United States Patent

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[54] **ADD AND SUBTRACT COUNTER**
13 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **235/92C,** 235/91, 235/117, 235/92R
[51] **Int. Cl.** **G06m 3/14,** G06m 1/10
[50] **Field of Search** ..... 235/91 (1,66), 117, 91; 340/378—9

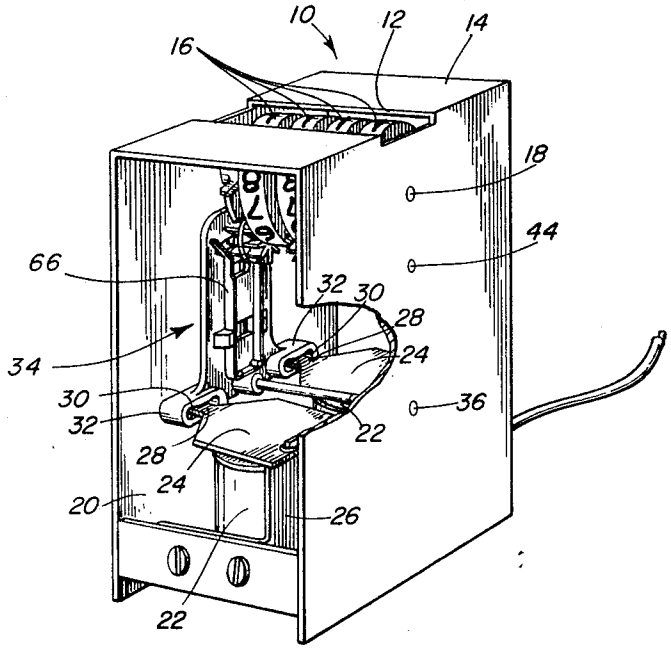
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Assistant Examiner—Joseph M. Thesz, Jr.
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ABSTRACT: A counter has a novel drive assembly including a pinion cooperating both with a number wheel and also with an oscillatable ratchet to permit selective adding and subtracting. The pinion member has two adjacent axial portions with each portion having teeth spaced about the circumference. The number wheel is in meshing engagement with a first portion of the pinion member and the ratchet is mounted for oscillation adjacent the second portion thereof. Biasing means is provided to urge a tooth of the pinion member into engagement with suitable means on the ratchet when the ratchet is in either of two positions spaced from a neutral point therebetween, so that return of the ratchet to its neutral point from one of those positions causes rotation of the pinion in a direction opposite to the direction of oscillation of the ratchet. The biasing means also prevents engagement of a tooth with the ratchet at a wrong point during the cycle to avoid spurious action.



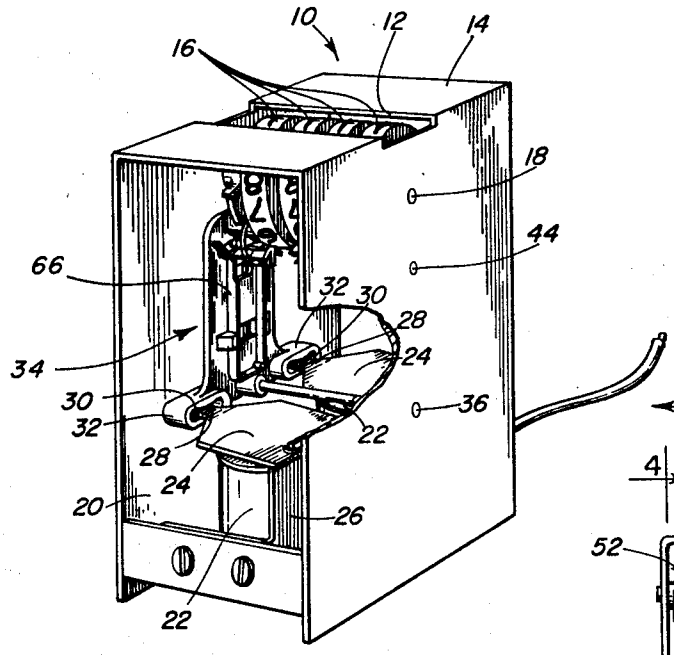


Fig. 1

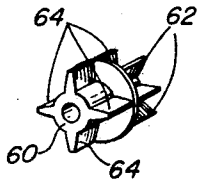


Fig. 3

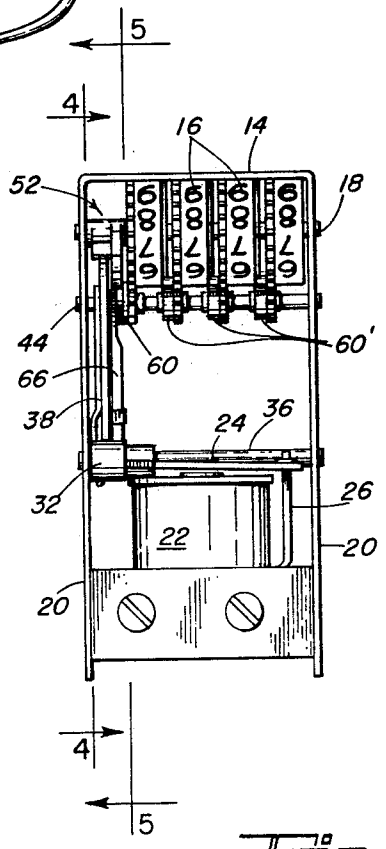


Fig. 2

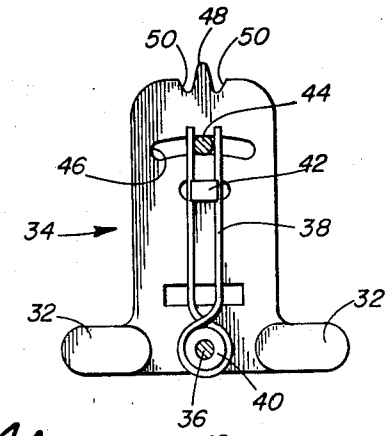


Fig. 4A

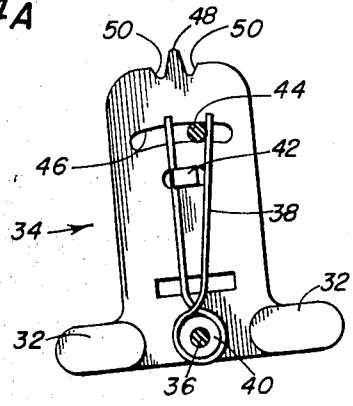


Fig. 4B

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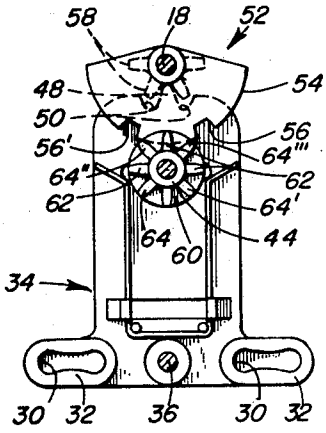


Fig. 5A

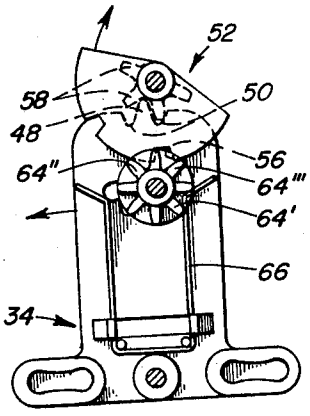


Fig. 5B

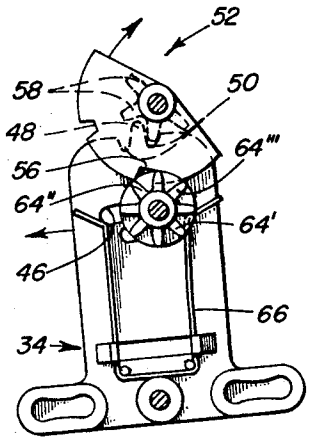


Fig. 5C

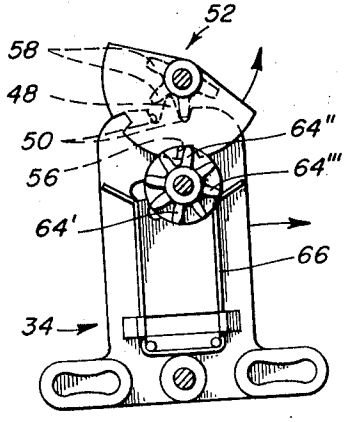


Fig. 5D

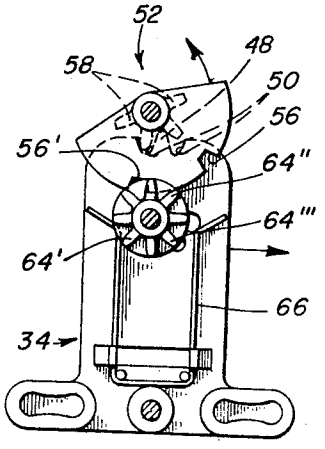


Fig. 5E

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ADD AND SUBTRACT COUNTER

BACKGROUND OF THE INVENTION

Counters are widely employed in industry and elsewhere for recording numerical data relative to various activities; for example, they are commonly used to record the number of repetitive operations of machines such as presses, they are used on turnstiles and the like to determine the total number of people in attendance at a function or location, etc. The input to the counting mechanism may be electromechanical or purely mechanical by virtue of manual or mechanical oscillation of a suitable pivot arm. Although it is conventional to provide means in such counters whereby they can be reset by overriding the normal drive mechanism therefor, generally such reset means does not function sequentially through the entire numerical range to provide a subtracting feature. In certain instances it is desirable to cancel one or more units regardless of the count appearing on the number wheels, and a number of devices have been proposed for this purpose. However, such devices have tended to be cumbersome or expensive to manufacture or to be unreliable or short-lived in operation.

Accordingly, the primary object of the present invention is to provide a novel counter for selective adding and subtracting, which is relatively simple and inexpensive to produce, and which nevertheless is highly efficient and accurate in operation.

A related object is to provide such a counter in which the actuating mechanism is relatively compact and operated by an electrical impulse.

SUMMARY OF THE INVENTION

It has now been found that the foregoing and related objects can be readily attained in an add and subtract counter including a rotatably mounted pinion member having two axially adjacent portions each with a multiplicity of axially extending teeth spaced about the circumference thereof. A number wheel member is rotatably mounted with a toothed portion thereof in meshing engagement with one of the toothed portions of the pinion member, and a ratchet member is mounted adjacent the other toothed portion of the pinion member. The ratchet member oscillates about an axis parallel to the axis of rotation of the pinion member, and between first and second positions and through a neutral point intermediate thereof. A generally curvilinear edge surface is provided on the ratchet member which is slidable upon the teeth of the other portion of the pinion member; the edge surface is configured for engaging a tooth of the pinion member in the first and second positions of the ratchet member so that the ratchet member rotates the pinion member during oscillation of the ratchet member in either direction.

Means is provided for selectively moving the ratchet member to and from the first and second positions thereof, and biasing means is operative upon the pinion member upon operation of the selective moving means to bias the pinion member is selectively moved from the neutral point. The biasing means operates against a following edge of a tooth of the pinion member at least during movement of the ratchet member from the neutral point and immediately prior to engagement of another tooth of the pinion member by the ratchet member curvilinear edge surface. The biasing means thereby urges the ultimately engaged tooth against the edge surface of the ratchet member for sliding contact thereon during movement of the ratchet member from the neutral point to one of the first and second positions, and it thereafter urges the same tooth into engagement by the edge surface at either of the positions. Return of the ratchet member to the neutral point from one of the first and second positions rotates the pinion member in a direction opposite to the direction of movement of the ratchet member.

Preferably, one portion of the pinion member has twice the number of teeth as the other, and most desirably the one portion has eight teeth, the other portion has four teeth and

toothed portion of the number wheel has 20 teeth spaced about its circumference. The generally curvilinear edge surface of the ratchet member desirably has a pair of spaced notches therein for engagement with the teeth of the pinion member.

In a preferred embodiment the means for selectively moving the ratchet includes a driving member mounted for oscillation about an axis parallel to the axis of the ratchet member. The driving member and ratchet member are desirably provided with complementary toothed elements to provide driving interengagement therebetween, and the biasing means for the pinion member is ideally mounted on the driving member for movement therewith. More specifically, the biasing means may include a pair of flat spring elements straddling the pinion member and normally out of contact therewith, so that the biasing means are brought into contact with the tooth of the pinion member upon oscillation of the driving member in one direction or the other from its neutral point.

Most preferably the counter includes a fixed element, and the driving member has an abutment element and second spring means thereon. The second spring means has two elements, one of which is positioned on each side of both the fixed element and also the abutment element. In this manner, each of the spring elements bears upon one of the stationary element and the abutment element when the ratchet is in either the first or the second position thereof so as to urge the ratchet toward the neutral point. The counter may utilize electromechanical drive means to selectively oscillate the drive member in either direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** of the drawings is a perspective view of an electromechanical counter embodying the present invention, with a portion of the frame broken away for clarity of illustration of the mechanism therein;

FIG. **2** is an end view of the counter of FIG. **1**;

FIG. **3** is a perspective view of a pinion employed in the counter of FIG. **1** to a somewhat enlarged scale;

FIGS. 4A and 4B illustrate the drive utilized in the counter as viewed along line **4–4** in FIG. **2** but to a slightly enlarged scale, and with FIG. 4A showing the driver in a neutral rest position and with FIG. 4B showing it displaced in a counterclockwise direction therefrom; and

FIGS. 5A—5E show the basic components of the add-subtract mechanism apart from the remainder of the counter, viewed along line **5–5** in FIG. **2** but drawn to a somewhat enlarged scale, with the several FIGS. depicting the different relationships that occur during the add and subtract cycles.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

Turning now in detail to the appended drawings, an electromechanical counter embodying the present invention has a frame, generally designated by the numeral **10**, with a viewing cut out **12** in the top wall **14** thereof through which are visible four number wheels **16**. The number wheels **16** are provided with circumferential teeth in a conventional manner and are rotatably mounted upon a shaft **18** which is supported between the sidewalls **20** of the frame **10**. Two electromagnetic coils **22** are mounted in the bottom portion of the frame **10**, and each is suitably and independently connected to an energizing source (not shown) of current which may take any of numerous forms depending upon the application for which the particular counter is intended. Clappers **24** are loosely supported at one end upon associated pedestals **26** (only one of which is visible) by seating a tongue at the upper end of the pedestal in a slot adjacent the rear edge of the clapper **24** so that one clapper is positioned to overlie each of the coils **22**. The tongue **28** at the front end of each clapper **24** is received in a recess **30** provided in each of the ears **32** projecting outwardly from the sides of the driver, the latter being generally designated by the numeral **34**.

The driver 34 is oscillatably mounted on a shaft 36 which is supported between the sidewalls 20, and it will be apparent that selective energization of one of the coils 22 will cause a downward movement of the associated clapper 24, which in turn will oscillate the driver 34 in either a clockwise or counterclockwise direction depending upon which coil 22 is energized. A sear-type biasing spring 38 is mounted on the front side of the driver 34 over a boss 40 projecting therefrom; the arms of the spring 38 straddle a projecting stop block 42 on the driver 34 and also a shaft 44 which projects through the arcuate slot 46 in the driver 34 and is supported between the sidewalls 20 of the frame 10. As will be noted with particular reference to FIGS. 4A and 4B, the driver 34 may be oscillated to the position shown in FIG. 4B under the influence of one of the magnetic coils 22, which is of sufficient strength to override the biasing force of the spring 38. When the coil is deenergized, the sear spring 38 forces the driver 34 back to the neutral position depicted in FIG. 4A by exerting closing force upon the stop block 42 on the driver 34 and the shaft 44.

A finger 48 projects from the upper edge of the driver 34, and recesses or notches 50 are provided therein at each side of the base of the finger 48. As is best seen in FIGS. 5A—5E, a generally semicircular ratchet, generally designated by the numeral 52, is oscillatably mounted on the shaft 18 adjacent the driver 34, and it has an arcuate or generally curvilinear edge 54 with a pair of recesses or notches 56, 56′ therein. On the back side of the ratchet 52 there are provided teeth 58 (shown in dotted line in FIGS. 5A—5E), the interior two of which mesh with the finger 48 of the driver 34. It will now be appreciated that oscillation of the driver 34 will cause the finger 48 to bear upon one of the teeth 58 of the ratchet 52, thus oscillating the ratchet 52 in the opposite direction. As the movement proceeds, the interior tooth 58 adjacent to the one acted upon by the finger 48 becomes engaged in one of the recesses 50 at its base, by which engagement the ratchet 52 may be driven past the point at which contact with the finger 48 ceases.

As is best seen in FIG. 2, four pinions 60, 60′ are rotatably mounted on the shaft 44 beneath the number wheels 16; the three pinions 60′ serve as transfer gears between adjacent number wheels 16, whereas the fourth pinion 60 is associated with the ratchet 52 and the first number wheel 16 and serves as a transfer gear therebetween. The construction of all pinions 60, 60′ may be similar, and only pinion 60 will be discussed in detail hereinafter. As is most clearly shown in FIG. 3, the pinion 60 has two distinct axial portions, one portion having twice the number of teeth as the other. The pinion 60 may be considered to have a number of narrow teeth 62 spaced equidistantly about the periphery of one of the axial portions (which, for the sake of description, may be designated the outer portion) and an equal number of wide teeth 64, the wide teeth 64 alternating with the narrow teeth 62 in the outer portion and extending across both axial portions to provide the reduced number of teeth present on the inner portion.

Referring in detail to FIGS. 5A—5E, the pinion 60 is mounted behind the driver 34 (FIGS. 5A—5E being considered a rear view) and is positioned relative to the ratchet 52 so that the ratchet 52 registers with the inner portion of the pinion 60; in this relationship the arcuate edge 54 can pass between adjacent wide teeth 64. A double element cantilever spring 66 is mounted upon the rear face of the driver 34 to oscillate with it, and the elements of the spring 66 straddle the pinion 60 and operate in the plane of the inner axial portion thereof. Reference to FIG. 2 will more clearly illustrate the axial position of the pinion 60 relative to the ratchet 52, the driver 34 and the cantilever spring 66 thereon.

FIG. 5A depicts the novel counting mechanism of the invention in a neutral or rest position, and FIGS. 5B—5D illustrate the mechanism at various stages during the registration of a count. It will be noted that in FIG. 5A the portion of the arcuate edge 54 of the ratchet between the recesses 56, 56′ is positioned between two of the adjacent wide teeth 64″, 64‴ of the pinion 60 on the axial portion thereof having the reduced number of teeth. Also, both elements of the cantilever spring 66 are out of contact with the pinion 60.

As counterclockwise movement is initiated by one of the coils 22 (not shown in FIGS. 5), the finger 48 bears upon one of the teeth 58 of the ratchet 52 and urges the ratchet 52 in a clockwise direction. This stage of operation is illustrated in FIG. 5B, which also shows the right-hand element of the spring 66 bearing upon the following edge of one of the wide teeth 64′ at the inner axial portion of the pinion 60. The influence of the spring on the tooth 64′ forces the diametrically opposed wide tooth 64″ to bear against the arcuate edge 54 of the ratchet 52 and maintain tooth 64‴ away from that edge. In the absence of such an influence, there would be a tendency for the tooth 64‴ to engage in the recess 56, permitting the ratchet 52 to rotate the pinion 60 and thus causing spurious action.

As counterclockwise movement of the driver 34 continues, as is shown in FIG. 5C, the interior tooth 58 of the ratchet 52 adjacent the tooth against which the finger 48 was bearing enters the recess 50 on the right-hand side of the finger 48, and is engaged by the shoulder of the driver member 34 defining that recess. This engagement permits the driver 34 to urge the ratchet 52 further in a clockwise direction, and the spring 66 is thereby urged more forcibly against the tooth 64′ due to the increased displacement of the driver 34 relative to the pinion 60.

Turning now to FIG. 5D, the relationship of the several parts is shown at a point after the counterclockwise movement of the driver 34 has reached its extreme and the sear-type biasing spring 38 becomes effective to move the driver 34 in a clockwise direction back to its neutral position. At this stage, the ratchet 52 has passed far enough to permit the spring 66 partially to rotate the pinion 60 and urge the tooth 64″ thereof into the recess 56. The force of the biasing spring 38 then urges the driver 34 to its neutral position which, in turn, oscillates the ratchet 52 in a counterclockwise direction by interengagement of the finger 48 of the driver with the teeth 58 of the ratchet 52. Due to the engagement of the tooth 64″ in the recess 56, movement of the ratchet 52 causes the pinion 60 to rotate in a clockwise direction during this return phase of the cycle. The teeth on the outer portion of the pinion 60 are suitably interengaged with complementary teeth on the adjacent number wheel 16 so that rotation of the pinion 60 in turn causes rotation of the associated number wheel 16 a sufficient distance to expose a sequential digit in the viewing aperture 12, thus registering a count.

FIG. 5E is simply an illustration of the manner in which the counting mechanism functions when it is desired to rotate the pinion and associated number wheel in the opposite direction to cancel a count recorded as previously described. Thus, FIG. 5E is generally equivalent to FIG. 5B with the various parts moving in directions opposite from those depicted therein and described with reference thereto. It will be appreciated that, in the position shown in FIG. 5E, the left-hand element of the cantilever spring 66 is bearing upon the surface (following edge) of the wide tooth 64′ opposite to that upon which the right-hand element bore in the position shown in FIG. 5B (which may now be considered the leading edge relative to the direction of rotation). The tooth 64″ is thereby urged against the arcuate edge 54 of the ratchet 52, and when the ratchet 52 and driver 34 oscillate to a sufficient extent in the directions illustrated the tooth 64″ will enter the recess 56′. Thereafter, return of the ratchet 52 in a clockwise direction, under the influence of the biasing spring 38 acting upon the driver 34, will rotate the pinion 60 in a counterclockwise direction thereby rotating the number wheel 16 and cancelling a count.

Although the drawings illustrate preferred embodiments of the invention, it should be appreciated that considerable deviation from the mechanisms and elements illustrated therein is possible without departing from the concept thereof. Thus for example, it is possible to employ a pinion wherein the number of teeth in one of the adjacent axial portions is related

to the number in the other portion by a factor other than 2, although this will normally entail suitable redesign of the cooperating number wheel and particularly the toothed portion thereof. It is also possible to utilize biasing means operating on the pinion other than the double element cantilever type spring illustrated, and such biasing means may be mounted on a part of the device other than the driving member. However, the described construction is particularly desirable because it minimizes the load upon the prime movers (e.g., the electromagnetic coils) at a time when it is most important to do so, i.e., at the initiation of the cycle. More particularly, since that biasing means does not contact the pinion until after movement of the driver has commenced, the desirable load minimization is achieved. As has been pointed out, the nature of the prime mover may also vary from the electromagnetic coils described, and other modifications and specific design features will be apparent to those skilled in the art.

Accordingly, it can be seen that the present invention provides a novel counter for selectively adding and subtracting. The counter is relatively simple and inexpensive to produce, while nevertheless being highly efficient and accurate in operation. The concept of the invention is especially applicable in the production of compact electromagnetic counters which offer relatively trouble-free operation.

I claim:

1. In an add and subtract counter, the combination comprising a rotatably mounted pinion member having two axially adjacent portions each with a multiplicity of axially extending teeth spaced about the circumference thereof; a number wheel member rotatably mounted with a toothed portion in meshing engagement with one of said portions of said pinion member; a ratchet member mounted adjacent the other portion of said pinion member for oscillation between first and second positions and through a neutral point intermediate thereof, the axis of oscillation being parallel to the axis of rotation of said pinion member, said ratchet member 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 other portion of said pinion member in said first and second positions of said ratchet member and for rotating said pinion member during oscillation of said ratchet member in either direction; means for selectively moving said ratchet member to and from said first and second positions; and biasing means operative upon said pinion member upon operation of said selective moving means to bias said pinion member in the same direction as that in which said ratchet member is selectively moved from said neutral point, said biasing means operating against a following edge of a tooth of said pinion member at least during movement of said ratchet member from said neutral point and immediately prior to engagement of another tooth of said pinion member by said ratchet member curvilinear edge surface, whereby said biasing means urges said another tooth against said ratchet member edge surface for sliding contact thereon during movement of said ratchet member from said neutral point to one of said first and second positions and thereafter urges said another tooth into engagement by said edge surface at either of said positions, whereby said ratchet member in returning to said neutral point will rotate said pinion member in a direction opposite to the direction of movement of said ratchet member.

2. The counter of claim 1 wherein said one portion of said pinion member has twice the number of teeth as said other portion thereof.

3. The counter of claim 1 wherein said one portion of said pinion member has eight teeth, said other portion of said pinion member has four teeth, and said toothed portion of said number wheel has 20 teeth spaced about the circumference thereof.

4. The counter of claim 1 wherein said generally curvilinear edge surface of said ratchet member has a pair of spaced notches therein for engagement with said tooth of said other portion of said pinion member.

5. The counter of claim 1 wherein said means for selectively moving said ratchet includes a driving member mounted for oscillation about an axis parallel to said ratchet member axis and wherein complementary toothed elements are provided on said driving member and ratchet member to provide driving interengagement therebetween.

6. The counter of claim 5 wherein said biasing means is mounted on said driving member and is movable therewith.

7. The counter of claim 6 wherein said biasing means includes a pair of flat spring elements straddling said pinion member and normally out of contact therewith, a different one of said spring elements being brought into contact with a tooth of said pinion member upon oscillation of said driving member in each direction from the neutral point.

8. The counter of claim 7 wherein said spring element contact is with a tooth on said other portion of said pinion member.

9. The counter of claim 7 wherein said counter includes a fixed element, and wherein said driving member has an abutment element and second spring means thereon, said second spring means having two elements, one of which is positioned on each side of both said fixed element and also said abutment element so that each of said spring elements bears upon one of said stationary element and abutment element when said ratchet is in one of said positions, to urge said ratchet toward said neutral point.

10. The counter of claim 5 wherein said counter includes electromechanical drive means to selectively oscillate said drive member in either direction.

11. In an add and subtract counter, the combination comprising a rotatably mounted pinion member having two axially adjacent portions each with a multiplicity of axially extending teeth spaced about the circumference thereof; a number wheel member rotatably mounted with a toothed portion in meshing engagement with one of the adjacent portions of said pinion member; a ratchet member mounted adjacent the other portion of said pinion member for oscillation between first and second positions and through a neutral point intermediate thereof, the axis of oscillation being parallel to the axis of rotation of said pinion member, said ratchet member 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 other portion of said pinion member in said first and second positions of said ratchet member and for rotating said pinion member during oscillation of said ratchet member in either direction; means for selectively moving said ratchet to and from said first and second positions including a driving member mounted for oscillation about an axis parallel to said ratchet member axis; and biasing means mounted on said driving member and movable therewith, operative upon said pinion member upon oscillation of said driving member to bias said pinion member in the same direction as that in which said ratchet member is selectively moved from said neutral point, said biasing means operating against a following edge of a tooth of said pinion member at least during movement of said ratchet member from said neutral point and immediately prior to engagement of another tooth of said pinion member by said ratchet member curvilinear edge surface, whereby said biasing means urges said another tooth against said ratchet member edge surface for sliding contact thereon during movement of said ratchet member from said neutral point to one of said first and second positions and thereafter urges said another tooth into engagement by said edge surface at either of said positions, whereby said ratchet member in returning to said neutral point will rotate said pinion member in a direction opposite to the direction of movement of said ratchet member.

12. The counter of claim 11 wherein said generally curvilinear edge surface of said ratchet member has a pair of spaced notches therein for engagement with said tooth of said other portion of said pinion member, and wherein said biasing means includes a pair of flat spring elements straddling said pinion member and normally out-of-contact therewith, a different one of said spring elements being brought into contact

with a tooth of said pinion member other portion upon oscillation of said driving member in each direction form the neutral point.

13. The counter of claim 11 wherein said one portion of said pinion member has twice the number of teeth as said other portion thereof, and wherein complementary toothed elements are provided on said driving member and ratchet member to provide driving interengagement therebetween.