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HIGH SPEED COUNTERMECHANISM

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Fig. 1.

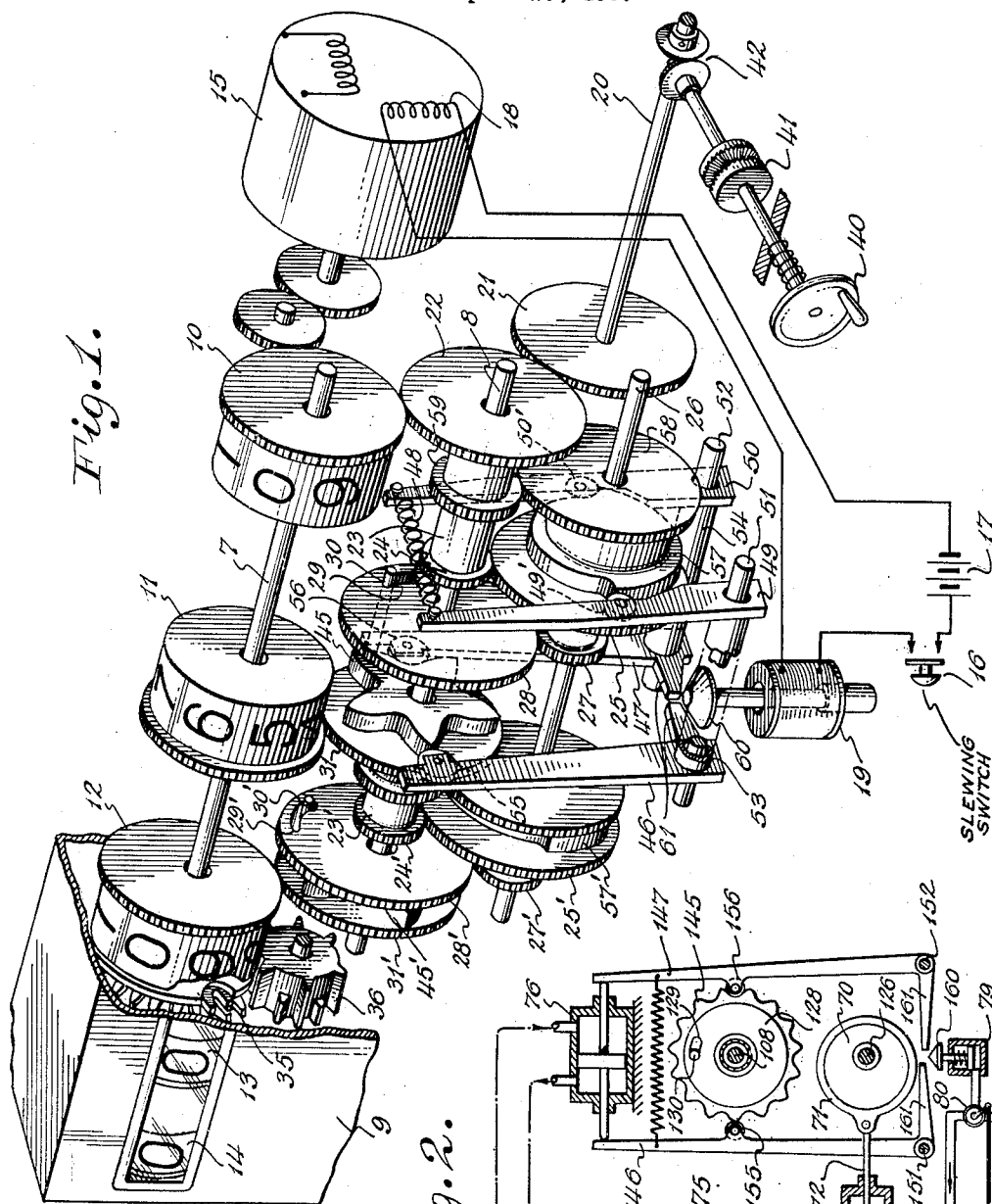
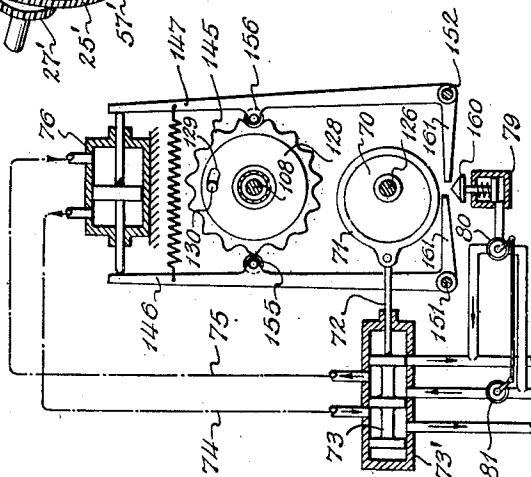


Fig. 2.



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## HIGH-SPEED COUNTER MECHANISM

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This invention relates generally to a counter mechanism and has reference more particularly to a counter mechanism capable of being driven at extremely high counting speeds.

The counter mechanism of the present invention is of the type which employs a series of number dials which may be continuously rotated through continuous gearing therebetween but also includes cam-controlled detent apparatus which, when operative, causes the numerals on the dials to line up to present an unambiguous reading.

An inherent advantage of the continuous gearing type of counter mechanism is that there is no repetitious shock common to the intermittent transfer type of counter. The intermittent transfer type of Geneva type counter mechanism is limited to counting speeds on the order of one thousand rotations per minute because of the shock created by a rapidly rotating element suddenly engaging a stationary element. On the other hand, the counter of the present invention employing continuous gearing can be driven many thousand rotations per minute because there is no rapidly moving member suddenly engaging a stationary member, since the interconnecting gearing rotates all of the members simultaneously but at different speeds, depending upon the number system for which the counter is designed. However, there being continuous gearing between the number dials, the numbers appearing thereon will all line up to present definite readings only at certain predetermined intervals depending upon the gearing ratios. Therefore, reference to any dial of the counter would at most any instant, show a number approaching and a number departing, whereby reading of the dials would be confusing, especially where a series of dials is to be read. By my invention I overcome this difficulty by providing a detent apparatus which, when operative, automatically lines up the numbers on the dials in readout position so as to present to an observer an unambiguous indication. Thus, the present invention overcomes confusion arising from non-alignment of numbers by providing a detent arrangement at the dials so that when the detents are engaged, the numbers appearing on the individual numeral dials indicate unambiguously the actual reading of the counter.

The counter of my invention may advantageously be employed in computer mechanisms wherein it is desired to count and/or present an indication of the number of rotations of a data input shaft to the computer. Or the

counter may be used to determine the quantity of fluid flowing through a conduit or the total number of rotations of the shaft of an engine or the like. Of necessity, these shaft rotations must be extremely accurate and also must be set into the computer as fast as possible. The counter of the present invention is ideally suited for such a device because it may be slewed from one setting to another setting at extremely high rates of speed, and by means of the detent mechanisms, the rotational position of the data shaft may be set with extreme accuracy. Another system in which the counter mechanism of my invention may be very advantageously employed is in a Loran navigation equipment wherein numeral indications are employed for designating the position of a craft relative to a pair of reference points.

Therefore, the principal object of my invention is to provide an improved counter mechanism capable of counting the number of rotations of a data shaft at an extremely high rate of speed.

Another object of my invention is to provide such a counter mechanism which employs a sequence of number dials each being rotated by continuous gearing connected therebetween.

A further object of the present invention is to provide such a counter mechanism in which there is provided a detent apparatus for each numeral member operable to present an unambiguous reading of the numerals thereon.

A further object of the present invention is to provide a counter mechanism capable of being slewed from one setting to another setting at an extremely high speed and having cam-controlled detent arrangements to present an unambiguous reading thereof.

Another object of my invention is to provide a counter mechanism in which a low speed counter may be driven by a high speed counter and in which the numerals of the low speed counter may be aligned by the detent mechanism of the high speed counter without excessive shock.

Further objects and advantages of my invention will become apparent from the following detailed description thereof when read in view of the accompanying drawing which illustrates a preferred form of my invention, wherein:

Fig. 1 is a schematic perspective view of a counter mechanism embodying the principles of my invention; and

Fig. 2 is a modification of the detent actuating apparatus illustrated in Fig. 1.

The counter illustrated in Fig. 1 of the drawings is a tens counter, that is, the numeral dials or members being calibrated in numbers from 0 to 9 and the numeral numbers indicating from right to left, units, tens, hundreds, thousands, etc. As above stated, it is possible to calibrate the numeral members in any number system desired. However, the tens numeral system has been illustrated as a very practical example and to simplify a complete understanding of my invention. Of course, if a different number system be employed it is necessary to alter the shape or contour of the detent members and the cam surface of the cam for controlling the detent members.

Referring now to Fig. 1 of the drawing, I have illustrated a base ten counter having a plurality of rotatably supported numeral members of lower and higher order; a units member 10, a tens member 11, a hundreds member 12, a thousands member 13, and a ten thousands member 14. A slewing motor 15 is provided for slewing the numeral members rapidly from one setting to another. However, it will be noted that I have applied the principles of my invention only between the units member 10, the tens member 11, and the hundreds member 12 because of the high reduction in the speed of rotation between the members in this selected number system. For example, let us suppose that the slewing motor 15 drive the units or low order numeral member 10 at ten thousand rotations per minute. This would mean that the tens numeral member 11 would be driven at one thousand rotations per minute. If, then, an intermittent transfer type counter were employed between members 11 and 12, as it is between members 12 and 13, the cut-away transfer pinion between 11 and 12 corresponding to pinion 36 between 12 and 13 would be driven at 1,000 rotations per minute for one tenth of one complete rotation of the member 12. Thus, the pinion must accelerate from zero R. P. M. to 1,000 R. P. M. substantially instantaneously. Acceleration of this magnitude, when rapidly repeated, may be expected to cause undue noise, wear, and early damage to the mechanism, even though its parts are made as small and light as practicable. Therefore, I have employed this type of counter only at the low speed end of the counter mechanism. Such intermittent transfer counters can very easily be driven at speeds below 1000 R. P. M. Therefore, in the present embodiment I have illustrated the thousands, and ten thousands numeral members of the counter as being operated by a conventional intermittent transfer type counter mechanism and the tens and hundreds numeral members as being operated by my novel counting mechanism.

In describing the counter mechanism of my invention I will first set forth the gearing connection between numeral members 10, 11 and 12 when the slewing motor 15 is energized. Slewing motor 15 is energized by closing the slewing switch 16 which supplies current from a suitable source 17 to the control winding 18 of the motor. Simultaneously, however, current is also supplied to a solenoid 19 which operates to render the detent arrangement inoperative. A data shaft 20 is connected by suitable gearing 21, 22 to the member 10 so that the data shaft 20 and numeral member 10 will be driven simultaneously and preferably in a 1:1 ratio. The counter will therefore indicate the exact number of rotations of the data shaft 20. If the slewing motor 15 be

deenergized, it is possible for the shaft 20 to be rotated manually through handle 40. When the slewing motor 15 is deenergized, the solenoid 19 will also become deenergized and therefore permit engagement of the detent apparatus to thereby present an unambiguous reading of the numbers on the numeral members. Under these conditions it may be necessary to further rotate shaft 20 by hand in one direction or the other in order to obtain a precise or desired setting of the counter mechanism.

Numeral member 10 which is rotatably mounted on a shaft 7 supported by the frame 3 of the counter mechanism meshes with gear 22 having an extension 23 which carries a smaller gear 24. Gear 22, extension 23, and gear 24 are integral and are mounted to rotate on a suitable supporting shaft 8 fixed to the frame 3. Gear 24 in turn, meshes with a gear 25 rotatably supported on a shaft 26 in the housing and has mounted integrally therewith another gear 27. Gear 27 in turn, meshes with still another gear 28 rotatably supported on shaft 8. Gear 28 has an arcuate slot 29 cut therein and adapted to receive a pin 30 which is supported on a gear 31 on shaft 8 so that pin 30 engages either end of slot 29 to rotate the gear 31 as gear 28 rotates. The pin and slot construction constitutes a conventional lost motion connection between the member 10 and the member 11 when the detent apparatus is operative. Also, the pin and slot connection provides a slight backlash in the gear train necessary for an unambiguous indication of the counter, to be more fully described below. However, when the detent apparatus is disengaged, the pin and slot provides a positive driving connection from one end of the gear reduction train to the other, i. e., between gears 22 and 31. Gear 31 is connected directly to the tens numeral member 11 rotatably mounted on shaft 7 supported in the housing. The ratio of the gearing between numeral members 10 and 11 are so selected that the numeral member 11 rotates once for every ten rotations of member 10. For example, in the construction illustrated, by providing a 1:1 ratio between gears 22 and 10, a 2:7 ratio between gears 24 and 25, a 7:20 ratio between gears 27 and 28 and a 1:1 ratio between gears 31 and 11, it will be seen that a 10:1 overall ratio is provided. These ratios, however, are purely exemplary and have been so selected as to enable the largest gears to be kept relatively small thereby reducing the overall size of the counter to a minimum.

The hundreds numeral member 12 is driven in the same manner as the tens member 11 through gearing which has the same ratios as that between the units numeral member 10 and the tens numeral member 11. Thus, gear 31 has an extension 23' upon which gear 24' is formed which unit is rotatably mounted on the shaft 8. Gear 24' meshes with gear 25' which has a gear 27' integral therewith, the gears 25' and 27' being rotatably mounted on supporting shaft 26. Gear 27' meshes with gear 28' in which is cut an arcuate slot 29' adapted to receive a pin 30' fixed to gear 31'. Gears 28' and 31' are independently rotatably mounted on shaft 8 in the same manner as gears 28 and 31 and the pin and slot connection therebetween serves the same function as above described with respect to pin and slot 29—30. Gear 31' directly meshes with the hundreds numeral member 12. The drive between numeral members 12, 13 and 14 is of the intermittent transfer type as above described. For this purpose member 12 has mounted at the end

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thereof a toothed portion 35 which engages a cut-away gear or pinion 36 once in every revolution of the member 12. Therefore, gear 36 is driven at 100 rotations per minute for one tenth of one rotation and drives numeral member 13 correspondingly, at a speed well within the capacity of intermittent counters of this type. Numeral member 14 is driven from numeral member 13 in the same manner.

The operation of the device as thus far described is as follows: If it is desired to slew the counter mechanism from one setting to another setting in a very short time interval, the operator presses slewing switch 16 which energizes control winding 18 of the slewing motor 15 through a suitable source of current 17. At the same time relay 19 operates to disengage the detent mechanism and numeral member 10 is rapidly driven by the motor 15. Numeral member 10 drives the data shaft 20 through gears 21 and 22. Numeral member 10 continually rotates numeral member 11 through gears 22, 24, 25, 27, 28, pin and slot connection 29 and 30 and gear 31 but at one-tenth the speed thereof. Numeral member 12 is similarly driven through gearing 24', 25', 27', 28', pin and slot connection 29', 30' and gear 31'.

However, as the numbers at the high order end of the counter mechanism are rotating relatively slowly, they may be easily read as the motor 15 rapidly drives member 10 and, as they approach the desired setting, the operator releases slewing switch 16 thereby deenergizing the motor 15. Simultaneously, current is no longer supplied to solenoid 19 and the detent apparatus is permitted to operate, in a manner to be described, to provide an unambiguous reading of the counter at the time the motor 15 is deenergized. However, when the motor 15 comes to rest, the reading of the counter may not be exactly the reading desired, in which case it may be necessary to rotate the counter mechanism to the desired readout position through a manual setting control. This is accomplished by providing a crank 40 which operates through a normally open clutching device 41 which when pressed inwardly, manually rotates the shaft 20 through suitable bevel gearing 42.

The detent device which, when engaged, provides an unambiguous indication of the number of rotations of the data shaft 20 will now be described. Supported on or integrally formed with the gear 31 is a detent member 45 which, in the case of the tens counter illustrated, is in the form of a star cam having five crests and five valleys, just one-half the number of digits appearing on the numeral members. The detent member is rotated, as will be described, through a predetermined angle equal to one tenth of one rotation of the member 11 by a first pair of detent actuating members or levers 46 and 47. These members derive their driving force or driving pressure from a spring 48 connected between the upper ends of a second pair of levers, hereafter referred to as cam follower levers 49 and 50 which are mounted generally parallel to and integral with the levers 46 and 47, respectively. These pairs of levers are rotatably mounted on shafts 51 and 52 supported in the housing of the counter, and the integral connection between members 46 and 49, and 47 and 50 is provided by sleeves 53 and 54 brazed or welded therebetween. The upper ends of levers 46 and 47 are provided with rollers or wheels 55 and 56, respectively, to provide a rolling con-

tact, when actuated between the detent member 45 and levers 46 and 47.

Movement of the levers 49 and 50 and therefore the driving movement of the respective detent actuating levers 46 and 47, is controlled by a cam 57. Rotation of the cam is provided through gear 58 integrally formed therewith and rotatably mounted on shaft 26, which gear meshes with a gear 59 formed on the extension 23 between gears 22 and 24. A two to one gear ratio is provided between gears 59 and 58 so that cam 57 will rotate one half a complete rotation for every complete rotation of member 10 thereby providing a five to one ratio between cam 57 and detent wheel 45. The cam 57 has one high portion and one low portion each extending through 180° such that in one half of one rotation thereof the cam follower 49 on cam follower lever 49 is on the high portion of the cam and the cam follower 50 of cam follower lever 50, for that one-half rotation, is on the low portion of the cam. Therefore, lever 46 which, as described, is integral with lever 49, is maintained adjacent one of the crests of the detent member 45 because the lever 49 is held out by the high portion of the cam 57. Similarly, the lever 47 is held in the diametrically opposite valley of the detent wheel 45 due to the fact that spring 48 causes lever 50 to rotate inwardly against the low portion of the cam 57. The levers will remain in this position for one half of one complete rotation of the cam 57. However, for the next half rotation the opposite sequence occurs. That is, the cam follower 49 on lever 50 is raised to the high portion of the cam 57. This imparts opposite rotation of the levers 49 and 50 and therefore levers 46 and 47. The detent wheel 45 is then rotated or driven by actuating wheel 55 on the upper end of lever 46 through the pressure applied thereto by spring 48. Simultaneously, the wheel 56 on the end of the lever 47 is forced outwardly by rotation of the cam follower lever 50 as the follower 50 thereof is raised by the high portion of the cam 57.

The rotary motion of detent member 45, however, must be initiated and the initiation must be in the proper direction. For this purpose, the pin and slot connection 29, 30 between gear 28 and 31 is provided. As the numeral member 10 is rotated, rotation is imparted, through gearing 24, 25, and 27, to gear 28. Such rotation of gear 28 engages one end of the slot 29 with the pin 30 which engagement initiates rotation in the proper direction of the detent member 45. The slot 29 subtends an angle which is smaller than the angle between successive members on the numeral member 11 for two reasons. In the first place, the slot must be long enough to compensate for the diameters of the pin 30. In the second place, the slot 29 must be slightly smaller than the angle between successive numbers on the numeral member in order to initiate motion of the numeral member in the proper direction just prior to the theoretical time at which the shift from one numeral to the other numeral occurs. Such construction makes it impossible for the detents to become poised on "dead center." This construction is necessary even though a slight misalignment of the numeral member may occur just before and just after it is shifted by the detent mechanism. However, this motion is so slight that the indication presented by the counter mechanism is not materially effected. Thus the slight motion imparted to the detent member 45 just before the shift occurs insures

that as the levers 49 or 50 drive the detent member 45, by the action of spring 48, in the proper direction, and the rotation thereof by the levers will continue through a predetermined angle, that is, an angle slightly less than the angle between one crest and the adjoining valley of the detent member 45. Since the slot 29 is slightly less than the angle between one crest and the adjacent valley of the detent member 45 the rollers 55 or 56 on the levers 49 or 50 may not immediately lie exactly in a valley. However, continued rotation of the gear 28 and therefore slot 29, will allow a slight rotation of the detent member 45 by the levers 49 or 50 so that the shift from one digit on the numeral member to the next will be complete. Each crest of the detent wheel 45 coincides with an odd digit of the numeral member 11 and each valley corresponds to an even digit; that is, of course, with respect to the cam actuator or lever 46. The opposite applies with respect to the actuator lever 47. The cam 57, having a 2:1 ratio relative to member 10, determines whether an odd or even numeral is presented on the numeral member 11. The angular position of the cam 57 relative to numeral member 10 is so adjusted that as the member 10 rotates from digit "9" to digit "0" the cam will rotate the levers 49 and 50 to thereby rotate detent actuator or drive levers 46 and 47, which will, in turn, through detent member 45, rotate numeral member 11 to present the next digit thereon in readout position.

The operation of the detent mechanism of the counter of my invention will now be described. Let us suppose that the slewing switch 16 is on and the slewing motor 15 is in operation. Upon release of the switch 16, motor 15 stops and solenoid 19 is deenergized. Such deenergization will disengage the conical lever disengaging member 60 formed on the end of the armature of the solenoid 19 from the extensions 61 on the levers 46 and 47 and allow levers 46, 49 and 47, 50 to rotate on their supporting shafts 51, 52, respectively. The levers will be forced to rotate towards each other through the action of spring 48. The cam 57, in the instantaneous position illustrated, allows the lever 50 through its follower to rotate lever 47. Lever 47 through roller 56 will then rotate or drive the detent wheel 45, which rotation has been initiated in the proper direction by engagement of the slot 29 with the pin 30, to the position shown, that is, rotate until the wheel 56 reaches a valley. Simultaneously, lever 46 is held adjacent the crest of the cam wheel 45 because the cam follower on lever 49 rests on the high portion of the cam 57. Assuming the rotation of the numeral member 10 be in such a direction as to cause cam 57 to rotate in a counterclockwise direction, the following action will take place. The cam follower of lever 49 will fall to the low portion of the cam 57 and the cam follower of the lever 50 will be raised by camming action to the high portion of the cam 57. This action will occur simultaneously. At the same time, gear 28 will rotate in a clockwise direction and the upper end of the slot 29 will engage the pin 30 and initiate rotation of the detent wheel 45 in a clockwise direction just before the shift from one numeral to the other is to occur. Then, as the cam follower of lever 49 drops to the low portion of the cam 57, lever 46 will rotate the cam wheel 45 through roller 55, until the wheel 55 reaches the valley adjacent the crest upon which the wheel 55 previously rested. Similarly, and at the same time,

the follower of lever 50 will be forced to the high portion of the cam 57. Such action will produce a rotation of lever 47 to thereby allow the crest on detent wheel 45 to rotate to a position opposite the wheel 56. Such rotation of the detent wheel 45 will rotate the numeral member 11 to the next succeeding digit where it will remain until numeral member 10 makes the next complete rotation.

However, due to the high speed of the motor 15, the desired setting may not immediately be indicated upon deenergization of the motor. Therefore, it may be necessary to rotate the counter by hand or by operating the motor for short intervals until the desired setting is presented.

The numeral member 12 is positively positioned by a similar arrangement of levers. The detent member 45' between gear 28' and gear 31' corresponds to detent member 45 and cam 57' corresponds to cam 57. However, for the sake of clearness, the levers associated with these cams have been omitted since they are identical with the levers just described.

In Fig. 2 of the drawings, there is illustrated a modification of the actuating means for the levers 46 and 47 of Fig. 1. In this modification the detent actuating levers 146 and 147 are illustrated as being hydraulically or pneumatically controlled. Such a control would be applicable to a counter mechanism wherein there is an extremely high number of revolutions between the numeral member 10 and the numeral member 11 in which case the detent member will have a great many crests and valleys and hence, a very small but closely spaced detent action is required. In the modification cam 57 is replaced by an eccentric 70 rotatably mounted on shaft 126 and rotated through suitable gearing at one half the speed of rotation of the numeral member 10. The eccentric 70 operates, through a ring 71 and shaft 72, a control valve 73. Control valve 73 controls the flow of the fluid in conduits 74 and 75 to operate the actuating cylinder 76 in one direction or the other depending upon the angular position of the eccentric 70. The actuating cylinder 76 is connected to and rotates detenting levers 146, 147 on shafts 151 and 152, respectively. The operation of the modification shown in Fig. 2 is as follows. In the position shown, eccentric 70 has translated actuator 72 to position valve element 73 so that fluid under pressure is admitted to the conduit 75. The resulting increase in pressure in the right hand side of the cylinder 76 therefore causes a rotation of levers 146 and 147 in a counterclockwise direction. Thus, the wheel 156 on lever 147 will fall to a valley of the detent member 145 and in so doing will hold the numeral member associated therewith at a definite angular position. At the same time, the pressure in the right hand side of the cylinder 76 will hold the wheel 155 adjacent to a crest of the detent member 145. Rotation of eccentric 70 through the next succeeding 90° will cause valve element 73 to move in the opposite direction to a neutral position relative to the valve parts. From this point only very slight angular movement of the eccentric 70 will open the control valve to cause fluid pressure to rapidly build up in the opposite side of the cylinder 76. Thus, the actuation of the lever members 146 and 147 may be very precisely controlled by small angular rotations of the eccentric 70. As the pressure in the left hand side of the cylinder 76 increases the levers will rotate in the opposite direction. Such rotation

will produce rotation of detent member 145 until wheel 155 on lever 146 reaches the next valley whereupon it is held there by the continued pressure of fluid in the left hand side of the cylinder 76. Rotation of the member 145 is initiated as in the mechanism above described, through pin and slot connection 129, 130.

Disengagement of the detent actuator levers 146 and 147 is effected by a conical member 160 similar to the lever-disengaging member 69 of Fig. 1 which, upon actuation thereof by fluid pressure in the cylinder 73, engages extensions 154 to rotate the levers 146 and 147 outwardly about the pivots 151 and 152. Fluid pressure is supplied to cylinder 73 for operating the member 160 through a control valve 80, and a shutoff valve 81 is operatively coupled therewith for simultaneously removing fluid pressure from the control valve 73'. If it is desired to slew the counter mechanism embodying the modification illustrated in Fig. 2, to a new setting, the valves 81 and 80 are actuated thereby to shut off pressure to the control valve 73' and simultaneously to admit fluid under pressure to the cylinder 73. Thereupon the element 160 is raised into engagement with the members 161 which effects disengagement between the detent actuator levers 146 and 147 and the detent member 129.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A counter mechanism for presenting an indication of the number of rotations of a data member, a low order numeral member connected to rotate with said data member and a higher order numeral member adapted to be rotatably coupled with said low order member, a star-shaped detent member having an odd number of crests and valleys connected to rotate said higher order member and a detent-actuator mechanism comprising a pair of pivotally mounted levers and means for urging the movable ends of said levers into engagement with said detent member at diametrically opposite sides thereof, said detent member having a contour such that when driven by said levers the rotation thereof will be through predetermined angles whereupon unambiguous indications of the digits on said higher order member will be presented, a cam member rotatably connected with said low order member for determining the next appearing digit on said higher order member, cam follower members associated with said cam member and coupled with said actuator levers for cyclically rotating said levers into engagement with said detent member for driving the same step by step through said predetermined angles, coupling means between said low order member and said detent member for initiating rotation of said detent member, and means for disengaging both of said detent-actuator levers and for simultaneously effecting continuous rotation of said high order member with rotation of said low order member through said coupling means.

2. A counter mechanism for presenting an indication of the number of rotations of a data member, a low order numeral member connected to rotate with said data member and a higher order numeral member adapted to be rotatably

coupled with said low order member, a star-shaped detent member having an odd number of crests and valleys connected to rotate said higher order member and a detent-actuator mechanism comprising a pair of pivotally mounted levers and means for urging the movable ends of said levers into engagement with said detent member at diametrically opposite sides thereof, said detent member having a contour such that when driven by said levers the rotation thereof will be through predetermined angles whereupon unambiguous indications of the digits on said higher order member will be presented, a cam member rotatably connected with said low order member for determining the next appearing digit on said higher order member, cam follower members associated with said cam member and coupled with said actuator levers for cyclically rotating said levers into engagement with said detent member for driving the same step by step through said predetermined angles, a pin and slot coupling between said low order member and said detent member for initiating rotation of said detent member, said slot being of such length as to allow rotation of said pin by said detent-actuator levers through said predetermined angles, and a disengaging cam engageable with said levers for rotating the same in opposite directions for effecting disengagement between said detent actuator levers and said detent member, and means for simultaneously actuating said disengaging cam and effecting continuous rotation of said higher order member with rotation of said low order member through said pin and slot coupling.

3. A counter mechanism for presenting an indication of the number of rotations of a data member, a low order numeral member connected to rotate with said data member and a higher order numeral member adapted to be rotatably coupled with said low order member, a star-shaped detent member having an odd number of crests and valleys connected to rotate said higher order member and a detent-actuator mechanism comprising a pair of pivotally mounted levers and fluid-controlled actuating means therefor for urging said levers to rotate in the same direction about said pivots, one end of each lever being positioned to engage said detent member respectively on diametrically opposite sides thereof, said detent member having a contour such that when rotated by said detent actuator mechanism the rotation thereof will be through predetermined angles whereupon unambiguous indications of the digits on said higher order member will be presented, a source of fluid under pressure, valve means and means driven in timed relation with said low order member for operating said valve means whereby cyclically to vary the fluid pressure supplied to and the direction of operation of said lever-actuating means, means driven in timed relation with said low order member for initiating rotation of said detent member, and means for effecting disengagement between said detent levers and said detent members and for simultaneously effecting continuous rotation of said high order member with rotation of said low order member.

4. In a counter device having a low order numeral wheel actuated by an input means and a higher order numeral wheel actuated by the input means at a predetermined ratio to the low order wheel, the combination of a wheel aligning device comprising a lost motion connection in the actuating means of the higher order wheel

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to permit limited movement of the wheel independently of the input means, and a detent device operable to effect such independent movement of the higher order wheel to place the significant numeral thereon in readout position, said detent device comprising a detent member in the actuating means of the higher order wheel to position the wheel within the limits of the lost motion connection, a pair of detent actuating members, and means to operate the detent actuating members by alternation during successive cycles of operation of the low order wheel.

5. In a counter device having a low order numeral wheel actuated by an input means and a higher order numeral wheel actuated by the input means at a predetermined ratio to the low order wheel, the combination of a wheel aligning device comprising a lost motion connection in the actuating means of the higher order wheel to permit limited relative movement of the wheel and the input means, and a detent device operable to effect such relative movement of the higher order wheel to place the significant numeral thereon in readout position, said detent device comprising a detent member in the actuating means of the higher order wheel to position the wheel within the limits of the lost motion connection, a pair of detent actuating members, and means to operate the detent actuating members by alternation during successive cycles of operation of the low order wheel.

6. In a counter device having a low order numeral wheel actuated by an input means and a higher order numeral wheel actuated by the input means at a predetermined ratio to the low order wheel, the combination of a wheel aligning device comprising a lost motion connection in the actuating means of the higher order wheel to permit limited relative movement of the wheel and the input means, and a detent device operable to effect such relative movement of the higher order wheel to place the significant numeral thereon in readout position, said detent device comprising a detent member in the actuating means of the higher order wheel to position the wheel within the limits of the lost motion connection, a pair of detent actuating members, and means actuated by the input means to operate the detent actuating members by alternation during successive cycles of operation of the low order wheel.

7. In a counter device having a low order numeral wheel actuated by an input means and a higher order numeral wheel actuated by the input means at a predetermined ratio to the low order wheel, the combination of a wheel aligning

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device comprising a lost motion connection in the actuating means of the higher order wheel to permit limited relative movement of the wheel and the input means, and a detent device operable to effect such relative movement of the higher order wheel to place the significant numeral thereon in readout position, said detent device comprising a detent member in the actuating means of the higher order wheel to position the wheel within the limits of the lost motion connection, a pair of detent actuating members, and means actuated by the input means in timed relation to the actuation of the low order wheel to operate the detent actuating members by alternation during successive cycles of operation of the low order wheel.

8. In a counter device having a low order numeral wheel actuated by an input means and a higher order numeral wheel actuated by the input means at a predetermined ratio to the low order wheel, the combination of a wheel aligning device comprising a lost motion connection in the actuating means of the higher order wheel to permit limited relative movement of the wheel and the input means, and a detent device operable to effect such relative movement of the higher order wheel to place the significant numeral thereon in readout position, said detent device comprising a detent member in the actuating means of the higher order wheel to position the wheel within the limits of the lost motion connection and a pair of detent actuating members, the detent member having a number of detent positions equal to one-half the numeral positions on the higher order wheel, the detent actuating members being arranged substantially oppositely with reference to the detent member whereby when one actuating member is aligned to engage a detent position the other is aligned between detent positions, and means actuated by the input means to operate the detent actuating members by alternation during successive cycles of operation of the low order wheel.

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References Cited in the file of this patent  
UNITED STATES PATENTS

| Number    | Name     | Date          |
|-----------|----------|---------------|
| 1,246,087 | Gooch    | Nov. 13, 1917 |
| 1,913,983 | Gardner  | June 13, 1933 |
| 2,089,682 | Chase    | Aug. 10, 1937 |
| 2,298,343 | Bugg     | Oct. 13, 1942 |
| 2,344,627 | Mixer    | Mar. 21, 1944 |
| 2,456,101 | Yeasting | Dec. 14, 1948 |