

July 6, 1943.

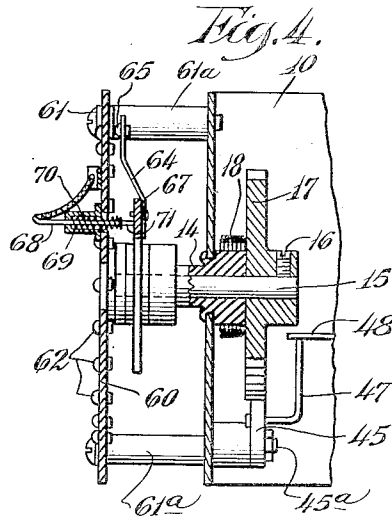
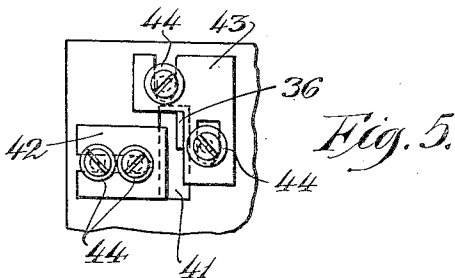
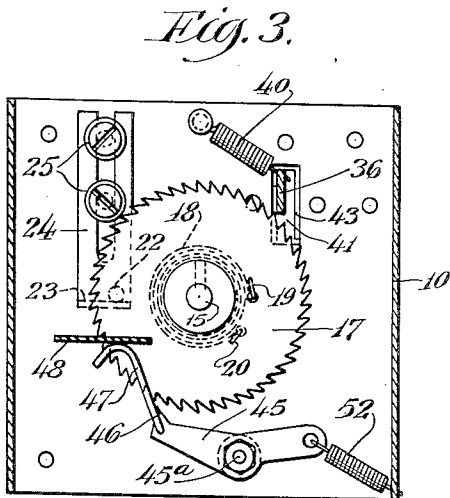
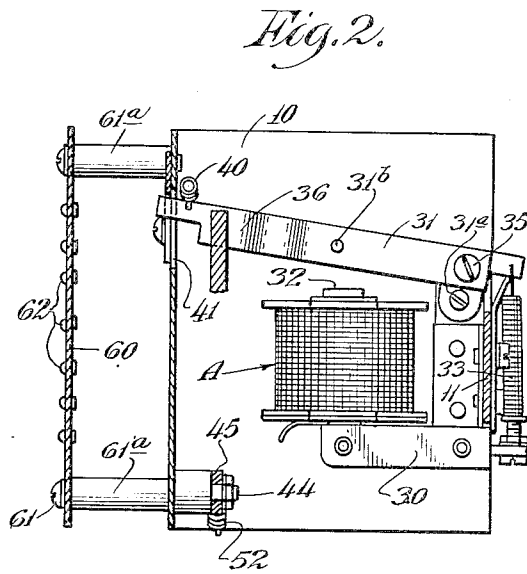
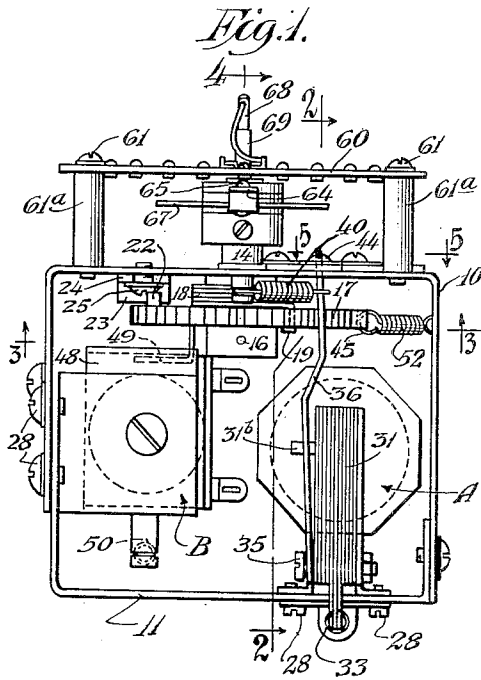
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2,323,840

RELAY OPERATED STEPPER ASSEMBLY

Filed July 22, 1940

2 Sheets-Sheet 1



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Fig. 6.

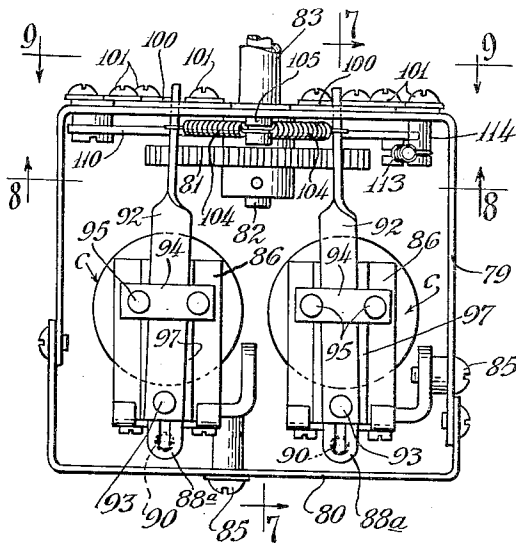


Fig. 7.

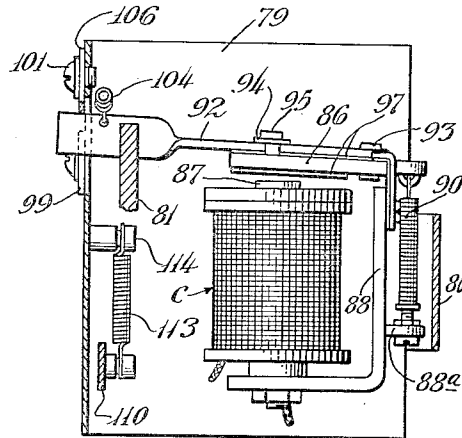
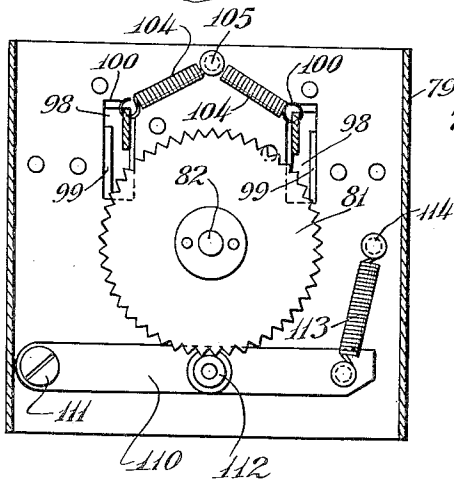


Fig. 8.



UNITED STATES PATENT OFFICE

2,323,840

RELAY OPERATED STEPPER ASSEMBLY

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4 Claims. (Cl. 175—337)

The present invention relates to devices or mechanisms of the type adapted to be actuated in step-by-step fashion, and more particularly to ratcheting types of devices or mechanisms adapted to be operated by imparting pulsations of electrical current to an electro-magnet which in turn, by means of an actuating pawl, operating upon a rotatable ratcheting member, effects selective adjustment of certain parts of a mechanism or apparatus such as for selectively completing portions of one or more of a plurality of different electrical circuits, or for selectively and remotely controlling the adjustment and/or operation of various types of apparatus.

Devices of this general class, as heretofore manufactured, have generally been rather complicated in construction, bulky in form, and relatively expensive to manufacture, all of which tended to limit their use in connection with certain types of apparatus to be controlled by such devices.

One of the main objects of this invention is to provide an improved ratcheting mechanism of the character indicated which is simple in construction, positive in operation and which is constructed and arranged for embodiment in a compact size unit of relatively small dimensions.

Another object is to provide an improved ratcheting mechanism including an electro-magnet adapted to be intermittently energized by pulsations of electrical current for imparting motion to an actuating pawl for effecting step-by-step adjustment of a ratchet member, and a check pawl for retaining the ratchet member in stepped positions of adjustment, together with a second electro-magnet for controlling the operation of the check pawl.

A further object is to provide an improved ratcheting member adapted to be rotated in step-by-step fashion against the reaction of a spring positioned to yieldingly urge the ratcheting member to a starting position, together with a check pawl for maintaining the ratcheting member in adjusted position under control of an electro-magnet.

Still another object of this invention resides in the provision of a rotatable ratchet wheel together with a pair of actuating pawls adapted to be operated independently of each other by separate electro-magnets, whereby selective energization of said magnets, through the medium of said pawls, effects rotatable adjustment of the ratchet wheel in step-by-step fashion in opposite directions.

Other objects and advantages of this invention

will be apparent from the following description taken in connection with the accompanying drawings in which—

Figure 1 is a top plan view of a ratcheting mechanism embodying the present invention.

Figures 2 and 3 are transverse vertical sectional views through the mechanism, taken substantially as indicated at lines 2—2 and 3—3 respectively on Figure 1.

Figure 4 is a fragmentary vertical axial section through the ratcheting member and associated parts, taken substantially as indicated at line 4—4 on Figure 1.

Figure 5 is a fragmentary front elevational view of the mounting member showing the adjustable stop elements for the actuating pawl.

Figure 6 is a top plan view of a ratcheting mechanism embodying a modified form of the present invention.

Figures 7 and 8 are transverse vertical sectional views, taken substantially as indicated at lines 7—7 and 8—8 respectively on Figure 6.

Figure 9 is a front elevational view of the mounting member showing the relationship of the adjustable stop elements for the dual set of actuating pawls.

Ratcheting mechanisms of the general type embodying the present invention are adapted to a relatively wide field of use, and the present construction herein illustrated and described is of the type adapted to be controlled by pulsations of electrical current for selectively adjusting a control element to a predetermined position. It is to be understood that said control element may be of various forms and may be utilized for carrying out various functions in connection with an apparatus or devices with which it is associated.

In the specific embodiment as represented in Figures 1 to 5 of the drawings I have disclosed a ratcheting mechanism adapted to be directly or remotely controlled by pulsations of electrical current and by virtue of which it is possible to complete portions of one or more of a plurality of different electrical circuits. In the construction shown in Figures 1 to 5, the device includes a mounting member 10, formed as a sheet metal stamping of generally U-shaped formation, as seen in Figure 1, and the free ends of the mounting member are reinforced and rigidly connected by means of a strap as indicated at 11, serving to complete the mounting member in the form of a rectangular box. Fixedly mounted in the front vertical wall of the mounting member 10 is a journal bearing 14 through which extends a shaft 15, projecting inwardly of the front panel

of the mounting member, beyond the bearing 14, and mounted on the inner end of said shaft by means of a set screw 16 is a ratchet wheel 17.

Said ratchet wheel is adapted to be rotated in step-by-step fashion as will hereinafter be described and is adapted when free to return to a normal starting position under control of a coil spring 18 surrounding the inner portion of the bearing 14 as seen in Figure 4. One end of the spring, as indicated at 19, extends through an aperture in the ratchet wheel while the other end of said spring as indicated at 20, extends through an aperture in the front panel of the mounting member.

In order to arrest the ratchet wheel at a normal starting position said ratchet wheel is provided on its face, adjacent the front panel, with a nubbin 22 adapted to engage or encounter an inwardly projecting flange 23 of a stop plate indicated at 24. Said plate is mounted for vertical adjustment on the inner surface of the front panel of the mounting member by means of screws 25 as seen in Figure 3 of the drawings, in order to obtain minute adjustment for obtaining relatively exact alignment of the ratchet wheel at its normal starting position.

Disposed within the frame mounting member are a pair of electro-magnetic relays which are designated as A and B and which, for convenience, may be generally termed, respectively an actuating relay and a holding relay, insofar as the movement of the ratchet wheel 17 is concerned. These relays are rigidly secured to the mounting frame by means of screws 28, and as may be seen in Figure 1 are disposed in closely spaced apart relation on opposite sides of the axis of rotation of the ratchet wheel.

The relay designated A, includes a laminated U-shaped core 30, including an upstanding outer leg to the upper end of which is pivoted, as indicated at 31^a, a laminated armature 31. The purpose in forming the core and the armature of laminations is so that when the relay is operated by alternating current for a relatively continuous period the laminated structure prevents overheating, as is well understood in the art. The armature 31 is yieldingly urged away from the core leg 32 of the relay by means of a coil spring indicated at 33, in a conventional manner. As may be seen in Figure 2 of the drawings the armature 31 swings about its pivotal connection 31^a in vertical direction.

Pivotally attached, as indicated at 35, to the rear end of the armature, immediately above the pivot 31^a is an actuating pawl 36 which extends in the general direction of the axis of rotation of the ratchet wheel, and is disposed substantially in alignment with the armature 31, with the forward portion of said pawl normally extending in close proximity to the teeth of the ratchet wheel 17, for rotating said wheel in step-by-step fashion. It is to be understood that the pivotal connection 35 of said pawl to the armature is such as to allow said pawl to move laterally, relatively to the armature, and thereby permit the pawl to accommodate itself during vertical movement of the armature to following the curvature of the teeth of the ratchet wheel, during stepped rotary movement thereof, without imposing lateral strain upon the pawl during the actuating stroke. Said pawl is connected to the armature for movement therewith as a unit and is guided in its lateral movement, relatively to the armature, by being provided with an aperture intermediate its length for telescopic fit on

a laterally projecting pin 31^b on said armature 31, as clearly seen in Figures 1 and 2 of the drawings.

Such lateral movement of the actuating pawl during the operation of the pawl upon the ratchet wheel in step-by-step fashion is opposed by a coil spring 40 connected at one end to the pawl and at the other end to a stud on the inner face of the front panel of the mounting member, as seen in Figure 3. Said spring is positioned at an oblique angle so as to draw the pawl in an upward and lateral direction when the armature is free to move away from the core 32 of the electro-magnet, A.

It is to be understood that the actuating pawl and the ratchet wheel may be so designed and co-related as to obtain a predetermined amount of rotative adjustment of the ratchet wheel by a single actuation of the pawl, and it may be also understood that the pawl may be so designed and arranged for shifting the ratchet wheel a predetermined number of teeth during each single actuation thereof.

In order to obtain relatively exact rotative step-by-step adjustment of the ratchet wheel the actuating pawl is limited in its vertical as well as lateral movements by having the forward end thereof extend through an apertured window 41 formed in the front panel of the mounting member, as seen in Figure 3 of the drawings. In order to obtain relatively fine close adjustment for limiting the stroke of the actuating pawl so as to preclude over-running or over-driving of the ratchet wheel there is provided, in association with said apertured window, suitable stop means as seen in Figure 5, consisting of adjustable stop members 42 and 43 movably secured to the front face of the front panel of the mounting member by means of screws 44. By virtue of such permissible adjustment of the members 42 and 43 the extent of lateral movement as well as vertical movement of the actuating pawl may be definitely determined.

In the construction shown the holding electro-magnetic relay B must be energized during the period relay A is being operated by pulsations of electrical current, in order to maintain the ratchet wheel in stepped positions of adjustment, as will now be described. Pivotally mounted on the inner face of the front panel of the mounting member as indicated at 45a is a check pawl 45 having a lever arm provided with an angularly extending nose 46 of proper shape for engaging the teeth of the ratchet wheel to effectively hold the ratchet wheel against reverse rotation, under influence of the spring 18, during the step-by-step movement of said wheel by actuation of the relay A.

Secured to the forward end of the lever arm of the check pawl is a relatively rigid extension 47, positioned to abut against the underside of an armature 48 of the relay B. Relay B is inverted with respect to relay A, in that its armature 48, is at the bottom, below the core and coil of the relay. It is to be understood that normally said armature is urged away from the core of the relay B by means of a coil spring, indicated in dotted outline at 50 in Figure 1 of the drawings, and it is to be understood that said spring, acting on the armature, exerts sufficient pressure on the extension 47 to hold the check pawl 45 out of engagement with the ratchet wheel 17. The check pawl, however, is normally urged in the direction for engagement with the teeth of the ratchet wheel by means of a spring 52 connected

to an oppositely extending arm of the check pawl 45 and to the mounting member 10, as seen in Figure 3 of the drawings. It will therefore be apparent that when the electro-magnetic relay B is energized, attracting its armature 48, the check pawl 45 will then be free to move into engagement with the teeth of the ratchet wheel 17, under influence of the spring 52.

Therefore, when the relay A, through means of the actuating pawl 36, is driving the ratchet wheel 17 in step-by-step fashion by periodic spaced pulsations of electrical current, the relay B must be energized at least long enough, at the intermittent deenergization periods of relay A, to permit the check pawl 45 to assume an operating relation with the teeth of the ratchet wheel to preclude return of the ratchet wheel to starting position under influence of the spring 18, during step-by-step advancement of the ratchet wheel. Desirably, during such operation of relay A, relay B is continuously energized. It will be apparent however that it is possible to also obtain proper operation of the device if, during operation of relay A, the relay B is intermittently energized in such timed relation to relay A that the check pawl 45 is permitted to function to hold the ratchet wheel 17 at stepped positions of adjustment. After the ratchet wheel has been adjusted to a predetermined position, under control of the relay A, said ratchet wheel 17, may at some desired future time be returned to its starting position by its spring 18, upon deenergizing of the relay B so that the armature 48, under pressure of spring 50, engages the extension 47 of the check pawl and moves it out of operative engagement with the teeth of the ratchet wheel.

It is to be understood, however, that the armature of the relay B and the extension 47 of the check pawl may be so disposed in relation to each other that the relay B functions in a converse manner. In other words, the armature of the relay B and the extension 47 may be in such relationship to each other than when the relay B is deenergized the check pawl is normally in operative engagement with the teeth of the ratchet wheel 17 so that the ratchet wheel may be held in stepped positions of adjustment and said wheel is permitted to return to a starting position only upon energizing of the relay B.

In the illustrative embodiment of my invention, I have shown in association with the operating shaft 15 of the ratchet wheel a selective circuit making apparatus which consists of a panel 60 of insulating material mounted in spaced relation to the front panel of the mounting member by means of studs 61 and spacers as indicated at 61a. Said panel 60 is provided with an arcuate series of spaced apart contact buttons 62 which may be understood to be connected by conductor wires to suitable electrical circuits to be controlled. Mounted in an insulated body rigidly attached to the end of the shaft 15, for rotation therewith, forwardly of the front panel of the mounting member, is a contact finger 64, the outer end of which is provided with a contact button 65 adapted to sequentially engage in the step-by-step manner the arcuate series of contact buttons 62.

Desirably the spacing of the contact buttons 62 corresponds to the angular displacement of the ratchet wheel 17 during each actuation by the pawl 36. As seen in Figure 4 of the drawings, the contact arm is connected to a disc element 67, of current conducting material, and the circuit may be completed between the disc element

and the particular contact 62 engaged by the contact finger 64, through means of a yieldable contact consisting of a contact finger 68 slidably mounted in a fixture 69 secured to the panel of insulating material 60. Mounted within the fixture 69, is a coil spring 70 surrounding the finger 68 and reacting against the underside of a head 71 of said finger for urging the head of said finger into contact with the disc 67. The free end of the finger 68 may be connected by a conductor wire in a portion of the electrical circuit to be controlled, and by virtue of this arrangement the contact finger 68 is in continuous circuit with the contact finger 64 for completing the particular electrical circuit including the contact button 62, engaged by the contact button 65 of the contact finger 64.

By virtue of the construction described, the ratcheting mechanism may be conveniently embodied in a relatively simple, compact form which lends itself to economical manufacture, and for embodiment in a unitary structure which lends itself to convenient manufacturing and assembly and for improved convenience in installation in the general fields of use thereof.

In the modified construction shown in Figures 6 to 9 the mounting means is of similar form to that described in Figures 1 to 5, and includes a U-shaped frame 79, and connecting bracket 80. A rotatable ratchet wheel 81 is fixedly mounted on a shaft 82 journaled in a bearing 83 secured to the front panel of the mounting member. It is to be understood that the shaft 82 may be connected to any suitable form of mechanism or apparatus to be controlled or actuated incident to the step-by-step adjustment of the ratchet wheel 81, as for example, the selective engagement of electrical contacts of various circuits as above described.

In the construction disclosed in Figures 6 to 9 I employ a pair of similar electro-magnetic relays indicated generally at C, rigidly connected to the mounting means by screws 85, and disposed in closely spaced apart relation on opposite sides of the axis of rotation of the ratchet wheel 81. Each of these relays includes an armature 86 which, as shown in the drawings, is movable in a vertical direction toward and away from a core 87 of the coil of the relay. Said armatures are each pivotally connected at their rear ends to separate field pieces indicated at 88, by lug and aperture form of hinge mounting, in a manner well understood in the art, and said armatures are urged in a direction away from the cores by means of the coil springs 90 connected to the outer ends of the armatures and to lug extensions 88a of the respective field pieces.

Mounted on each of the armatures is an actuating pawl 92, pivotally connected at 93, on a vertical axis, adjacent the hinged connection of the armature. Said pawls are in the form of bars lying flat on top of the armatures and having their forward ends bent at right angles and having portions disposed adjacent opposite sides of the toothed periphery of the ratchet wheel 81, in position to engage the teeth of said wheel in step-by-step fashion. By virtue of the pivotal connections at 93 said pawls are permitted a limited range of lateral movement relative to the armature and ratchet wheel and are guided and confined in such movement by means of bars 94 connected to the tops of the armatures, adjacent the free ends, by means of rivets 95.

Mounted on top of the armatures below the pawl 92 and also on the underside of the arma-

tures are strips 97 of non-magnetic material, such as copper, the function of which is to break up residual magnetism in the armatures so as to permit rapid and free movement of the armatures in response to pulsation of electrical current for energizing the coils of the relays.

The extreme forward portions of the pawls extend through apertured windows 98 formed in the front panel of the mounting member as seen in Figure 8, and associated with each of said windows, as seen in Figure 9, are adjustable bar-like elements 99 and 100 adjustably connected to the front panel of the mounting member by means of screws 101 for disposing the edges of said elements in over-lapping relation to the edges of the window to provide stop surfaces for the actuating pawls 92. The function of these elements is to permit minute adjustment for limiting the amount of lateral movement as well as the vertical movement of said pawls during actuation thereof and thereby obtain a nicety of adjustment for insuring proper step-by-step operation of the ratchet wheel.

The adjustment of the members 99 and 100 may be utilized for varying the stroke of the pawls for varying the angular range of rotation of the ratchet wheel upon each actuation of the pawl. In other words, the pawl may be permitted to operate in a manner for shifting the ratchet wheel a predetermined number of teeth during each actuation. The pawls are held in their upper inoperative positions by a pair of diagonally disposed coil springs 104, connected to the adjacent portions of the pawls, beyond the ratchet wheel, and to a common mounting stud 105 on the upper portion of the inner face on the front panel of the mounting member.

By virtue of the construction herein described, the respective relays C may be selectively energized by a pulsation of electrical current for effecting selective adjustment of the ratchet wheel 81 and through which adjustment of the shaft 82 is effected for controlling any desired type of mechanism or device requiring selective adjustment by remote control. In order to maintain the ratchet wheel 81 together with the shaft 82 in a desired position of adjustment I employ a check pawl comprising a lever 110 pivotally mounted at 111 adjacent the bottom of the inner face of the front panel of the mounting member as seen in Figure 8 of the drawings. Mounted intermediate the length of the lever is a freely rotatable roller 112 adapted to engage and seat between the teeth of the ratchet wheel, and connected to the outer end of the lever is a coil spring 113, the other end of which is anchored on a stud 114 on the mounting member for yieldingly maintaining the roller 112 in engagement with the teeth of the ratchet wheel 81 for releasably securing said ratchet wheel and the shaft 82 in any desired or arrested position of adjustment.

Although I have herein shown and described certain preferred embodiments of my invention, manifestly it is capable of further modification and re-arrangement of parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise forms herein disclosed, except as I may be so limited by the appended claims.

I claim as my invention:

1. For use with a step-by-step ratcheting mechanism, the combination of mounting means including an upright panel, a rotatable toothed

ratchet member mounted in close proximity and in substantially parallel relation to said panel, an electro-magnet carried on said mounting means and including a U-shaped core and a movable armature pivotally mounted on the end of one of the legs of the core on an axis extending transversely of the axis of rotation of said member so that said armature is movable into and out of engagement with the end of the other leg of said core, and an actuating pawl carried by the armature and extending in the same general direction as the axis of said member, in position to engage the teeth of said member upon actuation of the armature, said pawl being pivotally connected to the armature adjacent the pivot axis of the latter, whereby said pawl is permitted to swing laterally in a direction transverse to the direction of movement of the armature for permitting said pawl to follow and accommodate itself to the curvature of the toothed ratchet member during movement of said armature.

2. For use with a step-by-step ratcheting mechanism, the combination of mounting means including an upright panel, a rotatable toothed ratchet member mounted in close proximity and in substantially parallel relation to said panel, an electro-magnet carried on said mounting means and including a U-shaped core and a movable armature pivotally mounted on the end of one of the legs of the core on an axis extending transversely of the axis of rotation of said member so that said armature is movable into and out of engagement with the end of the other leg of said core, an actuating pawl carried by the armature and extending in the same general direction as the axis of said member, in position to engage the teeth of said member upon actuation of the armature, said pawl being pivotally connected to said armature for permitting lateral movement thereof for accommodating itself to the curvature of the toothed ratchet member during actuation of the armature, and means on the armature cooperating with the pawl for guiding said pawl during its lateral movement.

3. For use with a step-by-step ratcheting mechanism, the combination of mounting means including an upright panel, a rotatable toothed ratchet member having journal support on and disposed in close parallel relation to said panel, an electro-magnet carried on the mounting means and including an armature pivoted for movement on an axis extending transversely to the axis of said member, an actuating pawl pivotally mounted on said armature for lateral movement transversely of the movement of the armature, the outer end of said pawl extending through an apertured window in said panel, and stop means carried by the panel at said aperture for limiting the lateral and vertical movement of the pawl, a portion of said pawl being disposed in close proximity to the teeth of said member and adapted to actuate the latter in step-by-step fashion incident to the movement of the armature.

4. For use with a step-by-step ratcheting mechanism, the combination of mounting means including an upright panel, a shaft supported by said panel, a rotatable toothed ratchet member mounted on said shaft in close proximity and in substantially parallel relation to said panel, a pair of electro-magnets carried on the mounting means and each including an armature pivoted for movement about an axis extending transversely to the axis of said member, a pair of actuating pawls pivotally mounted on the respective

armatures for lateral movement transversely of the direction of movement of said armatures, said pawls extending in the direction of the axis of said member and each having portions positioned for engaging teeth of said member on opposite sides of its axis of rotation, whereby selective energization of said electro-magnets causes step-by-step adjustment of the ratchet member

for minute selective positioning of the shaft, said panel being provided with apertures through which the end portions of said actuating pawls extend, and means provided on the panels adjacent the apertures to limit the lateral and vertical movement of said pawls.

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