging means including a slot in one of said members and a stud on the other of said members slidably engaged in said slot; and spring means bearing against said other portion of said pinion member to urge rotation of said pinion member in a direction counter to the forward direction of oscillation of said ratchet, said spring means bearing against a following edge of one of the teeth of said pinion member at all times when another of the teeth of said other portion is not engaged in said recess of the curvilinear edge surface and for an additional period of time prior to disengagement of a tooth from said recess, said ratchet being oscillatable about an arc sufficient to rotate said pinion member at least to a point where said spring means bears against the following edge of a tooth of said pinion member whereby said spring means urges a tooth of said pinion member into engagement within said recess as said ratchet oscillates in a forward direction, said ratchet rotates said pinion member in a counter direction and disengages from the first tooth, and reengagement of said first tooth within said recess during oscillation of the ratchet in the reverse direction is prevented by said spring means urging rotation of the pinion member in the direction counter to forward oscillation of the ratchet.

9. The counter of claim 8 wherein said counter is provided with limiting means for restricting the arc of oscillation of said driving member to minimize the tendency for damage from overdrive.

10. The counter of claim 8 wherein said slot has an elongated portion extending secantally outwardly across an imaginary line drawn between the axes of said ratchet and driving member and a substantially radially extending portion at the outer end of said elongated portion.

11. The counter of claim 8 wherein said spring means is a flat spring having one end fixedly mounted and its other end free and bearing tangentially against said other portion of said pinion member.

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U.S. Cl. X.R.

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