

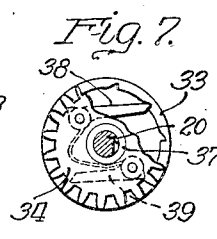
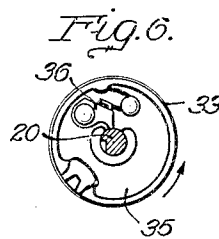
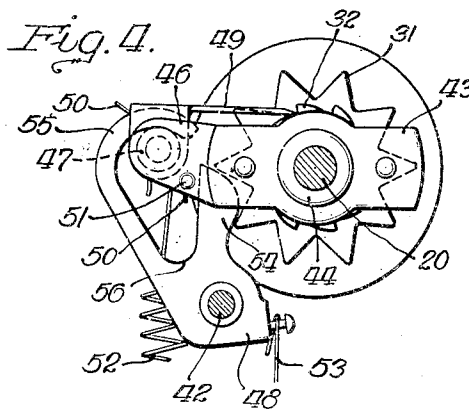
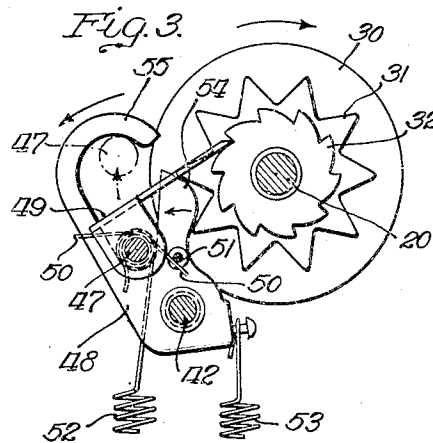
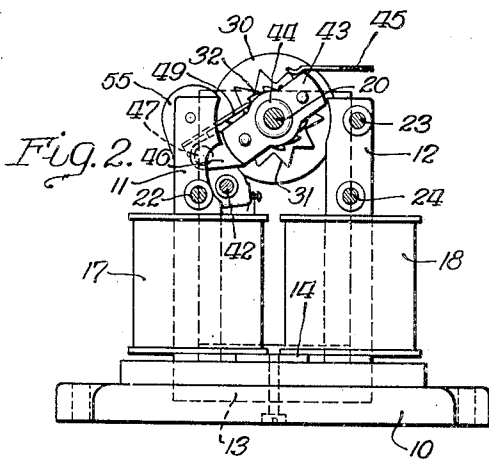
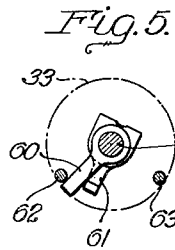
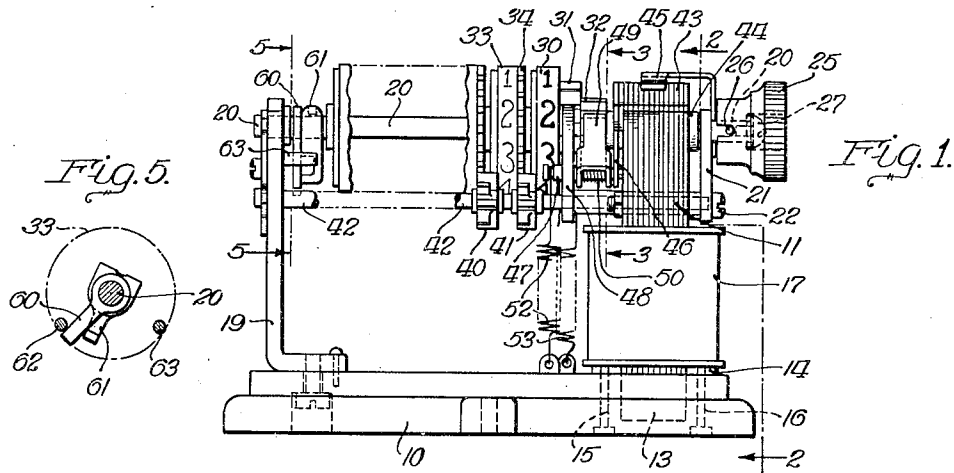
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COUNTER-ACTUATING MECHANISM

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COUNTER-ACTUATING MECHANISM

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11 Claims. (Cl. 235—92)

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The present invention relates in general to mechanical counters, and the object of the invention is to produce an improved device of this character.

A special object of the invention is the production of a more simple and efficient electromagnetic actuating mechanism for a mechanical counter than has been known heretofore.

Another object is the production of a new and improved arrangement for restoring the number wheels of the counter to normal or zero position.

The foregoing and other features of improvement will be described fully hereinafter, reference being had to the accompanying drawing, in which—

Fig. 1 is a front or plan view of the complete counter, except for the cover;

Fig. 2 is an end view, partly in section, on the line 2—2, Fig. 1;

Fig. 3 is a section, on an enlarged scale, taken on the line 3—3, Fig. 1;

Fig. 4 is a section on the line 2—2, Fig. 1, similar to Fig. 2, except that the electromagnet is omitted and the parts are shown on an enlarged scale;

Fig. 5 is a section on the line 5—5, Fig. 1;

Fig. 6 is an end view of the tens number wheel showing the restoring pawl; and

Fig. 7 is a view of the same number wheel from the other end and showing the ratchet drive mechanism.

Referring to the drawing, the various parts of the counter are supported on a base 10, which may be of molded Bakelite or other suitable material, and of rectangular shape, as is apparent from Figs. 1 and 2.

The laminated core of the electromagnet is U-shaped, as seen in Fig. 2, and comprises the two vertical legs 11 and 12 and the integrally formed yoke 13, the latter being received in a recess in the base 10 near one end thereof. The magnet core is secured in the recess by a clamping member 14 which is held by the machine screws 15 and 16. This clamping member 14 rests on top of the yoke 13 and when the screws 15 and 16 are tightened up it holds the magnet core firmly in place. The windings of the electromagnet are indicated at 17 and 18.

At the opposite end of the base is disposed an L-shaped supporting bracket 19 which is secured to the base 10 by screws as indicated in Fig. 1.

The main shaft 20 is rotatably supported on the bracket 19 at one end and by means of a plate 21 at the other end. The plate 21 is secured to the legs 11 and 12 of the magnet core by means of bolts 22, 23 and 24, and is made of brass or

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other non-magnetic material. The shaft 20 may be rotated in its bearings by means of a knob 25. This knob is prevented from turning on the shaft by a cross pin 26, the ends of which are received in a slot in the base of the knob; and is held on the shaft by a screw 27 which is threaded into the end thereof.

Mounted on the shaft 20 in the usual manner are a plurality of number wheels corresponding to the different orders of digits in the decimal system. The units number wheel is indicated at 30 and the tens number wheel at 33. Other number wheels corresponding to successively higher orders of digits are mounted to the left of the tens number wheel 33, but are not shown in detail.

The tens number wheel and those corresponding to the higher orders of digits are all alike. Fig. 6 shows the tens number wheel 33 as seen from the left hand end. There is an annular recess 35 in the end of the wheel, which affords space for mounting the pivoted pawl 36, which is spring-pressed against the shaft 20. The shaft is provided with a longitudinally extending ratchet tooth for coaction with the pawls such as 36. As will be readily understood from Fig. 6, the number wheel shown is rotatable in a counter-clockwise direction on the shaft. It will also be appreciated that the shaft is rotatable in a clockwise direction without disturbing the number wheel; but if the shaft is rotated in a counter-clockwise direction, the ratchet tooth on the shaft will engage the pawl and thereby rotate the number wheel. This arrangement is provided for restoring the number wheels to zero position, as will be described more fully later on.

The units number wheel 30 is also provided with a restoring pawl as shown in Fig. 6. At the right hand end the units number wheel is provided with a star wheel 31 and a ratchet wheel 32. These parts are formed integrally with the number wheel. It may be mentioned here that the number wheels are preferably of molded Bakelite or other suitable plastic.

A transfer mechanism is provided through the medium of which each number wheel except the last controls the number wheel of the next higher order. This mechanism includes the transfer pinions such as 40 and 41, which are rotatably mounted on the shaft 42, Fig. 1. This shaft is supported at one end on the bracket 19 and at the other end on the plate 21.

Each time the units number wheel, for example, advances to display the digit 0, it rotates the pinion 41 according to the principle of the Geneva movement. The pinion 41 is in mesh

with and rotates the gear 34, which is mounted adjacent the tens number wheel on a hub 37 with which the latter is provided. The gear wheel 34 rotates the tens number wheel by means of a ratchet and pawl mechanism.

Fig. 7 shows the arrangement clearly. The gear 34 is supported on the hub 37 and is provided with the two pawls 38 and 39, which are spring-pressed outwardly so as to cooperate with the internal ratchet teeth on the number wheel 33. There are ten peripherally disposed ratchet teeth, corresponding to the ten digits.

The armature of the electromagnet is laminated and is indicated at 43. The armature is rotatably mounted on the shaft 20 by means of the bearing sleeve or bushing 44. The laminations of the armature may be held together by rivets, as indicated in Fig. 2.

The armature is somewhat thicker than the pole pieces, as shown in Fig. 1, and the left hand lamination is longer than the others, forming an arm 46 which overlaps the left hand pole of the electromagnet, as seen in Fig. 2. At the end of arm 46 there is a stud 47, which is riveted to the arm, and on the stud is mounted a pawl 49 which cooperates with the ratchet wheel 32. The pawl is held against the ratchet wheel by a spring 50, the coils of which surround a part of stud 47 and which is tensioned between the rear end of the pawl 49 and a pin 51 on arm 46. This pin has a head to prevent the spring from slipping off and is riveted to the arm 46. The pin is shown in Fig. 4, and the pin and head thereof appear in Fig. 3, where the pin is shown in section.

The armature 43 is biased to its normal position, that is, the position in which it appears in Figs. 1 and 2, by means of a coil spring 52 one end of which is fastened to the base 10 and the other end of which is hooked around the stud 47 near the end thereof. The stud may be grooved as shown in Fig. 1 to prevent the spring 52 from slipping off. A bumper spring 45 is secured to the plate 21 by bolt 23 and extends to the left and forward over one end of armature 43. The end of this spring is engaged by armature 43 just before it reaches normal position.

The reference numeral 48 indicates the stop pawl, which is pivotally supported on shaft 42, the same shaft that carries the transfer pinions such as 41. The stop pawl includes two parts, a curved arm 55 which is engaged by the stud 47 when the armature 43 is in actuated position, and a dog 54 which has a curved cam surface cooperating with the star wheel 31. Between these parts there is a space in which the stud 47 oscillates during operation of the armature, said space ending at the bottom in a rounded notch 56 in which the stud 47 rests when the armature 43 is in normal position.

The stop pawl 48 is biased toward the star wheel 31 by means of a coil spring 53. One end of this spring is attached to base 10 and the other end is hooked over a pin which projects from the stop pawl, as shown in Fig. 4.

At the left hand end of shaft 20 and between the last number wheel and the bracket 19 there are two arms 60 and 61. Arm 60 is rotatable on shaft 20, while arm 61 is fixed thereto by a set screw or in any suitable manner. There are also two pins 62 and 63 which are fixed to the bracket 19. These parts are included in the number wheel restoring mechanism, as will be explained presently.

The construction of the improved counter hav-

ing been described, its operation will now be explained briefly. For this purpose it will be assumed that the windings 17 and 18 of the electromagnet are connected in a suitable electrical circuit over which impulses of current may be delivered to the counter. The impulses may be produced as the result of successive operations of some machine, for example, and the counter may be employed to count the impulses and register the total number thereof.

As previously mentioned, the armature 43 is biased to the position in which it appears in Figs. 1 and 2 by the coil spring 52. In this position the operative end of pawl 49 is resting in one of the notches in the ratchet wheel 32, as shown in Fig. 3, for example. Also the stud 47 is resting in the bottom of the notch 56 in the stop pawl 48. This holds the curved dog 54 against the star wheel 31 and prevents any accidental rotation of the units wheel in a forward direction. The units wheel is not positively locked against forward rotation, and can be advanced by rotating the shaft 20, which causes the teeth of the star wheel to oscillate the stop pawl 48 and armature 43 slightly, but the tension in springs 52 and 53 is sufficient to bias the dog 54 quite firmly in the direction of the star wheel to prevent any inadvertent rotation of the units wheel such as might otherwise be caused by a shock or jar.

When the electromagnet is energized by an impulse of current, the armature 43 is attracted and is rotated on shaft 20 in a clockwise direction to the position in which it is shown in Fig. 4, thereby advancing the units number wheel 30 by means of pawl 49 and ratchet wheel 32. The units number wheel is advanced an angular distance equal to the spacing between digits and is thus caused to display the digit 1, assuming that the initial setting was zero.

At the beginning of the movement of the armature, the stud 47 leaves the notch 56 in the stop pawl and thus leaves the pawl free to move away from the star wheel 31 as a tooth of the wheel rides past the dog 54. That is, the stop pawl is free to move except for spring 53, which yields to permit the described action of the stop pawl responsive to the positive drive of the ratchet and star wheels by the pawl 49.

At the end of the movement of the armature the stud 47 engages the curved arm 55 of the stop pawl, as shown in Fig. 4. There is a magnetic cushioning effect as the armature becomes aligned between the poles of the electromagnet, which substantially eliminates the shock as the stud engages the arm 55. In this position of the armature 43 and stud 47 the stop pawl 48 is positively locked against movement away from the star wheel 31, and hence the latter is locked by the dog 54, which is now resting in the next adjacent notch of the star wheel. The described locking of the stop pawl prevents overrun by the units number wheel and insures that it will be rotated only one notch of the ratchet wheel.

Upon cessation of the current impulse the electromagnet becomes deenergized and the armature is rotated back to normal position by the spring 52. During the return movement the stop pawl 48 is free of restraint by the stud 47; but the dog 54 is held against the star wheel 31 by the spring 53 with ample force to prevent retrograde movement of the units number wheel due to the slight friction between pawl 49 and the ratchet wheel as the pawl slides over the wheel preparatory to dropping into the notch behind the next

tooth. In the fully restored position of the armature the stud 47 rests in the notch 56 of the stop pawl, as previously described. Just prior to reaching this position the armature 43 engages the buffer spring 45 which substantially eliminates the shock which would otherwise occur when the stud 47 reaches the notch 56.

The foregoing explanation covers the operation of the counter in response to one impulse. Subsequent impulses operate the counter similarly, with the result that the units number wheel is rotated step by step to increase its reading by one (1) each time an impulse is received. After nine impulses have been counted, the next impulse steps the units number wheel to zero; but at the same time the transfer arrangement between the units number wheel and the tens number wheel advances the latter wheel one step and causes it to display the digit 1. The number displayed is therefore the number ten (10) which is equal to the number of impulses received.

It will be understood that any number of impulses may be counted up to the capacity of the counter. If six number wheels are provided, the capacity is 999,999. The impulses to be counted may be received at irregular intervals or they may be rapidly recurring impulses of a series. Due to the improved armature and pawl construction, together with the stop pawl arrangement, the drive is exceedingly fast and accurate and the counter will respond properly to impulses received at a rate in excess of 15 impulses per second.

In order to set the counter to zero, the knob 25 is rotated by hand in a counterclockwise direction (as seen from the right in Fig. 1) as far as it can be turned. The knob 25 rotates shaft 20 in a clockwise direction as seen in Fig. 5, thereby also rotating the arm 61, which eventually engages the arm 60 and rotates it also. The rotation is stopped when the arm 60 engages the pin 62. The parts are shown in this position in Fig. 5.

The knob 25 is now rotated in the opposite direction, thereby rotating the shaft 20 in a counterclockwise direction, as seen in Fig. 5. Arm 61 rotates with shaft 20 and disengages itself from arm 60. Fig. 6 shows the shaft 20 in the same position as in Fig. 5, while the number wheel is in the proper position to display the digit 7. From these considerations it will be appreciated that as shaft 20 is rotated the tooth on the shaft will eventually reach the pawl 36, whereupon further rotation of shaft 20 will carry the number wheel along and cause it to successively display the digits 8, 9 and then zero (0). The other number wheels are similarly picked up by the shaft 20, either sooner or later depending on the position in which they happen to be standing, and all the wheels are thus simultaneously reset to zero. It should be pointed out in this connection that the shaft is rotated somewhat more than 360 degrees so that a number wheel already in zero position is nevertheless picked up at the start of the return rotation of shaft 20 and is rotated through 360 degrees, or from zero to zero.

During the return rotation of shaft 20 the arm 61 eventually engages the arm 60 and moves it around until it engages the pin 63. This positively stops the rotation of shaft 20. The arrangement is such that the rotation of the shaft is stopped just as the number wheels reach zero position, which avoids the possibility that the operator might inadvertently rotate the number

wheels too far. As a matter of fact the number wheels can be rotated slightly beyond the zero position, but the wheels are self-aligning within certain limits, and they automatically return exactly to zero position as soon as the shaft 20 is released.

In further explanation of the automatic aligning feature, it will be understood by reference to Fig. 7 that as the number wheel 33, for example, is advanced to zero position the pawl 38 (also 39) will drop into the notches of the internal ratchet on the number wheel one after the other. These notches serve to align the corresponding digits with respect to the sight opening of the counter, as will be understood from the previous explanation of the transfer mechanism. Now when the number wheel displays the digit zero, the pawls drop into the corresponding notches, and if the number wheel is advanced somewhat beyond this point the pawls start to lift out of the notches, with the result that when the shaft 20 is released the number wheel is restored exactly to zero by the camming action of the pawls.

From the foregoing it will be seen that the invention provides a highly desirable mechanical counter, which is compact in design, economical to manufacture, and very efficient and accurate in operation.

While the drawing shows an excellent construction and design of the parts, which has been tested and found to give excellent results, it is recognized that modifications may be made without departing from the principles of the invention. I do not therefore wish to be limited to the exact form of the invention as illustrated and described, but desire to include and have protected by letters patent all forms and modifications which come within the scope of the appended claims.

I claim:

1. In a mechanical counter having a shaft and counting means rotatably mounted thereon and including a units number wheel carrying ratchet teeth, a device for angularly advancing said number wheel step by step, said device comprising an electromagnet having pole pieces disposed on opposite sides of said shaft, said pole pieces having arcuate pole faces defining a circle not greater in diameter than said number wheel, a bi-polar armature rotatable on said shaft between said pole faces, a pawl carried by said armature for advancing the ratchet to advance said number wheel responsive to angular displacement of said armature when the electromagnet is energized, a pivotally mounted member forming stops for positively limiting the angular displacement of said armature in either direction of operation thereof, and resilient buffer means for engagement with one pole of said armature to cushion the angular displacement thereof in one direction of operation.

2. In a mechanical counter having a shaft and a units number wheel rotatably mounted thereon and carrying a star wheel and a ratchet wheel associated therewith and rotatable therewith as a unit, a device for rotating said ratchet step by step to rotate the associated star wheel and number wheel accordingly, said device comprising an electromagnet, an armature for said electromagnet rotatably mounted on said shaft, a pawl supported on said armature and adapted to advance said ratchet wheel when the armature is rotated responsive to energization of said electromagnet, a pivoted dog cooperating with said star wheel, and means whereby said arma-

ture controls said dog to lock the star wheel and ratchet wheel in advanced position.

3. A counter as claimed in claim 2, together with means for controlling said dog by the armature in its normal position to prevent accidental rotation of the number wheel, star wheel, and ratchet wheel associated therewith.

4. In a mechanical counter having a units number wheel, a star wheel and a ratchet wheel disposed side by side on a shaft and rotatable thereon as a unit, a device for angularly advancing said ratchet wheel step by step to advance said star wheel and associated number wheel accordingly, said device comprising an armature rotatably mounted on said shaft axially adjacent said ratchet wheel, an electromagnet for rotating said armature from a normal position and a spring for restoring the same to normal, a stud supported on said armature, a pawl pivoted on said stud for rotating said ratchet wheel responsive to rotation of said armature, and a pivoted member controlled by said stud and adapted to cooperate with said star wheel to prevent overrun of the ratchet wheel and associated parts when the armature is rotated by energization of said magnet.

5. In a mechanical counter having a shaft carrying a units number wheel, a star wheel and a ratchet wheel associated therewith and rotatably mounted on said shaft as a unit, a device for angularly advancing said ratchet wheel step by step to advance the associated star wheel and number wheel accordingly, said device comprising an armature rotatably mounted on said shaft, an electromagnet for rotating said armature upon energization of the magnet, a pawl operated by the armature to rotate said ratchet and therewith the star wheel and associated number wheel, a single spring for restoring said armature and said pawl, a pivoted dog for cooperation with said star wheel, means whereby said armature holds said dog against the star wheel in two positions of the armature corresponding to the energized and deenergized conditions of said electromagnet, and a spring for holding said dog against said star wheel when the armature is moving between said positions.

6. A device of the class described comprising a shaft, an element rotatably mounted on said shaft and forming an operating member and an exteriorly peripherally toothed ratchet which is rotatable therewith as a unit, an armature rotatably mounted on said shaft adjacent thereto but axially spaced therefrom, electromagnetically actuated means for angularly displacing said armature, a pawl actuated by said armature responsive to angular displacement thereof by said electromagnetically actuated means for rotating said ratchet to rotate said operating member, and a single spring means for maintaining said armature in normal position relative to said electromagnetically actuated means and for also maintaining said pawl in normal position relative to said ratchet.

7. The structure defined in claim 6, together with a pivotally mounted member forming stops for limiting the angular displacement of said armature in either direction of operation thereof.

8. The structure defined in claim 6, together with a star-wheel disposed between said operating member and said ratchet and rotatable therewith, and a pivotally mounted member forming stops for limiting the angular displacement of said armature in either direction of

operation thereof and also forming a detent for engagement with said star wheel to control the rotation thereof and therewith the rotation of the associated operating member responsive to rotation of said ratchet.

9. The structure defined in claim 6, together with a device for controlling the operation of said armature and of said ratchet, said device comprising a star-wheel coupled with said ratchet and with said operating member and rotatable therewith, a pivotally mounted member having an arm for engagement with said star-wheel, and an extension on said member for coaction with the armature in the extreme operatively actuated positions thereof.

10. The structure defined in claim 6, together with a device for controlling the operation of said armature and of said ratchet to prevent overtravel thereof, said device comprising a star-wheel coupled with said ratchet and with said operating member and rotatable therewith, a pivotally mounted control member, an arm on said control member for detent engagement with said star-wheel, means on said control member forming a groove for coaction with said armature in normal position thereof, and an extension on said control member for coaction with said armature in the extreme operatively actuated position thereof.

11. A device of the class described comprising a shaft, an element rotatably mounted on said shaft and forming thereon an operating member from which extends in axial direction an exteriorly peripherally toothed star wheel and axially adjacent thereto an exteriorly peripherally toothed ratchet, an armature mounted for angular oscillation on said shaft axially adjacent said ratchet, electromagnetically actuated impulse-responsive means for angularly displacing said armature from a normal to an operated position, a pivotally mounted pawl actuated by said armature responsive to angular displacement thereof by said electromagnetically actuated means, said pawl being in coacting engagement with said ratchet for angularly advancing such ratchet to rotate said star wheel and associated operating member, and a pivotally mounted member forming stops for limiting the angular displacement of said armature in either direction of oscillation thereof and also forming an extension for coacting detent engagement with said star wheel to control the rotation thereof thereby controlling the rotation of its associated operating member responsive to angular advance of said ratchet.

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