

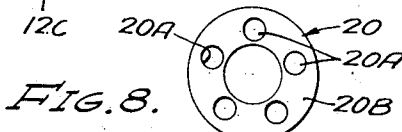
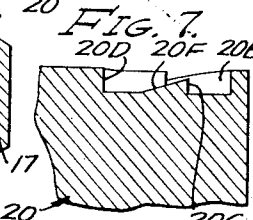
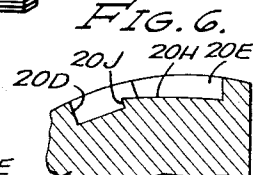
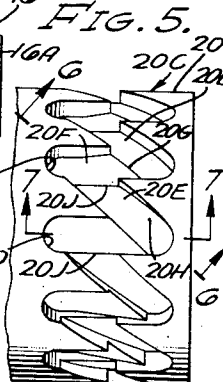
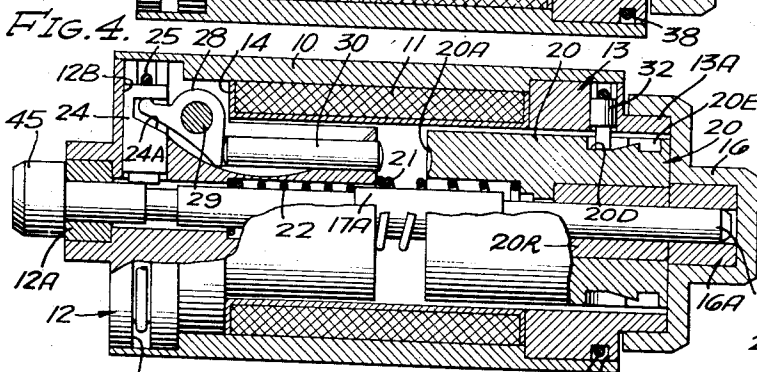
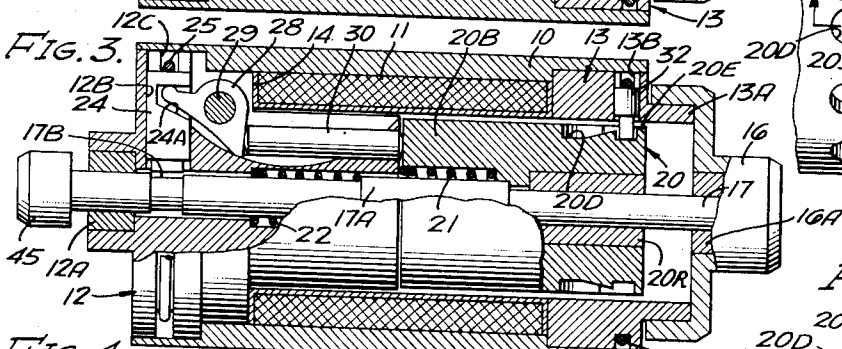
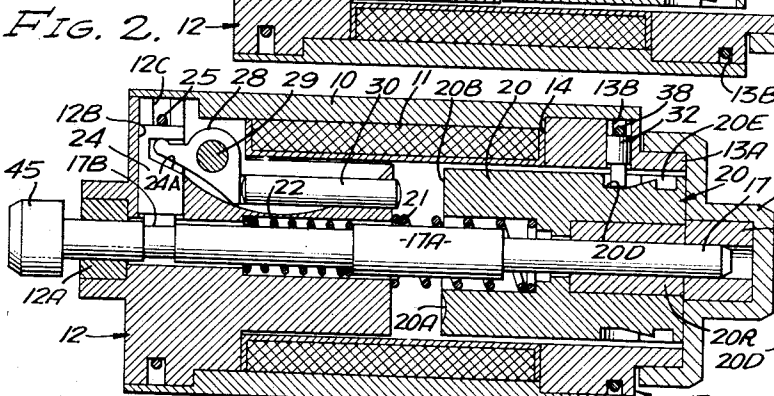
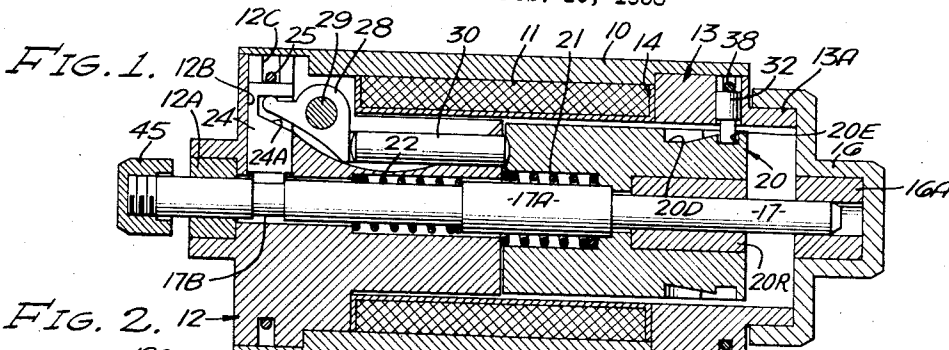
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2,887,883

SOLENOID CONSTRUCTION

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SOLENOID CONSTRUCTION

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12 Claims. (Cl. 74—2)

The present invention relates to an improved solenoid construction and particularly one which incorporates a latching mechanism for maintaining an actuated element of the solenoid in an actuated position.

Briefly, the present arrangement involves a solenoid having a coil, a plunger and an actuating rod, the latter two elements being moved to an attracted position when the coil is energized. The coil is preferably energized with current pulses, there being a first pulse for moving the rod to an actuated position and a second succeeding pulse for causing the rod to move back to its unactuated position. Upon application of the first or actuating current pulse, a latching mechanism serves to latch the rod in an actuated position. Such latching mechanism is released by the plunger which is suitably indexed to different positions for this purpose.

It is, therefore, an object of the present invention to provide an improved solenoid construction which includes an operable member that may be moved to operative and inoperative positions, using current pulses which flow for a short period of time.

Another object of the present invention is to provide an improved solenoid construction in which the coil may be of small size since current for operating the same flows for a relatively short period of time, and in the nature of a current pulse.

Another object of the present invention is to provide an improved solenoid incorporating a new latching and unlatching mechanism arranged so that the solenoid is relatively small, considering the functions performed.

Another object of the present invention is to provide an improved solenoid construction which incorporates a magnetizable plunger that is indexed to different positions upon successive energizations of the coil for purposes of operating a latching mechanism.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 illustrates a solenoid construction embodying features of the present invention and as shown therein, the coil is energized and the actuating rod is held in latched position.

Figures 2, 3 and 4 show successively different operating positions of the solenoid illustrated in Figure 1.

Figure 2 shows the solenoid after the condition shown in Figure 1 has been achieved and the original energizing current pulse interrupted.

Figure 3 illustrates the manner in which the actuating rod is unlatched, upon application of the deactuating current pulse.

Figure 4 shows the solenoid after the deactuating current pulse has been interrupted.

Figure 5 is a perspective view showing the groove structure of the plunger.

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Figures 6 and 7 are sectional views taken respectively on the lines 6—6 and 7—7 in Figure 5.

Figure 8 is a plan view of the front end of the plunger illustrated in the previous views.

The solenoid includes a steel cylindrical jacket 10 which snugly receives and houses the coil 11. A pair of steel end members 12 and 13 are secured in opposite ends of the jacket 10 in abutting engagement with opposite ends of the coil form 14. These end members 12 and 13 are of special construction, as described later. An end bell 16, in the nature of a cover is secured on the annular flange 13A of member 13 and has a bearing 16A therein for slidably receiving one end of the push rod 17. Such push rod 17 is slidable, not only in bearing 16A but also in bearing 12A in member 12.

A specially constructed steel plunger 20 is slidably mounted on the push rod 17, the bearing 20R on plunger 20 serving that purpose.

The plunger 20 is biased to the right in the various figures by a prestressed coil compression spring 21, having one of its ends bearing against an inner annular shoulder on plunger 20 and having its other end bearing against the stationary end member 12.

The push rod 17 is also biased to the right but by a different prestressed coil compression spring 22 having one of its ends bearing against an inner flanged portion of stationary end member 12 and having the other one of its ends bearing against the enlarged portion 17A of push rod 17.

The rod 17 is formed with an annular grooved portion 17B which is a locking groove that cooperates with the lower reduced portion of latch member or key 24, slidably mounted in a radial slot 12B in end member 12. This latch member 24 is pressed inwardly toward the groove 17B by a circular prestressed spring 25 which is retained in the annular grooved portion 12C in the end member 12.

The latch member 24 may be raised by a lever 28, in the form of a bell crank, which is pivoted about the axis of pivot pin 29 which has its ends secured in spaced portions of the stationary end member 12. One end of the bell crank 28 extends into a notched portion 24A of key 24 and the other end of the crank 28 is positioned for engagement with one end of the latch actuating pin 30 which is slidably mounted in a generally cylindrical portion of the stationary end member 12 in such a manner that such other end of pin protrudes from the end member and may be engaged by selected portions of the plunger 20, under certain conditions explained later, when the coil 11 is energized.

The plunger 20 has a pin actuating face which is shown in Figure 8 and as seen therein, such face has a series of indentations or clearance dimples 20A separated by flat portions 20B which serve successively to engage and move the pin 30 to unlatch or unlock the push rod, 17.

The plunger 20 is successively rotated to different indexed positions after the coil 11 is energized and then deenergized using a cam groove structure 20C therein which is more clearly illustrated in Figures 5, 6 and 7 and which cooperates with the spring biased pin 32 shown in Figure 1.

The cam pin 32 is slidably mounted in a cylindrical radial extending opening through the stationary end member 13 and has its lower reduced end portion disposed in the cam groove 20C and biased in such cam groove by the prestressed circular spring 38 which is retained in the annular groove 13B.

The cam groove structure 20C includes a series of longitudinally or axially extending grooved portions 20D that are in communication at their forward and rear ends with different angularly disposed or skewed grooved portions 20E in a generally zigzag pattern as shown.

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Each of such grooved portions 20D, as shown in Figure 7, has a rearwardly extending rising portion 20F that terminates at a wall 20G of the adjacent groove 20E. Also, as seen in Figure 6, each angular or skewed groove 20E has a continuous portion or base 20H that extends forwardly at an angle and rises in that direction with respect to the center of the generally cylindrical plunger 20; and such base 20H terminates at the wall 20J of the adjacent groove 20D.

Using this construction and the energy stored in the plunger spring 21, the plunger 20 is successively indexed during the return movement of the plunger 20; i.e., after the coil 11 is deenergized.

Thus, under the conditions shown in Figure 1, the cam pin 32 is in the cam groove 20E and behind the wall 20G so that subsequently when the coil 11 is deenergized and the plunger 20 is returned by spring 21, the cam pin 32, due to its engagement with the wall 20G, causes the plunger 20 to not return to the right to its position shown in Figure 2 but also causes the plunger 20 to rotate about its own axis until the pin 32 is in the next longitudinally straight groove 20D.

The operation of the latchable solenoid construction is now described. It is understood that this solenoid may be used in all applications in which solenoids have heretofore been used, for example, in actuating switches, valves and like devices and a portion of such device is represented by the member 45 threaded on the rod 17.

The coil 11 is intended to be energized by current pulses, the first current pulse serves to move the rod to its actuated position shown in Figure 1 and to cause the rod to be latched in its actuated position, also shown in Figure 1. The next current pulse applied to coil 11 serves to unlatch the rod 17 and to cause the rod to return to its unactuated position shown in Figure 4.

Just prior to the application of the first or actuating current pulse to coil 11, the solenoid is in the condition shown in Figure 4 wherein the pin 32 is in the longitudinally straight groove 20D and correspondingly one of the plunger indentations or clearance dimples 20A is aligned with the pin 30. This current pulse causes the plunger 20 to move without turning to its attracted position shown in Figure 1 and without moving pin 30 any appreciable distance. This means that the bell crank 28 is not appreciably disturbed and the latch 24 is free to move into the annular rod groove 17 when and as such rod 17 is also moved to the left. Thus the rod 17 becomes latched in its actuated position shown in Figure 1 and also the pin 32 is now in the angular or skewed groove 20E behind the groove wall 20C. It is noted that the actuating rod is fabricated of nonmagnetizable material and is actuated mechanically by lateral motion of the plunger.

Upon the termination of such current actuating pulse, the spring 21 returns the plunger 20 to its position shown in Figure 2, the rod 17 remaining in latched actuated position. The spring 21 not only causes the plunger 20 to move to the right but also causes it to rotate about its axis due to the engagement of the pin 32 in the skewed or angular groove 20E until the next flat portion 20B is aligned with the axis of pin 30 and such pin 32 enters the next longitudinal straight groove 20D as shown in Figure 2. Thus, just prior to the next or deactuating current pulse, the solenoid is latched and indexed as shown in Figure 2.

Upon application of the deactuating current pulse, the plunger 20 is moved to its attracted position, without turning as shown in Figure 3, since the pin 32 moves in a longitudinal straight groove 20D and consequently, the flat portion 20B engages and moves the pin 30 to, in turn, pivot the crank member 28 and raise the latch 24 out of the rod groove 17B to thereby cause the rod 17 to move to its deactuated position (shown in Figure 4) under the influence of rod spring 22. Near the end of the stroke of plunger 20, the pin 32 enters the skewed

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groove 20E as shown in Figure 3 to thereby condition the plunger 20 for subsequent turning when the deactuating current pulse is interrupted. When such current pulse is interrupted, the grooved portion 17B is moved out of registry with the latch 24 before the latch 24 is free to move into latching position and consequently, the rod 17 moves to its position shown in Figure 4 under the influence of rod spring 22 and at substantially the same time, the plunger 20 is moved to the right while being turned, all under the influence of plunger spring 21 to index the plunger 20 so that, as shown in Figure 4, the next succeeding indentation 20A is aligned with the axis of pin 30.

While the particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. In a solenoid construction of the character described, a coil, an actuating rod, a plunger, first means biasing said rod in a non-actuated position, second means biasing said plunger in a non-actuated position, said plunger being moved to an attracted position upon energization of said coil against the action of said first and second means respectively, latching means automatically effective to latch said rod in actuated position, and means operated by said plunger for operating said latching means to unlatch said rod.

2. In a solenoid construction of the character described, a coil, an actuating rod, a plunger, said plunger and rod both being moved to an attracted position upon energization of said coil, latching means for latching said rod in its attracted position, a latch operating mechanism for operating said latching means to unlatch said rod, selected portions of said plunger being effective to operate said mechanism, and indexing means for alternatively rendering said selected portions effective and ineffective to operate said mechanism.

3. In a solenoid construction of the character described, a coil energizable with pulses, an actuating rod, a plunger, said coil, rod and plunger being coaxially arranged and said plunger being moved to an attracted position upon energization of said coil, latching means for latching said rod after being moved by said plunger, selective means for operating said latching means, and sequentially operated means for indexing said selective means.

4. A construction as set forth in claim 3 in which said sequentially operated means includes, a spring for returning said plunger to its non attracted position, and a pin stationarily mounted with respect to said coil and engaging a cam slot in said plunger.

5. In a solenoid construction of the character described, a generally cylindrical solenoid casing of magnetizable material, an end cover on said casing, bearing means in said cover, a cylindrical coil in said casing, a pair of end members of magnetizable material in opposite ends of said casing with said coil between the same, one of said end members having bearing means therein, a rod slidably mounted in the first and second mentioned bearing means, said rod having an enlarged portion and a grooved portion, a latching member slidably mounted in said one end member, spring means on said one end member and pressing said latching member in said grooved portion, a bell crank having one arm thereof engageable with said latching member and pivoted on said one end member, an actuating pin slidably mounted in said one end member and engageable with a second arm of said crank for lifting said latching member out of said grooved portion, a magnetizable plunger slidably mounted on said rod, first spring means acting between said one end member and said enlarged portion of said rod for biasing said enlarged portion away from its attracted position, second spring

means acting between said one end member and said plunger for biasing said plunger away from its attracted position, said plunger having circumferentially spaced means thereon indexably into alignment with said pin and engageable therewith to operate said crank and lift said latching member out of said grooved portion, said plunger having a cam groove thereon, a cam pin slidably mounted in the other end member, spring means urging said cam pin into said cam groove, said cam groove being so constructed that said cam pin rotates said plunger about its axis under the influence of said second spring means when said coil is deenergized to index one of said circumferentially spaced means into alignment with said actuating pin.

6. A solenoid construction comprising a stationary structure, a coil mounted on said structure, an actuating rod slidably mounted on said structure, a magnetizable plunger slidably and rotatably mounted on said rod, a latching mechanism mounted on said structure for latching said rod in latched position, first spring means acting between said structure and said rod for urging said rod out of its latched position, second spring means acting between said structure and said plunger urging said plunger out of attracted position, selectable means on plunger for operating said latching means, and cam means acting between said structure on said plunger for causing the plunger to rotate to an indexed position under the influence of said second spring means to position one of said selectable means in operative position with respect to said latching means.

7. In a solenoid construction, a coil, a stationary structure on which said coil is mounted, a rod slidably mounted with respect to said structure, a plunger slidably and rotatably mounted with respect to said structure and attracted by said coil, a latching mechanism mounted on said structure for latching said rod, said plunger being attracted by said coil and having selectable means thereon engageable with said latching mechanism for operating the same to unlatch said rod, and cam means acting between said structure and said plunger to index one of said selectable means into operative position with respect to said latching mechanism.

8. In a solenoid construction arranged for energization with a series of actuating current pulses, each of which is time spaced from a deactuating current pulse, a coil to which said pulses are applied, a structure on which said coil is mounted, a rod slidably mounted on said structure to different operative positions, a plunger slidably and rotatably mounted with respect to said structure and attracted by said coil and effective to move said rod, a

latching mechanism for latching said rod in one of its operative positions and having an operating element, said plunger having spaced selectable means thereon for engaging and operating said element of said latching mechanism, said means being spaced by depressed portions on said plunger which are sufficiently depressed to provide clearance at all times between said plunger and said element, cam means acting between said plunger and said structure for recurrently indexing one of said depressed portions in alignment with said element so that said element is not operated when said plunger is attracted by one of said pulses and for recurrently indexing one of said selectable means into alignment with said element so that said element is operated when said plunger is attracted by a succeeding one of said pulses.

9. In a solenoid construction of the character described, a coil, a rod movable between two operative positions, a plunger movable between two positions and attracted by said coil and effective to move said rod, a latching means for latching said rod in one of its operative positions, and means operated by said plunger only upon alternate current pulses applied to said coil for operating said latching means.

10. In a solenoid construction of the character described, a coil, a first member movable with respect to said coil and attracted thereby, a second magnetizable member movable with respect to said coil and attracted thereby and effective to move said first member, latching means effective to latch said first member and operated by said second member, and means for indexing said second member in operative position with respect to said latching means only for alternate pulses applied to said coil.

11. In a solenoid construction, a coil energizable with a series of current pulses, an actuating member movably mounted with respect to said coil, magnetically operated means for moving said member, latching means for latching said member in an operative position, and means attractable by said coil and rendered alternately effective to operate said mechanism only by alternate pulses applied to said coil.

12. In a solenoid construction, a coil energizable with a series of current pulses, an actuating member movably mounted with respect to means magnetically associated with said member for moving the same, latching means for latching said member in an operative position, and recurrently operated means attractable by said coil and operating said latching means only by alternate pulses applied to the coil.

No references cited.