May 22, 1956 R. J. WAGNER 2,746,305

RATCHET MECHANISM

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FIG. 1.

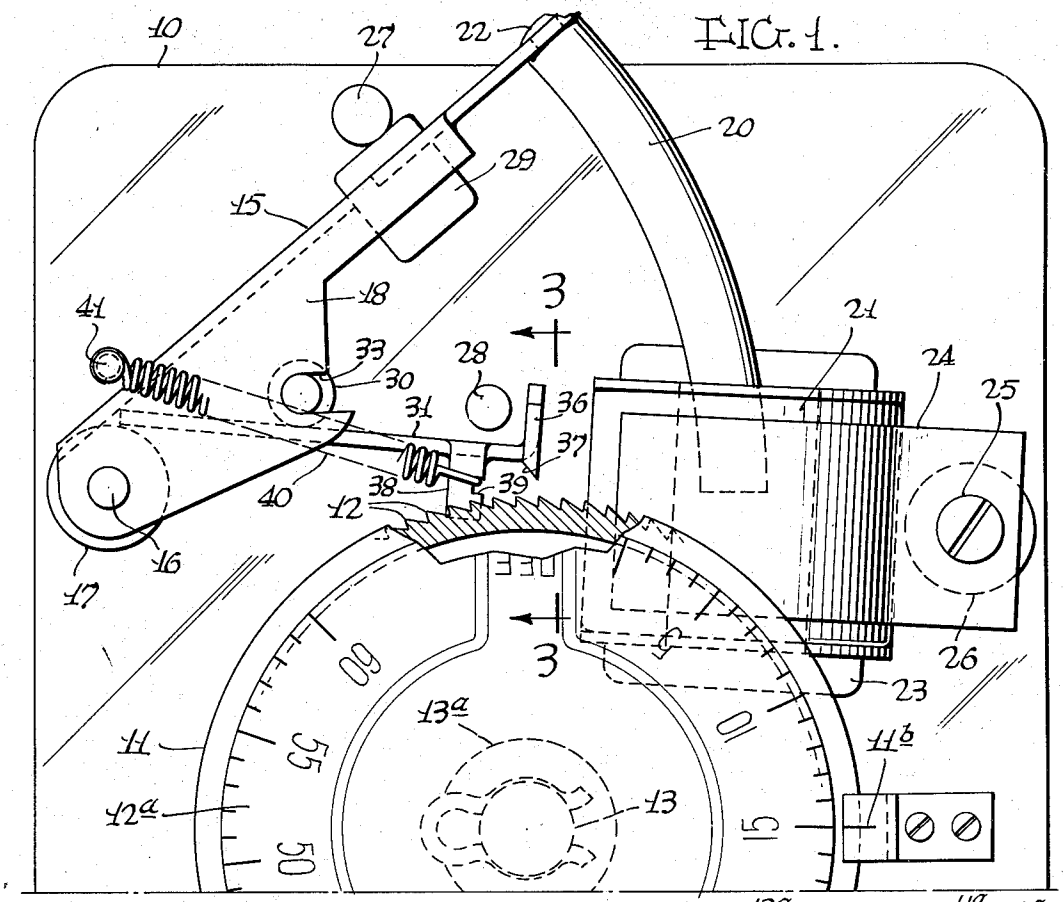


FIG. 2a.

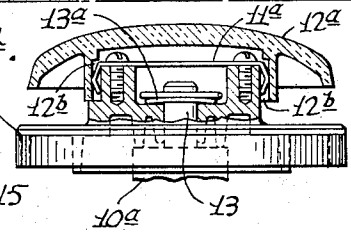
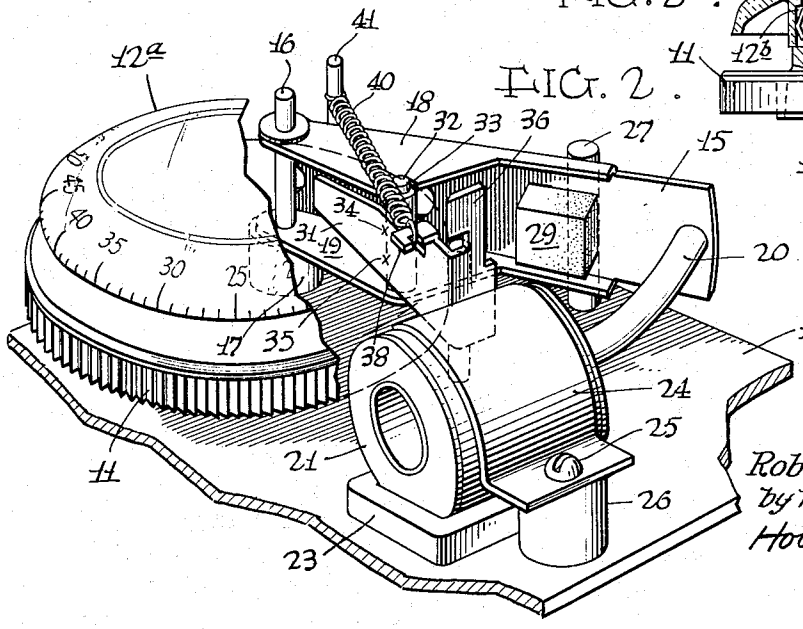


FIG. 2.



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FIG. 4.

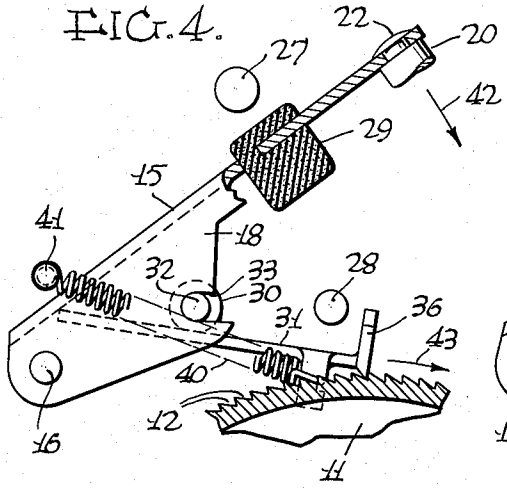


FIG. 5.

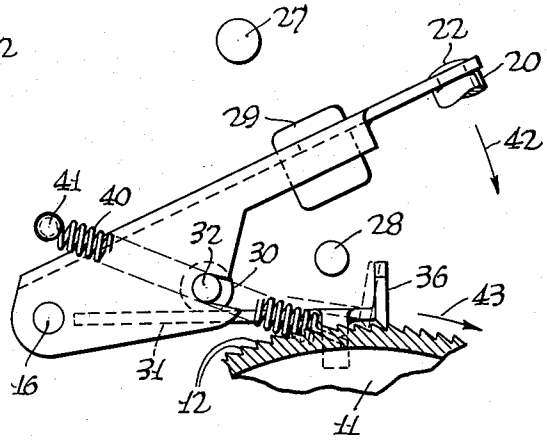


FIG. 6.

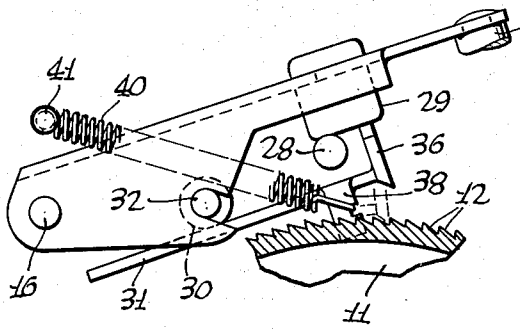


FIG. 7.

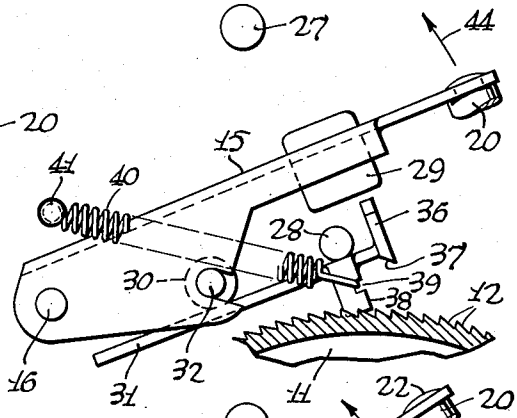


FIG. 3.

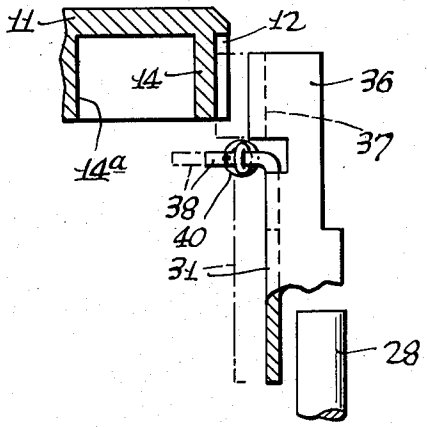
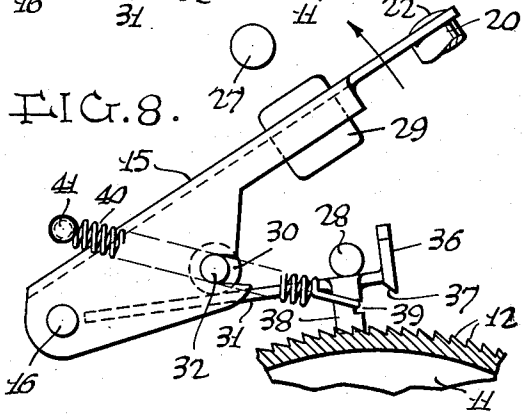


FIG. 8.



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RATCHET MECHANISM

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Application June 12, 1951, Serial No. 231,223

6 Claims. (Cl. 74—153)

This invention relates to ratchet mechanisms and more particularly to a novel rotary-type ratchet mechanism having the structural features hereinafter described.

While the ratchet mechanism provided by this invention is intended to be used wherever it may find useful application, it is especially adapted for use in an automatic control apparatus for a pressure cooker, such as disclosed in the copending joint application of Harvey E. Hortman, Jr. and the present applicant, Serial No. 231,224, filed June 12, 1951, now Patent No. 2,702,336. In such apparatus, the ratchet mechanism serves as a timing mechanism to time the pressure cooking operation. Further, in such apparatus, the toothed ratchet member is operatively connected to a knob or dial which is set manually for the desired cooking time and which is returned to its "off" position by the ratchet mechanism during the timing operation. It is, therefore, essential that the control knob or dial be freely rotatable to set the same, and it is also essential that the ratchet mechanism operate in proper increments of movement to give accurate timing. Further, it is necessary that rotation of the control knob or dial, even during operation of the ratchet mechanism, shall not injure such mechanism, as it is possible that a user might move the control knob from one position to another after the timing operation has started. Further still, it is necessary that the toothed ratchet member be removable for servicing purposes, without causing injury to the ratchet mechanism.

One object of the present invention is to provide an improved ratchet mechanism which, while capable of general usage, is particularly adapted to meet the requirements in an apparatus of the character above mentioned.

Another requirement is that the ratchet mechanism continue to operate to give accurate incremental displacements regardless of large variations in the actuating force applied thereto. In the aforementioned apparatus, a solenoid is used to actuate the ratchet mechanism and it is essential that correct operation take place over wide variations in the supply voltage. In prior devices it was observed that at lower voltages insufficient force was developed to move the ratchet through a full tooth advance. At higher voltages the force of the solenoid was sufficient to cause overtravel of the ratchet member. Attempts at increasing the resistance to travel through increased friction merely aggravated the situation at the lower voltages.

A major object of this invention is to provide a ratchet mechanism which will possess the proper force and velocity characteristics regardless of wide variations in applied actuating force.

A further object of the invention is to provide a ratchet mechanism which is simple in construction and which is inexpensive to manufacture.

Other objects and features of the invention will be apparent from the following detailed description with reference to the accompanying drawings, wherein

Fig. 1 is a plan view of the ratchet mechanism, with

a portion of the toothed member broken away for the purpose of illustration;

Fig. 2 is a perspective view of the mechanism, with a portion of the toothed member broken away to disclose some of the parts;

Fig. 2*a* is a sectional view taken diametrically of the knob or dial;

Fig. 3 is a fragmentary sectional view taken along line 3—3 of Fig. 1; and

Figs. 4 to 8 are operational plan views of the operating mechanism, showing the operation at various stages of a complete operating cycle.

Referring more particularly to the drawings, the mechanism is shown mounted on a base plate **10**. A rotary member **11**, having ratchet teeth **12** on the periphery thereof, is arranged for rotation about a central stud **13** extending from a support **10***a* fixed on the base **10**. In the form illustrated, the toothed member has a depending peripheral flange **14** (see Fig. 3) on which the teeth **12** are formed. A spring washer **13***a* is placed on stud **13** and bears against the top surface of member **11** to force said member into engagement with the support **10***a* so as to provide a predetermined frictional resistance to rotary movement of said member. In the embodiment shown in the afore-mentioned application, the total frictional resistance also includes that of a cam follower (not shown) which is spring biased against a cam race **14***a* of member **11**. A control knob or dial **12***a*, having time-indicating indicia thereon, is attached to member **11** by means of a resilient strip **11***a* secured to member **11** and having its ends seated in internal recesses **12***b* of the dial. Stationary indexing means **11***b* enables manual setting of the dial, with consequent setting of member **11**. It may be assumed, as in the aforementioned apparatus, that the cam race **14***a* operates a switch (not shown) which stops operation of the mechanism when the dial reaches its "off" position.

An actuating member **15** is arranged for pivotal movement about a vertical pivot pin **16** which is supported by a cylindrical support **17** secured to or formed integrally with the base plate and extending upward therefrom. As may be clearly seen in Fig. 2, the member **15** is preferably formed of flat metal stamped and bent to provide lateral flanges or extensions **18** and **19**, the latter being provided with apertures through which the pin **16** extends.

At the free end of the pivotal member **15** is secured an arcuate element **20** which is formed of magnetic material and which constitutes a movable core operable in one direction by a solenoid **21** mounted on the base plate **10**. The element **20** may be secured to the end of member **15** by being riveted thereto as shown at **22**. The operating solenoid **21** is shown seated in a recessed block **23** secured to or formed integrally with the base plate **10**, the solenoid being held in place by a clamp **24** secured by a screw **25** to a support **26** secured to or integral with the base plate. It is intended that the solenoid **21** shall be intermittently energized, for example, by means of a current-operated thermal switch device as shown in the above mentioned copending application.

The range of pivotal movement of the actuating member **15** is established by spaced stops **27** and **28** in the form of pins secured to and extending upwardly from the base plate **10**. The stop **28** serves a further purpose to be described presently, and it is located accordingly. A cushion element **29**, which may be formed preferably of a sponge-type rubber, is carried by the arm **15** in a position for engagement with the stops **27** and **28**. As shown in Fig. 4, the cushion element **29** may be mounted on the arm **15** by providing a slot opening in the arm and by forming the cushion element so that a portion thereof may be inserted through the opening for interlocking attachment to the arm **15**.

The side flanges 18 and 19 on member 15 also serve to rotatably support a pivot pin 30 for a pawl lever 31 which is rigidly secured to pin 30. The pin 30 has reduced end portions, the lower end portion seating in an aperture (not visible) provided in flange 19, and the upper end portion 32 seating in an open recess 33 provided in the flange 18. The pawl lever 31 may be secured to the body of pin 30 in any suitable manner, for example, by spot welding pin to lever 31 at raised projections 34 and 35.

As may be clearly seen in Fig. 2, the pawl lever 31 is preferably formed of flat metal stamped and bent to form a pawl portion or element 36 having a tapered edge 37, and to provide a lateral extension or lug 38 having a recess 39. A helical tension spring 40 has one end looped about the extension or lug 38 in recess 39 thereof, and has its other end looped about a stationary pin 41 extending upwardly from the base plate 10. It should be noted that the pawl 36 is at such an elevation (Fig. 3) that it is engageable with the teeth 12, while the lug 38 is at a lower elevation so that it may extend beneath the peripheral portion of the toothed member 11. Further, the anchorage pin 41 for one end of the spring 40 is so located that the pivot axis of lever 31 may shift to one side or the other side of the longitudinal axis of spring 40, as hereinafter more fully described.

Considering the operation of the device, in its inoperative state the movable parts are disposed as shown in Fig. 1, the spring 40 exerting a clockwise force on lever 31 with respect to its pivot 30 so that the inner end of said lever abuts against member 15, and due to this abutment the member 15 is held in the position shown, with the cushion element 29 against stop 27. Energization of solenoid 21 causes movement of the core 20, as shown in Fig. 4, in the direction of the arrow 42, and consequently causes member 15 to move in the same direction toward the stop 28. The movement of member 15 is against the force of spring 40 which at first continues to hold the pawl lever 31 with its inner end in abutment with member 15. Consequently the pawl lever moves with member 15 during the initial movement of the latter. After a small amount of movement of member 15, as shown in Fig. 4, the pawl element 36 engages one of the teeth 12, and continued movement of member 15 causes the pawl to move the toothed member 11 in the direction of arrow 43 through the distance of one tooth. During this movement, pivot 30 of lever 31 moves toward the opposite side of spring axis, as shown in Fig. 5, the lever 31 rocking about its point of engagement with the ratchet tooth. When the pivot of lever 31 moves to the opposite side of the spring axis, the spring moves lever 31 counter-clockwise with a snap action until the pawl end of the lever abuts against the cushion element 29, as shown in Fig. 6. This snap movement of the lever 31 disengages the pawl 36 from the engaged tooth, and the motion of the toothed member 11 stops.

It should be noted that just prior to the snap movement of the lever 31 pivot 30 is directly in line with fixed pivot 16 and the engaging surface of pawl portion 36 of lever 31 and the back of the cooperating tooth 12 of member 11. The center distances thus determine the maximum displacement of pawl 36 on the periphery of member 11. The toggle linkage also insures a high force magnification at the approach to the on-center position. Moreover the velocity characteristic of the pawl during the interval of tooth engagement is governed by this toggle action. It is such that the velocity does not go abruptly to zero, rather it gradually decreases and tends to prevent excessive amounts of momentum being imparted to the member 11 which would cause it to overtravel the desired one tooth displacement. The force characteristic imparted to pawl 36 is carefully balanced by a predetermined frictional

resistance to rotation as imparted in the aforementioned apparatus by the friction spring washer mounted over shaft 13 or by some other convenient means. It has been found that this arrangement provides the proper force and velocity characteristic at the pawl to assure consistent predetermined incremental angular displacement of the rotatable member 11 over wide variations in the power input by the solenoid 21 and its cooperating core 20. In practice it was found to give reliable incremental displacements to the ratchet member 11 with variation of line voltage to the solenoid of between 75 v. and 140 v. on the normal 115 v. supply line.

In the device shown in the aforementioned application, the time interval of solenoid energization is controlled by a current-operated thermostatic switch which is in series with the solenoid and an electrical heating load. This "on" interval is of approximately 8 seconds duration, and it is during this interval that the mechanism takes up the position shown in Fig. 6.

It will be noted that in the solid line position of Fig. 6, i. e., during the greater portion of the "on" interval, the pawl is not in engagement with the ratchet teeth and member 11 can be freely rotated in either direction without damaging the dial advance mechanism. The period of actual tooth engagement by the pawl is only a fraction of a second and thus there is, practically speaking, no danger of jamming the mechanism if the dial is turned by the user. In prior devices the pawl remains engaged with the tooth throughout the period of energization and is responsible for tooth breakage and mechanism damage when rotation is attempted.

Deenergization of the solenoid 21 causes member 15 to move in the direction of arrow 44 away from stop 28 and toward stop 27, as shown in Fig. 7, under the force of spring 40 which acts through the pawl lever 31. Very shortly, however, the pawl lever 31 abuts against stop pin 28, as shown in Fig. 7, and force of spring 40 then causes the lever 31 to rock about pin 28, which in turn causes continued return movement of member 15 through the pivotal interconnection thereof with lever 31. At this time the pivot of lever 31 moves toward the axis of spring 40, as shown in Fig. 8, and when the lever pivot passes just beyond the spring axis, the spring moves the lever clockwise about its pivot until the inner end of the lever abuts against member 15, as shown in Fig. 1. By the time this happens, the moving parts are so located relative to the toothed member 11 that the pawl 36 does not engage the teeth. The parts are then disposed as shown in Fig. 1 under the force of spring 40, and the mechanism is ready for the next operating cycle.

From the foregoing description, it will be seen that the invention provides a spring toggle arrangement through which the toothed ratchet member is moved through the distance of exactly one tooth during each operating cycle, regardless of large variations in power input to the pawl actuating member. Further, the pawl is abruptly moved out of engagement with the ratchet teeth after such movement of the toothed member so that throughout substantially the entire timed period the toothed ratchet member is freely rotatable.

While a preferred embodiment of the invention has been illustrated and described, the invention is not limited thereto. It contemplates such modifications and further embodiments as may occur to those skilled in the art.

I claim:

1. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, a pivoted actuating member, a pair of fixed stops in the path of movement of said actuating member and defining limits of arcuate movement of said actuating member, a pawl element pivotally carried by said actuating member and movable between one of said stops and said rotary member for repeated engagement with said teeth, and toggle

means connected to said pawl element and acting resiliently to retain the pawl element to one side or the other side of a critical center position, said pawl element during its engagement with said teeth being moved beyond said critical position whereupon said toggle means effects removal of the pawl element from said teeth, and said one stop being engageable by the pawl element to effect return movement of the pawl element beyond said critical position.

2. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, a pivoted actuating member, a pair of fixed stops in the path of movement of said actuating member and defining limits of arcuate movement of said actuating member, a pawl element pivotally carried by said actuating member and movable between one of said stops and said rotary member for repeated engagement with said teeth, and a helical tension spring connected to said pawl element and arranged to retain the pawl element to one side or the other side of a critical center position, said pawl element during its engagement with said teeth being moved beyond said critical position whereupon said spring effects removal of the pawl element from said teeth, and said one stop being engageable by the pawl element to effect return movement of the pawl element beyond said critical position.

3. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, a pivoted actuating member, a pair of fixed stops defining limits of arcuate movement of said actuating member, a pawl lever pivoted intermediate its ends on said actuating member, one end of said lever being engageable with said actuating member, the other end of said lever having a pawl portion engageable with said teeth, a helical tension spring having one end connected to said lever and the other end connected to a fixed anchorage, the lever pivot being shiftable between positions on opposite sides of the spring axis, the spring normally urging the first end of said lever into engagement with said actuating member and also urging the latter against one of said stops, and means for moving said actuating member toward the other stop to cause said pawl portion to engage said teeth and move said rotary member, the engagement of said pawl portion with said teeth causing the lever pivot to shift to the opposite side of the spring axis, whereupon said pawl portion is disengaged from said teeth, the return movement of said actuating member effecting engagement of said lever with said other stop to move the lever pivot to the first side of the spring axis, whereupon the spring returns said lever to its original position.

4. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, a pivoted actuating member carrying a cushion element, a pair of fixed stops defining limits of arcuate movement of said actuating member and engageable by said cushion element, a pawl lever pivoted intermediate its ends on said actuating member, one end of said lever being engageable with said actuating member, the other end of said lever having a pawl portion engageable with said teeth, a helical tension spring having one end connected to said lever and the other end connected to a fixed anchorage, the lever pivot being shiftable between positions on opposite sides of the spring

axis, the spring normally urging the first end of said lever into engagement with said actuating member and also urging the latter against one of said stops, and means for moving said actuating member toward the other stop to cause said pawl portion to engage said teeth and move said rotary member, the engagement of said pawl portion with said teeth causing the lever pivot to shift to the opposite side of the spring axis, whereupon said pawl portion is disengaged from said teeth and the lever abuts against said cushion element, the return movement of said actuating member effecting engagement of said lever with said other stop to move the lever pivot to the first side of the spring axis, whereupon the spring returns said lever to its original position.

5. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, an actuating member, pivoted on an axis spaced from said rotary member, a fixed stop between said members in the path of movement of said actuating member and defining a limit of arcuate movement of the actuating member toward said rotary member, a pawl element pivotally carried by said actuating member extending between said stop and said rotary member and movable therebetween for repeated engagement with said teeth, and toggle means connected to said pawl element and acting resiliently to retain the pawl element to one side or the other side of a critical center position, said pawl element during its engagement with said teeth being moved beyond said critical position whereupon said toggle means effects removal of the pawl element from said teeth, and said stop being engageable by the pawl element to effect return movement of the pawl element beyond said critical position.

6. A ratchet mechanism, comprising a rotary member having ratchet teeth on the periphery thereof, a pivoted actuating member, a fixed stop spaced from said rotary member, a pivot on said actuating member, a pawl element mounted on said pivot and movable between said stop and said rotary member for repeated engagement with said teeth, a helical tension spring having one end connected to said pawl element and the other end connected to a fixed anchorage, the location of the anchorage being such that said pivot is movable from one side to the opposite side of the spring axis during the engagement of the pawl element with said teeth, whereby the pawl element is moved by said spring out of engagement with said teeth after having stepped said ratchet member, said fixed stop being engageable by said pawl element to cause movement of said pivot back to said one side of the spring axis, thus causing the spring to reposition the pawl element for repeat engagement with said teeth.

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