

May 19, 1959

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2,887,623

DUAL ACTION SOLENOID

Filed March 10, 1955

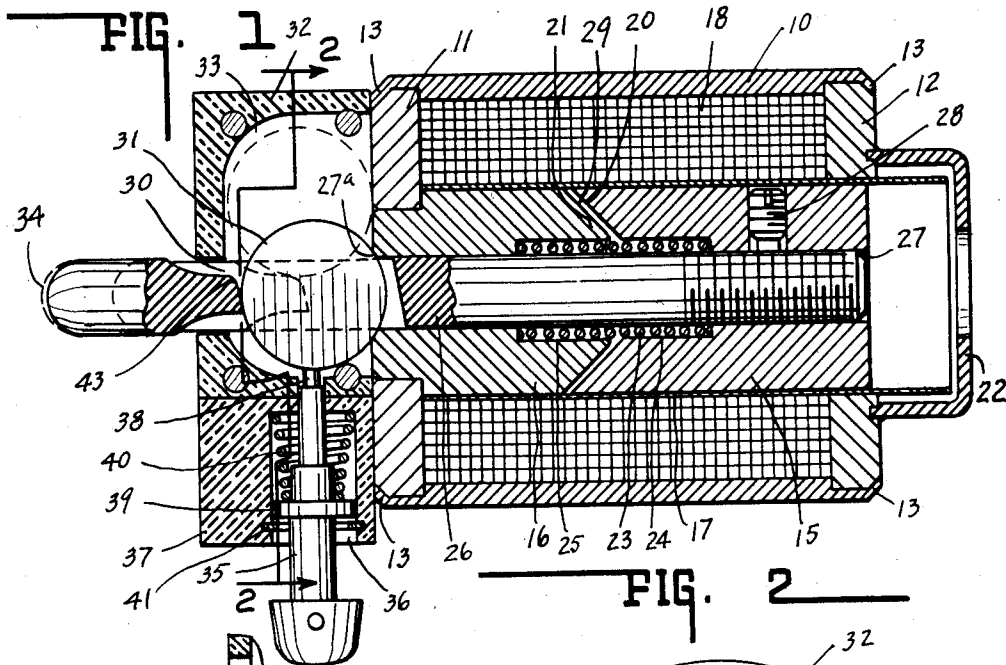


FIG. 2

FIG. 3

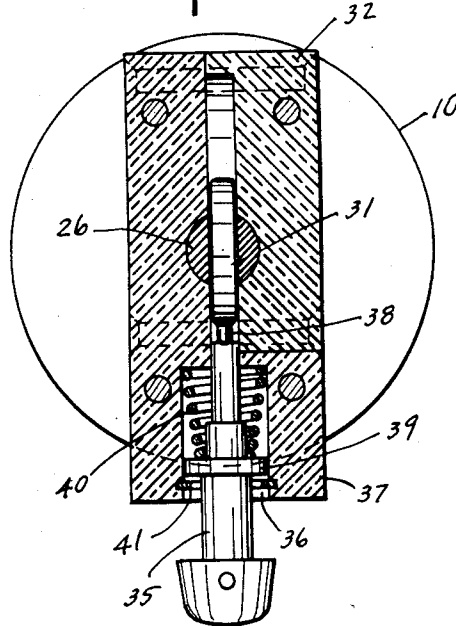
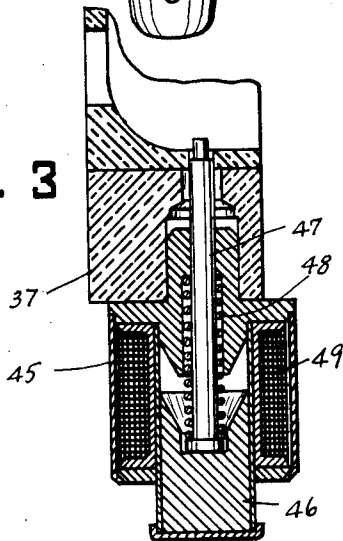
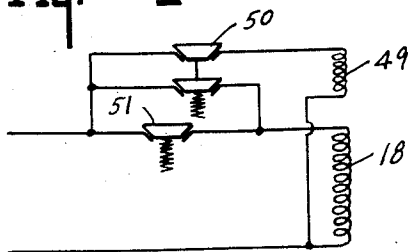


FIG. 4



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2,887,623

DUAL ACTION SOLENOID

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Application March 10, 1955, Serial No. 493,405

9 Claims. (Cl. 317—123)

This invention relates generally to solenoids and more particularly to solenoids which may be latched and unlatched in response to energization.

The principal object of this invention is to provide a solenoid having a magnetically actuated latching device whereby the latch will be operable despite the effects of gravity on the latch.

Another object of this invention is to provide a solenoid of such character that it may be momentarily energized to place the core in one position and momentarily energized a second time to restore the core to its normal position.

In accordance with this invention there is provided a solenoid having a locking mechanism consisting of a magnetically actuated lock or latch which may be moved into a latching position in response to outward movement of a core and which may be dislodged from latching position to permit restoration of the core to its normal position.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

Fig. 1 is a longitudinal cross section of a solenoid embodying the invention.

Fig. 2 is a cross section taken on line 2—2 of Fig. 1.

Fig. 3 is a partial cross section of a magnetic release member adapted to be used in the solenoids illustrated in Figs. 1 and 2.

Fig. 4 is a circuit diagram illustrating a typical circuit for operating the structure of Fig. 1 as modified by Fig. 3.

Referring to the drawing, this invention comprises a solenoid having a casing member 10 of magnetic material, at one end of which is a pole plate 11, and at the other end of which is a pole plate 12. The ends of the casing 10 may be spun over, as illustrated at 13, into clamping engagement with the plates 11 and 12 to support them, as shown in Fig. 1.

The plates 11 and 12 include apertures in their central portions adapted to receive armature 15 and a magnetic pole piece 16. The armature 15 and pole piece 16 are enclosed by a spool 17 on which may be wound an energizing winding 18. The pole piece 16 may be fixed in any suitable manner to plate 11, while the armature 15 is slidably supported within the spool 17, whereby energization of winding 18 may cause the armature to move to the left and slightly beyond the position shown in Fig. 1.

The armature 15 is formed at its left hand end to have an inverted frusto conical portion 20, while the pole piece 16 is provided with a projecting conical extension 21. The member 15 is normally forced to the right into engagement with the inner surface of stop member 22 by means of a spring 23 confined within the counter bores 24 and 25 of members 15 and 16, respectively. Armature 15 is provided with an extension 26 threaded within the central bore 27 of member 15 and locked therein by means of a set screw 28. The extension 26 protrudes outwardly of pole piece 16 and is provided with a slot 30

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adapted to receive a locking disc 31. Disc 31 may be made of a magnetic material, whereby it will be attracted by pole piece 16 in the position shown in Fig. 1 when the coil 18 is energized and the armature moves extension 26 to its outermost position shown in Fig. 1 at 34.

A disc confining block 32 may be secured in any suitable manner to the plate 11, and a chamber 33 is formed therein to accommodate the disc 31 when in its uppermost position. For moving disc 31 into its uppermost position, there is provided a manually operable push rod 35 mounted within a bore 36 in a block 37 secured in any suitable manner to the plate 11. The push rod 35 includes a portion 38 extending upwardly toward disc 31, and a collar 39 is mounted on push rod 35 for providing an abutment for a coil spring 40 and also for guiding the rod within the bore 36. For limiting the outward movement of push rod 35 a snap ring 41 may be mounted in a suitable groove formed in block 37, as shown in Fig. 1. In order to dislodge the disc 31 manually, push rod 35 may be pushed inwardly into engagement with disc 31, causing it to start upward movement. As soon as it has started such movement, a cam 43, formed in the slot 30 of extension 26, cams the disc 31 upwardly as the extension 26 moves to the right.

For providing electrical release of disc 31 a magnetically actuated push rod may be substituted for manually operated push rod 35. In Fig. 3 a solenoid 45 may be mounted on block 37, and the armature 46 of solenoid 45 may be arranged to push a rod 47 against the action of a return spring 48. When the solenoid coil 49 is energized, armature 46 will move upwardly to move the rod 47 into engagement with disc 31 to dislodge it.

Fig. 4 illustrates an electrical circuit for controlling a solenoid having a main energizing coil 18 and release coil 49. The two coils may be connected in parallel with one another through a double contact switch 50, while the main coil 18 may be connected through a main actuating switch 51. In operation switch 51 may be closed to energize the main coil 18, whereupon the extension 26 is moved to the left, and the disc 31 is magnetically attracted into the position shown in Fig. 1 where it rests between the cam 43 and the periphery of the bore 27a of pole piece 16. It will be noted that extension 26 has a certain amount of over travel, as indicated by the gap 29 between the portions 20 and 21 of members 15 and 16, respectively. Thus, the extension 26 moves to the left far enough to admit disc 31 completely into the slot 30 and disc 31 becomes locked between the cam 43 and the edges of bore 27a when extension 26 moves to the right under the influence of spring 23.

To release the disc 31, the switch 50 may be closed, thereby energizing windings 18 and 49. Since winding 18 is energized, the armature moves to the left until the surfaces 20 and 21 engage, thereby providing space for the disc 31 to move upwardly. Winding 49 actuates push rod 47 forcibly moving the disc 31 upwardly against the magnetic attraction of the pole piece 16. As explained before, disc 31 will be forced completely out of slot 30 by cam 43. When switch 50 is opened, spring 23 will return armature 15 and extension 26 to its right hand position.

From the foregoing description it will be apparent that the solenoid provided in accordance with this invention includes latching means which may be actuated against the forces of gravity, and which has a positive action by reasons of magnetic attraction. The latching mechanism also requires positive unlocking forces, either by means of a manual push rod or by means of a solenoid actuated push rod.

The invention claimed is:

1. A solenoid comprising a main coil, a magnetic circuit energized by said coil and including a tubular pole

piece within said coil, an armature slideably mounted within said coil and having a slotted extension protruding through said pole piece and movable outwardly thereof in response to energization of said coil, guide means disposed in the path of movement of said armature for slideably supporting said extension, a disc of magnetic material supported in said guide means adjacent said pole piece and the path of movement of said extension for movement into armature locking position in the slot of said extension by magnetic attraction to said pole piece when said extension moves outwardly thereof, a push rod mounted in said guide means to extend into proximity with said disc when said disc has moved into said slot, and a solenoid operatively associated with said push rod for thrusting said push rod into engagement with said disc to move it outwardly of said slot to permit restoration of said armature to its normal position.

2. A solenoid comprising a main coil, a magnetic circuit energized by said coil and including a tubular pole piece within said coil, an armature slideably mounted within said coil and having a slotted extension protruding through said pole piece and movable outwardly thereof in response to energization of said coil, guide means disposed in the path of movement of said armature for slideably supporting said extension, a latching means of magnetic material supported in said guide means adjacent said pole piece and the path of movement of said extension for movement into armature locking position in the slot of said extension by magnetic attraction to said pole piece when said extension moves outwardly thereof, a push rod mounted in said guide means to extend into proximity with said latching means when it has moved into said slot, and a solenoid operatively associated with said push rod for thrusting said push rod into engagement with said latching means to move it outwardly of said slot to permit restoration of said armature to its normal position.

3. A solenoid comprising a main coil, a magnetic circuit energized by said coil and including a tubular pole piece within said coil, an armature slideably mounted within said coil and having an extension protruding through said pole piece and movable outwardly thereof in response to energization of said coil, guide means disposed in the path of movement of said armature for slideably supporting said extension, a latching means of magnetic material supported in said guide means adjacent said pole piece and the path of movement of said extension for actuation by magnetic attraction to said pole piece into latching engagement with said extension when said extension moves outwardly of said pole piece, and a push rod mounted in said guide means to extend into proximity with said latching means for engagement with said latching means to move it out of latching engagement to permit restoration of said armature to its normal position.

4. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted within said coil and having a slotted extension movable outwardly thereof in response to energization of said coil, guide means disposed in the path of movement of said extension for movably supporting said extension, a disc of magnetic material supported in said guide means adjacent said magnetic circuit and the path of movement of said extension for movement into armature locking position in the slot of said extension by magnetic attraction to said pole piece when said extension moves outwardly thereof, a push rod mounted in said guide means to extend into proximity with said disc when said disc has moved into said slot, and a solenoid operatively associated with said push rod for thrusting said push rod into engagement with said disc to move it outwardly of said slot to permit restoration of said armature to its normal position.

5. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted

within said coil and having a slotted extension movable outwardly thereof in response to energization of said coil, guide means disposed in the path of movement of said extension for movably supporting said extension, a disc of magnetic material supported in said guide means for movement transverse to said extension, said disc being disposed adjacent said magnetic circuit and the path of movement of said extension for movement into armature locking position in the slot of said extension by magnetic attraction to said pole piece when said extension moves outwardly thereof.

6. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted within said coil and movable outwardly thereof in response to energization of said coil, and a latching means of magnetic material supported for movement transverse to said armature, said latching means being disposed adjacent said magnetic circuit and the path of movement of said armature for actuation by magnetic attraction to a portion of said magnetic circuit into latching engagement with said armature when it moves outwardly of said coil, and means in operative relation with said latching means operable to disengage said latching means to permit restoration of said armature to its normal position.

7. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted within said coil and having a slotted extension movable outwardly thereof in response to energization of said coil, spring means operatively associated with said armature for holding it in an idle position, guide means disposed in the path of movement of said extension for movably supporting said extension, a disc of magnetic material supported in said guide means adjacent said magnetic circuit and the path of movement of said extension for movement into the slot of said extension by magnetic attraction to a portion of said magnetic circuit when the main coil is energized, whereby said spring moves said extension with said disc in the slot to a locked position when said coil is de-energized, a push rod mounted in said guide means to extend into proximity with said disc when it has moved into said slot, a release coil operatively associated with said push rod for thrusting said push rod into engagement with said disc, a source of potential, a switch coupled with said source and said main coil for energizing said main coil to move said armature into said locked position, and switch means common to said main coil and said release coil for energizing said main coil and said release coil to move said armature to a disc releasing position and to thrust said push rod into engagement with said disc to move it outwardly of said slot, whereby said spring may restore said armature to its idle position.

8. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted within said coil and having an extension movable outwardly thereof in response to energization of said coil, spring means operatively associated with said armature for holding it in an idle position, guide means disposed in the path of movement of said extension for movably supporting said extension, latching means of magnetic material supported in said guide means adjacent said magnetic circuit and the path of movement of said extension for movement into latching engagement with said extension by magnetic attraction to a portion of said magnetic circuit when the main coil is energized, whereby said spring moves said extension to a locked position when said coil is de-energized, a release member mounted in said guide means in operative relation with said latching means, an electrical release means operatively associated with said member for disengaging said latching means, a source of potential, a switch coupled with said source and said main coil for energizing said coil to move said armature into said locked position, and switch means common to said main coil and said release means for energizing said main coil and said release

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means to move said armature to a releasing position and to actuate said release means, whereby said spring may restore said armature to its idle position.

9. A solenoid comprising a main coil, a magnetic circuit energized by said coil, an armature movably mounted within said coil and movable outwardly thereof in response to energization of said coil, means for biasing said armature to an idle position, a latching means of magnetic material supported adjacent said magnetic circuit and the path of movement of said armature for movement into latching engagement with said armature by magnetic attraction to a portion of said magnetic circuit when the main coil is energized, whereby said biasing means moves said armature to a locked position when said coil is de-energized, a release member mounted in operative relation with said latching means, an electrical release means operatively associated with said release

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member for disengaging said latching means, a source of potential, a switch coupled with said source and said main coil for energizing said coil to move said armature into locked position, and switch means coupled to said release means for energizing said release means to actuate said release means, whereby said biasing means may restore said armature to its idle position.

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