June 19, 1945. C. AMBRUSTER 2,378,676

MECHANISM FOR PRODUCING MECHANICAL MOVEMENT

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Fig. 1.

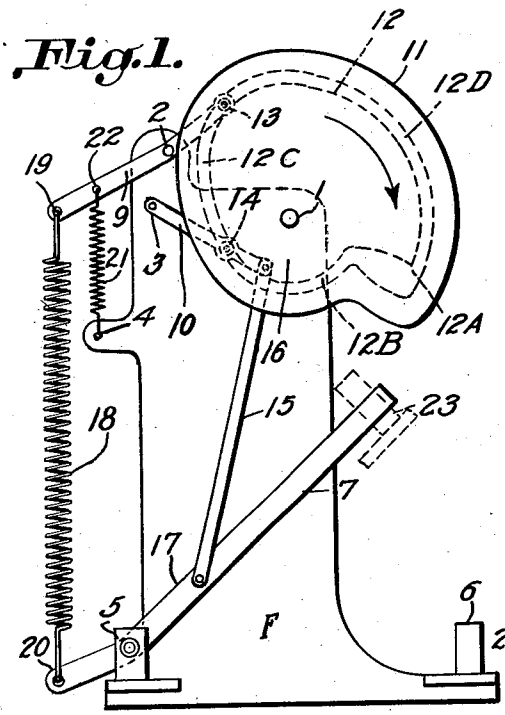


Fig. 2.

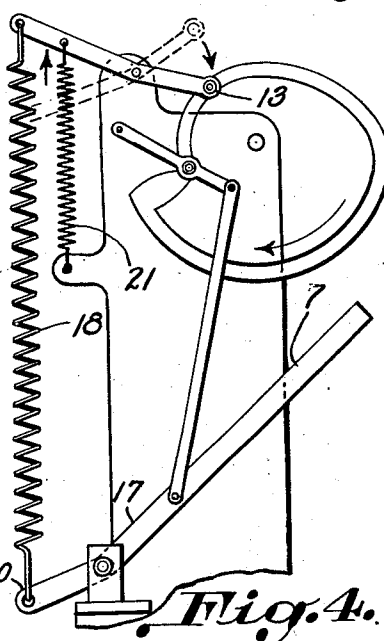


Fig. 4.

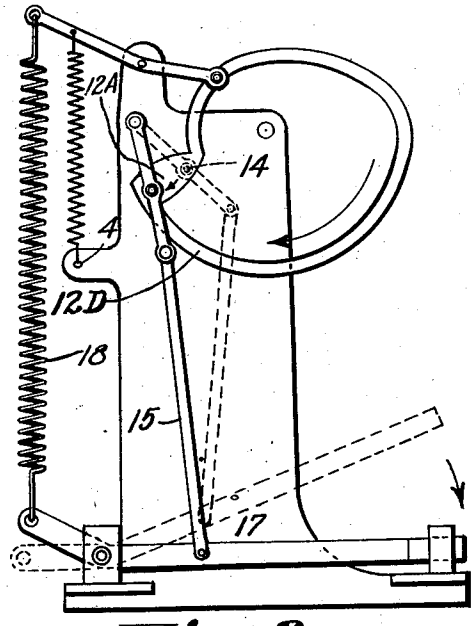
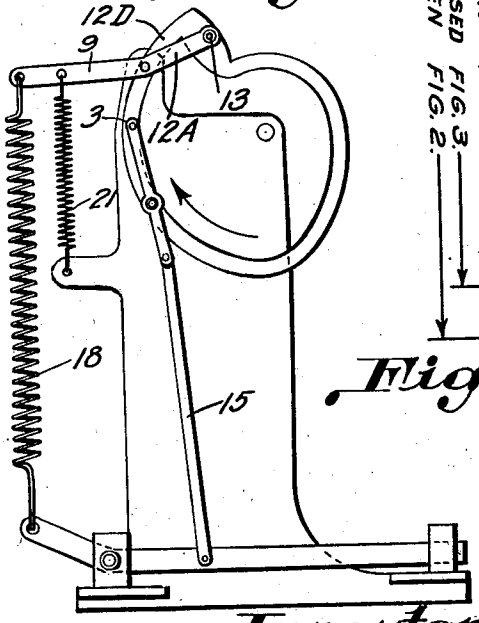


Fig. 3.



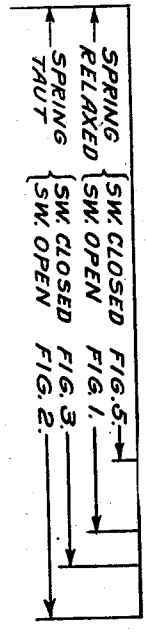


Fig. 9.

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Fig. 5.

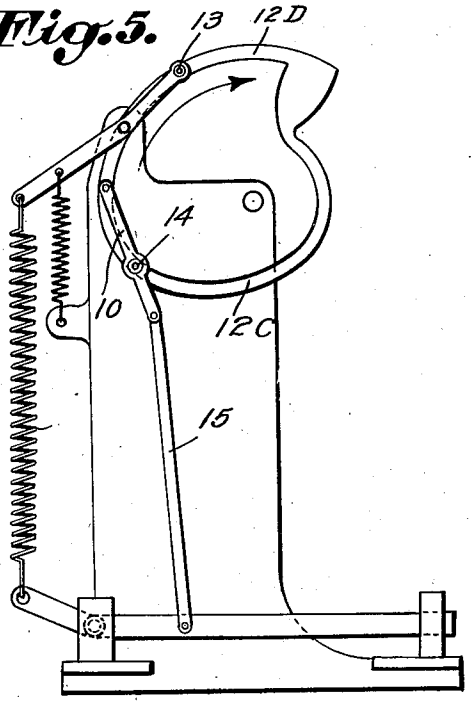
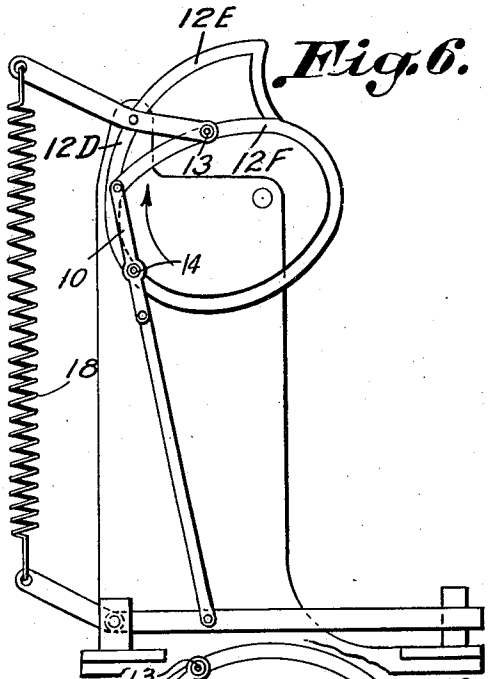


Fig. 6.



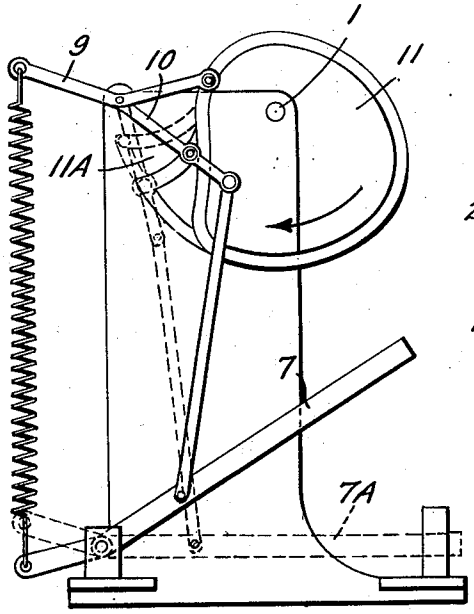


Fig. 7.

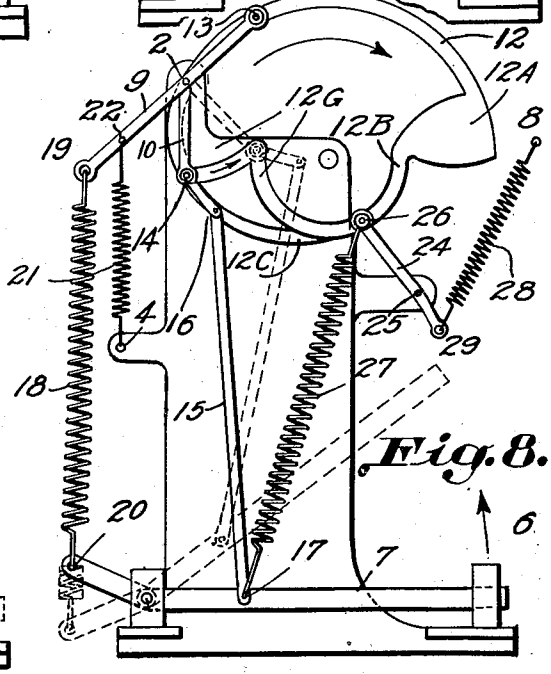


Fig. 8.

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UNITED STATES PATENT OFFICE

2,378,676

MECHANISM FOR PRODUCING MECHANICAL MOVEMENT

Cornelius Ambruster, Roslyn, Pa.

Application March 7, 1941, Serial No. 382,182

8 Claims. (Cl. 74—54)

This invention relates to a mechanism for producing mechanical movement and more particularly to a mechanism for actuating members with a snap action and has for its primary object the provision of a mechanism which is durable, strong, positive acting and capable of operating effectively after long periods of nonuse.

While not limited thereto, my improved mechanism is particularly suitable for actuating the contact elements of electrical switches or circuit breakers. It is well known to provide such switches with springs in order to achieve rapid motion of the switch blade during either opening or closing of the switch. In accordance with my invention, means are provided for controlling the action of the switch blade and its actuating spring, and for relaxing the spring after it has performed its function so as to remove all stresses from both the spring and the remainder of the mechanism while the switch blade is in a static position. Included in my improved mechanism are simplified means for locking the switch in position after each movement thereof.

It is a specific object of this invention to provide an improved spring actuated mechanism having a sequence of operation controlled by a cam, the sequence being such that after actuation of the mechanism by the spring, the spring is completely relaxed until it is called upon to reactuate the mechanism.

Additional objects and advantages of my invention will appear as the following description proceeds and the features of novelty which characterize my invention will be set forth in the claims appended to and forming part of this specification.

For a more complete understanding of my invention reference should be had to the following description read in connection with the accompanying drawings in which:

Figure 1 is a view showing the operative elements of an embodiment of my invention the position of the cam operator corresponding to the switch open and spring relaxed;

Figure 2 is a partially schematic view showing the relative position of the operative elements shown in Figure 1 the illustration of the cam being wholly schematic and consisting of only the locus of the cam groove, the position shown corresponding to the switch open and spring taut;

Figure 3 is a view similar to Figure 2 in the third position of the cam operator corresponding to the switch closed and spring taut;

Figure 4 is a view similar to Figure 2 in the fourth position of the cam operator corresponding to the switch closed and the spring relaxed;

Figure 5 is a view similar to Figure 2 in the fifth position of the cam corresponding to the switch closed and locked and the spring relaxed;

Figure 6 is a view of a modified embodiment of my invention, the modification relating particularly to the cam operator which is illustrated schematically by showing the locus of the cam grooves only;

Figure 7 is a view of a second modification showing two schematically illustrated cam operators for actuating a double pole switch in sequence, one portion of the double pole switch being shown in full lines and the other being shown in dotted lines;

Figure 8 is a view of a third modified embodiment of my invention with the cam schematically illustrated adapted to accomplish both opening and closing movements in accordance with my invention, various positions of the operative elements being shown in full and dotted lines;

Figure 9 is a table showing the relative extension of the spring element of the mechanism when in the positions indicated in Figures 1, 2, 3 and 5.

Throughout the drawings like reference numerals have been used for like operative elements. Referring to Figure 1, the points 1, 2, 3, 4 and 5 are fixed in positional relation to each other, the parts there located being attached to the framework F of the mechanism. 7 is a switch blade pivoted and moving about the center 5. 6 is the clip of the switch and when the blade 7 contacts it the switch is closed. 9 is a bell crank and 10 a lever pivoted and turning about the centers 2 and 3 respectively. 11 is a cam overlying the bell crank 9 and lever 10, rotating about the center 1, which may be a shaft for driving the cam. On the under side of cam 11 is a groove or channel 12—*a*, *b*, *c*, *d*. 13 and 14 are pins, which may be equipped with rollers, which are attached to and extend upwards from the bell crank 9 and lever 10 respectively, and enter the channel 12 in the cam. 15 is a link attached to the lever 10 at 16 and the switch blade 7 at 17. 18 is a tension spring attached to bell crank 9 at 19 and to switch blade extension at 20. 21 is an auxiliary tension spring attached to bell crank 9 at 22 and to framework at 4. The channel 12 in the cam consists of 4 sections, 12—*a* is a radial sector, the next section to the left, 12—*b*, is an arc of minimum radius, next follows a spiral arc, 12—*c*, the radius increasing to a maximum, which radius is then maintained through 12—*d* to 12—*a*. The pivoted centers 2 and 3 are located near the line of the arc of maximum radius. See Fig. 4. Fig. 1 shows the pin 14 at the minimum radius with the switch open and pin 13 at the maximum radius with the spring 18 relaxed. This is one of the two static positions of the mechanism. Figs. 2, 3, 4 and 5 show other positions, 2, 3 and 4 occurring during the rotation

of the cam, 5 being the other static position when the switch is closed and the spring 18 relaxed.

In all the figures except Fig. 1 the body of the cam is omitted for the sake of clearness, the channel only being indicated. The cam 11 is rotated clockwise as indicated by curved arrow. In Figures 4, 5, 6 and 8, the pivot centers and the link attachment pins appear to be in the channel of the cam. Actually as shown in Figure 1 the levers 15 and 10 overlie the frame by which the pivot centers are supported and the cam overlies the levers; the rollers extending outwards and into the adjacent cam channel.

In Fig. 2 the cam has rotated sufficiently to move the pin 13 from the maximum radius to the minimum radius, putting the spring 18 under tension.

In Fig. 3 the cam has rotated further and allows pin 14 to enter the radial sector 12—*a*. The spring 18 immediately closes the switch as the pin 14 snaps from the minimum to the maximum radius, the cam continues to rotate and the pin 14 enters the arc 12—*d*. As the pin 14 travels in the channel the switch is always locked in position through the connecting link 15. In Fig. 4 the cam has rotated to allow pin 13 to enter radial sector 12—*a* and the pin snaps from the minimum to maximum radius, relaxing the spring. Since the spring 18 is completely relaxed when bell crank 9 is in this position, the light auxiliary spring 21 is required to insure complete movement of 13 through 12—*a* to 12—*d*. As rotation of cam continues, pin 13 enters 12—*d* and in Fig. 5 mechanism reaches second static position with switch closed and locked and spring 18 relaxed. As cam next rotates from position Fig. 5 to position Fig. 1 pin 14 travels the spiral arc 12—*c* raising the lever 10 which in turn opens the switch through the link 15.

Fig. 9 shows relative extension of spring 18 between points 19 and 20 in the various positions shown. Note that in static positions, Figs. 1 and 5, spring 18 is relaxed and in motive positions, 2 and 3, spring is taut.

It is apparent several variations embodying the same general principles are possible. For instance, the clip of the switch could be located at 23, as shown in dotted lines in Figure 1. Then the spring would open the switch and it would be closed by the positive action of the cam instead of vice-versa. Or, the channel 12—*e* Fig. 6 could be shallower than the balance of the channel in the cam and the deeper channel carried along the path 12—*f*, then the pin 14 being no longer than the depth of the shallow channel the switch connecting member 10 would be released as previously described, but the pin 13 being longer would perforce follow the path 12—*f* to the maximum arc 12—*d*, the spring 18 would thus be positively relaxed as the cam rotated and the auxiliary spring 21 (Fig. 1), would be unnecessary.

If the cam were appropriately shaped and the other parts suitably rearranged the motion of the pins 13 and 14 under the influence of the springs could be towards the center of the cam instead of away from it as previously described, but the same results would be accomplished.

The spring 18 as shown is an extension spring. By shifting the spring connection points 19 and 20 to the other side of the centers of motion 2 and 5, a compression spring could be used.

In the case of a multiple switch it might be desirable to close or open the blades in sequence instead of simultaneously. Fig. 7 shows a two pole switch. Two cams are shown mounted on and revolved by the shaft 1. In cam 11—*a*, shown dotted, the radial sector is ahead of corresponding sector in cam 11, consequently switch blade 7—*a* closes first and blade 7 follows, as cam 11 later releases pin 14 as shown. The springs can later be relaxed and the blades opened, simultaneously or in sequence, as desired, by appropriately shaping the cams.

Fig. 8 shows the mechanism arranged to both open and close the switch by spring action, the springs being relaxed after they have functioned. The bell crank 9 and the lever 10 are both pivoted at 2. Through the spring 18 and the link 15 they function as previously described to close the switch as the pins 13 and 14 are positioned by the channel 12 in the rotating cam. 12—*g* is an additional channel in the cam, spanning the same sector as 12—*c*. 12—*c* is shallower than the balance of the channel. Pin 13 is of such length that it can follow 12—*c*, but the pin 14 is longer and must follow 12—*g*. There is a lever 24 pivoted at 25 carrying a pin 26 of the same length as 13 so it also follows 12—*c*. A tension spring 27 is attached to this lever at 26 and to the switch blade at 17. The light auxiliary spring 28 functions the same as spring 21. In Fig. 8 the pin 26 has just traversed the spiral arc 12—*c* to the arc of minimum radius 12—*b* so the spring 27 is taut. When the pin 14 reaches the radial opening of the channel 12—*g* the pin 14 snaps through this channel as shown by the dotted lines as the spring 27 opens the switch. The cam continues to rotate until the radial channel 12—*a* arrives at pin 26 and the pin snaps through to the maximum radius, relaxing the spring 27. The switch is now open with springs 18 and 27 both relaxed, the pin 14 having meanwhile traversed the channel 12—*g*.

It is apparent that this combination mechanism might be used for other purposes than for moving a switch blade where similar results are desirable.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A mechanism comprising a pivoted member, a spring for effecting snap action movement of said member, and cam means for controlling the movement of said member under the influence of said spring, said cam means including a spiral arc surface terminating in a substantially right angled surface spanning the differences between the maximum and minimum radii of the said arc for stressing said spring prior to actuation of said member and for completely relaxing said spring after actuation of said member so that said spring is stressed only when required to produce snap action movement of said member.

2. A mechanism comprising a pivoted member, a spring having one end attached to one end of said pivoted member, a second pivoted member connected at one end to the opposite end of said spring, a cam rotatable about a center, cam surface on said cam having portions of differing radii terminating in a substantially radial surface spanning the difference between maximum and minimum radii of said portions, means on the free end of said first mentioned pivoted member engaging said cam surface, means on said second mentioned pivoted member engaging said cam surface, said last mentioned two means being positioned on said cam with reference to said radial surface so that as said cam rotates through a complete revolution said spring is stressed by actuation of said second pivoted member, said first

pivoted member is released through engagement of said first mentioned means with said radial surface and moved under the influence of said spring, and said second pivoted member is released through engagement of said second mentioned means with said radial surface and said spring is completely relaxed.

3. A mechanism comprising a pivoted member, movable between an upper and lower position, a pair of springs attached to said member, one of said springs acting to cause snap action movement of said member from its upper to its lower position, the other of said springs causing snap action movement of said member from its lower to its upper position, a rotatable cam, for controlling the movement of said pivoted member under the influence of said springs, a pair of radial surfaces on said cam and cam followers adapted to successively engage said surfaces and connected to said springs to cause said springs to be relaxed immediately following each actuation of the pivoted member upon rotation of said cam.

4. A mechanism comprising a first pivoted member movable between a first and second position, a second pivoted member spaced from said first member, a spring connected at its ends to said pivoted members, a rotatable cam having a cam surface provided with a radial portion, a pair of cam followers tracking on said cam surface, a linkage connecting one of said cam followers to said first mentioned pivoted member, means connecting the other of said cam followers to said second mentioned pivoted member, said cam followers being positioned relative to said cam surface so that upon rotation of said cam said follower connected to said linkage first enters said radial portion of said cam surface to cause said first pivoted member to be moved from said first position to said second position under the influence of said spring, and upon further movement of said cam said follower connected to second pivoted member enters said radial portion to cause relaxing of said spring.

5. A mechanism comprising a pivoted member, a rotatable cam, a linkage connected to said pivoted member on one side of its pivot point and having a cam follower engaging said cam to control the movement of said pivoted member between an upper and lower position in accordance with the rotation of said cam, a spring connected to said pivoted member on the opposite side of its pivot point so as to move said member in one direction with a snap action, a pivoted lever connected to the opposite end of said spring and having a cam follower engaging said cam to control the stressing and relaxing of said spring in accordance with the rotation of said cam, said cam having a surface on which said cam followers track such that as said cam revolves through a complete revolution said spring is stressed, said pivoted member is moved to one position with a snap action under the influence of said spring, said spring is relaxed, and said pivoted member is moved to its opposite position slowly.

6. A mechanism for effecting circuit connections comprising a pivoted member movable between an upper and a lower position and adapted to close a circuit in one of said positions, a rotatable cam having an annular groove forming a cam surface, said groove having a portion of constant radius, a portion of varying radius and a radial portion, a linkage having one end connected to said pivoted member and having a pin at its opposite end tracking in said groove to control the movement of said member between said two positions upon the actuation of said cam, a spring connected at one end of said pivoted member to effect snap action movement thereof in the circuit closing direction, a pivoted lever having one end connected to the opposite end of said spring, a pin at the opposite end of said lever tracking in said groove ahead of said first mentioned pin in the direction of movement of said cam, whereby upon one complete revolution of said cam said pins track in said portions of said groove so as to successively cause said pivoted member to be locked in one position with said spring relaxed, said spring to be stressed, said pivoted member to be moved to its opposite position with a snap action under the influence of the energy stored in said spring, said member to be locked in said last mentioned position, said spring to be relaxed, and said member to be moved from its opposite position to its first position and locked in said position.

7. A mechanism comprising a pivoted member adapted to close an electrical circuit, a spring attached to said pivoted member to effect rapid movement thereof in a circuit closing direction, a cam having a cam surface consisting of portions of constant and varying radii in successive arcs and a radial portion, a pair of cam followers tracking on said cam surface, means for connecting one of said cam followers to said pivoted member to cause movement thereof in accordance with the rotation of said cam, pivoted means connecting the other of said cam followers to the free end of said spring so as to cause stressing and relaxing of said spring in accordance with movement of said cam, said cam followers tracking on said cam surface so that they successively enter said radial portion of said cam surface, said cam follower connected to said pivoted member first entering into said radial portion to cause said pivoted member to move to its circuit closing position quickly under the influence of said spring, and said other cam follower subsequently entering said radial portion to cause said spring to be relaxed whereby all stresses are removed from said mechanism after actuation of said pivoted member to said circuit closing position.

8. A mechanism comprising a cam arranged to rotate about a center surfaced by a spiral arc about said center terminating in a substantially right-angled surface spanning the difference between the maximum and minimum radii of the said arc, a pivoted member having an attached spring, one end of said pivoted member engaging said cam as it is rotated, said end engaging the spiral surface to tighten said spring and the right angled surface to relax said spring, a second pivoted member attached to the other end of said spring, means on said second pivoted member engaging said cam to control the movement of said second pivoted member, whereby, as said cam is rotated: said end of said first pivoted member is engaged by said spiral cam surface to tighten said spring; said controlling means on said second pivoted member is engaged by said right angled cam surface to release said second pivoted member for movement under the influence of said tightened spring; and said end of said first pivoted member is engaged by said right angled cam surface to restore said first pivoted member to its initial position relaxing said spring.

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