J. G. MITCHELL.

ELECTROMAGNETIC STEP-BY-STEP MECHANISM.

APPLICATION FILED MAY 4, 1918.

1,289,863.

Patented Dec. 31, 1918.

Fig. 1.

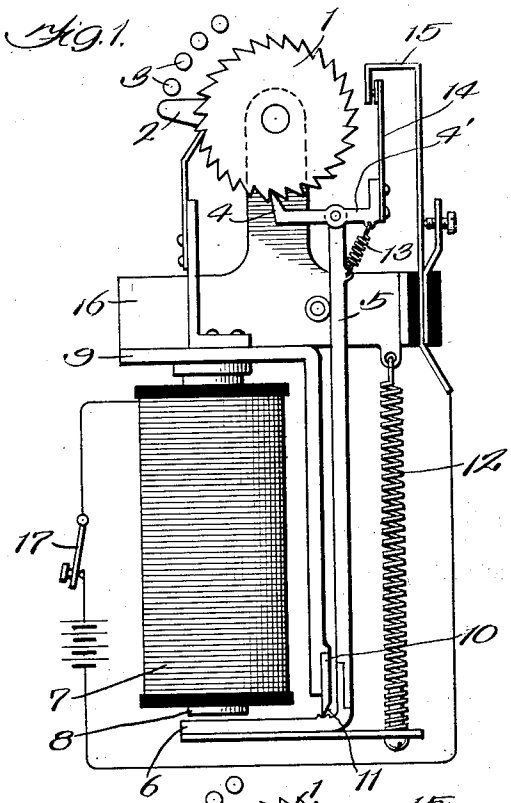


Fig. 2.

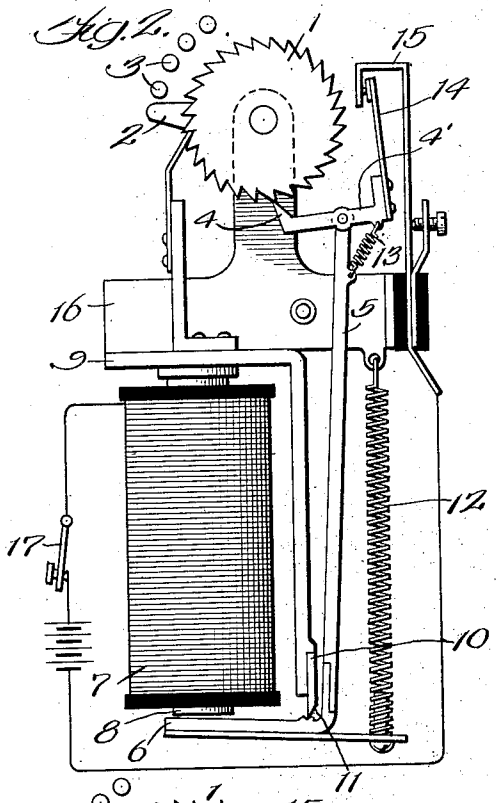


Fig. 3.

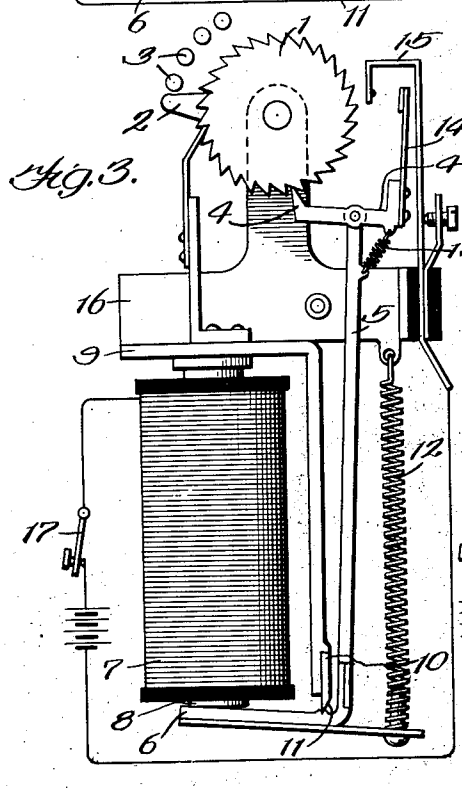
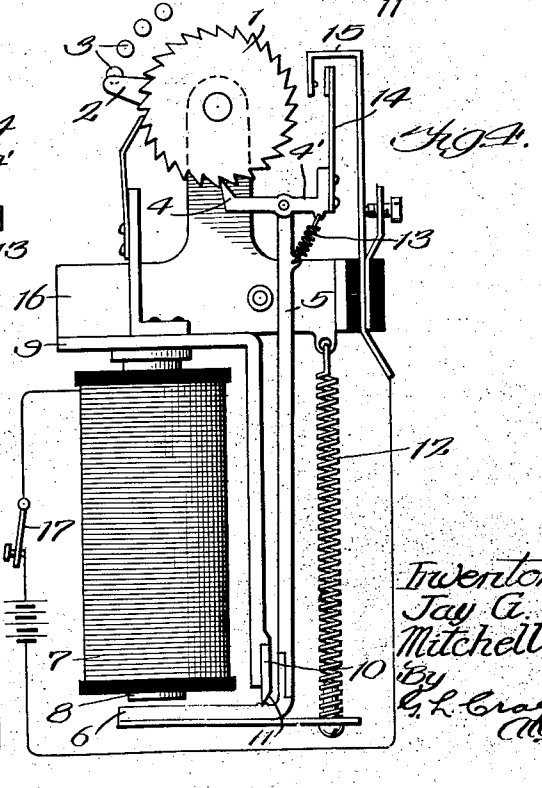


Fig. 4.



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ELECTROMAGNETIC STEP-BY-STEP MECHANISM.

1,289,863. Specification of Letters Patent. Patented Dec. 31, 1918.

Application filed May 4, 1918. Serial No. 232,474.

To all whom it may concern:

Be it known that I, JAY G. MITCHELL, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Electromagnetic Step-by-Step Mechanism, of which the following is a full, clear, concise, and exact description.

My invention relates to actuating mechanism employing a ratchet member, such as a ratchet wheel, for effecting step by step movement of an element, a circuit changing switch for example. My invention in particular relates to mechanism of the general class described employing an electromagnet and a ratchet actuating pawl moved by the magnet.

In accordance with one feature of my invention, a switch is employed in the magnet circuit that has one contact operable by the pawl to enable the pawl to open and close the switch, the teeth of the ratchet member or wheel being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet.

As I have preferably embodied my invention the ratchet actuating movement of the pawl is effected by means of a spring and the restoring movement of the pawl is effected by the magnet and when the invention is thus embodied, the construction is so designed that the teeth of the ratchet member will prevent circuit closing movement of the pawl while the pawl is being moved by the spring but when the pawl reaches the limit of its ratchet actuating movement the circuit of the magnet is closed by the pawl in order that the magnet may effect restoring movement of the pawl against the force of the spring, the influence of the magnet upon the pawl being stronger than that of the spring. When the pawl has about reached the limit of its restoring movement it drops into engagement with a fresh tooth and in so doing the pawl opens the circuit of the magnet to permit the spring to function to move the ratchet member another step. The apparatus will continue in operation to effect intermittent operation of the ratchet member as long as the circuit of the restoring magnet may be closed by the pawl each time the pawl reaches the limit of its forward movement due to the action of the spring. In order that the apparatus may be set into operation or may be arrested in its operation there is desirably another switch in the magnet circuit which should be closed when the circuit closing movement of the pawl occurs if the device is to continue in operation and which should be opened if the device is to be thrown out of action.

I will explain my invention more fully by reference to the accompanying drawing showing the preferred embodiment thereof and in which Figure 1 is a view in elevation of an apparatus constructed in accordance with my invention, the magnet circuit being diagrammatically indicated, the pawl being illustrated in this figure at the conclusion of a ratchet wheel actuating stroke; Fig. 2 is a view generally similar to Fig. 1 but showing the pawl in a partially restored position, the magnet circuit with the apparatus as illustrated in each of Figs. 1 and 2 being closed; Fig. 3 shows the apparatus with the pawl completely restored preparatory to a fresh operation, the magnet circuit being now opened; and Fig. 4 illustrates the pawl partially advanced toward the foremost position thereof illustrated in Fig. 1, the switch governed by the pawl remaining open until the pawl reaches the foremost position illustrated in Fig. 1.

Like parts are indicated by similar characters of reference throughout the different figures.

The ratchet member illustrated is in the form of a ratchet wheel 1 but the invention is not to be thus limited. In the embodiment of the invention illustrated a wiper 2 is shown in conjunction with the ratchet wheel which serves to move the wiper step by step over waiting contacts 3 of an electro-magnetic step by step operating switch and while the invention is of particular service in operating such a switch it is not to be limited to this purpose. The ratchet wheel is turned in a clockwise direction by means of a pawl 4 pivotally mounted upon the upper end of a lever 5 by means of which lever the pawl is bodily moved forwardly and reversely. This lever is fixedly secured to the armature 6 of an electro-magnet 7. The core 8 of the magnet carries a yoke 9 of magnetic material that takes part in defining the magnetic circuit. The lower end of the yoke 9 carries a blade 10 that furnishes a pivoting knife edge 11 upon which the lever 5 and the armature 6, as an integral unit, are pivotally mounted. A

pawl actuating spring 12 turns the armature-lever unit 5—6 in a counter-clockwise direction in moving the pawl forward to turn the ratchet wheel one tooth. As illustrated, the pawl is maintained in engagement with the ratchet wheel by means of a spring 13 that is interposed between the lever 5 and the tail 4^1 of the pawl, the place where the pawl is pivotally mounted upon the lever being between the ratchet wheel engaging nose of the pawl and the tail of the pawl. The magnet 7 acts in opposition to the spring 12, serving to turn the armature-lever unit 5—6 in a clockwise direction upon the conclusion of each forward movement of the pawl in order to restore the pawl to its initial or starting position illustrated in Fig. 3. In order that the magnet may automatically be caused to function, the tail of the pawl carries one contact 14 of a switch which is serially included in the circuit of the magnet, the complemental contact 15 being stationarily mounted upon a frame piece 16 of the apparatus. Due to the formation of the teeth of the ratchet wheel, circuit opening movement of the pawl is prevented while the pawl is being moved by the magnet from the position illustrated in Fig. 1 nearly to the position illustrated in Fig. 3 in order that the pawl may be engaged with a fresh ratchet tooth, the teeth permitting circuit opening movement of the pawl when the pawl drops into engagement with a fresh tooth as illustrated in Fig. 3 and also permitting the maintenance of the circuit opening adjustment of the pawl during the ensuing bodily movement thereof effected by the spring from the position illustrated in Fig. 3 nearly to that illustrated in Fig. 1. Some master switch is in the circuit of the magnet to control the time or duration of operation of the apparatus, such a master switch being diagrammatically illustrated at 17.

By the apparatus of my invention the magnet does not interfere with the pawl actuating function of the spring and the spring does not interfere with the operation of the magnet whereby each of these agencies is enabled to perform its own function in its own period of time whereby faulty operation is prevented. Where a spring is employed to actuate the pawl the pawl actuating impulses are uniform, a result which would not be assured if the pawl were actuated by a magnet whose degree or strength of energization varies. Where a magnet is employed for restoring the pawl it should be strong enough to overcome the force of the pawl actuating spring but it is not essential that the energizations of the magnet should be uniform since the function of the magnet is merely to restore the pawl and not to actuate it.

While I have herein shown and particularly described the preferred embodiment of my invention I do not wish to be limited to the precise details of construction shown as changes may readily be made without departing from the spirit of my invention, but having thus described my invention I claim as new and desire to secure by Letters Patent the following:—

1. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a lever upon which said pawl is pivotally mounted; a spring in operative connection with said lever to turn it and thereby effect bodily movement of the pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said lever is moved by its actuating spring; a magnet whose armature is also in operative connection with said lever and acting in opposition to the spring to effect reverse bodily movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet to engage a fresh ratchet tooth and permitting circuit opening movement of such pawl when the pawl drops into engagement with a fresh tooth and also permitting the maintenance of the circuit opening adjustment of the pawl during the ensuing bodily movement thereof effected by the spring.

2. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a lever upon which said pawl is pivotally mounted; a spring in operative connection with said lever to turn it and thereby effect bodily movement of the pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said lever is moved by its actuating spring; a magnet whose armature is also in operative connection with said lever and acting in opposition to the spring to effect reverse bodily movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet to engage a fresh ratchet tooth.

3. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a lever upon which said pawl is pivotally mounted; a spring in operative connection with said lever to turn it and thereby effect bodily movement of the

pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said lever is moved by its actuating spring; a magnet whose armature is also in operative connection with said lever and acting in opposition to the spring to effect reverse bodily movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to permit circuit opening movement of the pawl when the pawl drops into engagement with a fresh tooth and also permitting the maintenance of the circuit opening adjustment of the pawl during an ensuing bodily movement thereof effected by the spring.

4. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a lever upon which said pawl is pivotally mounted; a magnet whose armature is in operative connection with said lever to effect bodily movement of the pawl; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet.

5. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a lever upon which said pawl is pivotally mounted; means for effecting bodily movement of the lever in a direction to cause the pawl to move the ratchet member; a magnet whose armature is in operative connection with said lever to effect reverse bodily movement of the pawl to bring the pawl into engagement with a new ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet and permitting circuit opening movement of such pawl when the pawl drops into engagement with a fresh tooth.

6. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a spring in operative connection with said pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said pawl is moved by its actuating spring; a magnet whose armature is also in operative connection with said pawl and acting in opposition to the spring to effect reverse movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet to engage a fresh ratchet tooth and permitting circuit opening movement of such pawl when the pawl drops into engagement with a fresh tooth and also permitting the maintenance of the circuit opening adjustment of the pawl during the ensuing movement thereof effected by the spring.

7. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a spring in operative connection with said pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said pawl is moved by its actuating spring; a magnet whose armature is also in operative connection with said pawl and acting in opposition to the spring to effect reverse movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet to engage a fresh ratchet tooth.

8. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a spring in operative connection with said pawl, the pawl and ratchet member being so related that the ratchet member is turned a step when said pawl is moved by its actuating spring; a magnet whose armature is also in operative connection with said pawl and acting in opposition to the spring to effect reverse movement of the pawl to position the pawl to engage another ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to permit circuit opening movement of the pawl when the pawl drops into engagement with a fresh tooth and also permitting the maintenance of the circuit opening adjustment of the pawl during an ensuing movement thereof effected by the spring.

9. The combination with a ratchet member; of a pawl in actuating relation to the ratchet member; a magnet whose armature is in operative connection with said pawl to effect movement of the pawl; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet.

10. The combination with a ratchet member; of a pawl in actuating relation to the

ratchet member; means for effecting movement of the pawl in a direction to cause the pawl to move the ratchet member; a magnet whose armature is in operative connection with said pawl to effect reverse movement of the pawl to bring the pawl into engagement with a new ratchet tooth; and a switch in the magnet circuit having one contact operable by said pawl to enable the pawl to open and close the switch, the teeth of the ratchet member being formed to prevent circuit opening movement of the pawl while the pawl is being moved by the magnet and permitting circuit opening movement of such pawl when the pawl drops into engagement with a fresh tooth.

In witness whereof, I hereunto subscribe my name this 29th day of April, A. D., 1918.

JAY G. MITCHELL.