Dec. 5, 1939. C. N. WEILER 2,182,685

SOLENOID

Filed Aug. 14, 1937

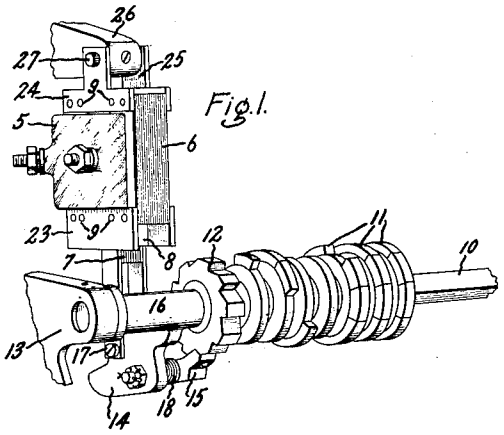
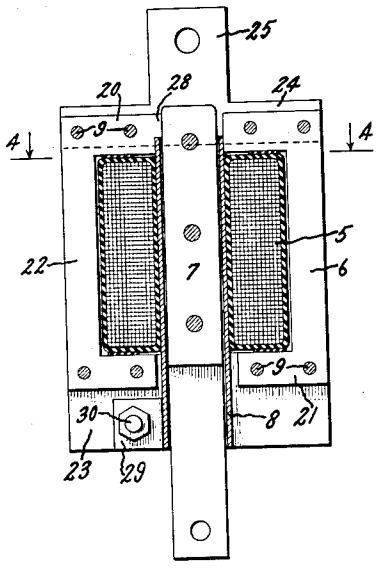


Fig. 1.

Fig. 2.



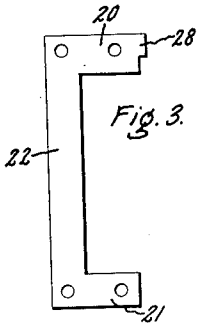


Fig. 3.

Fig. 4.

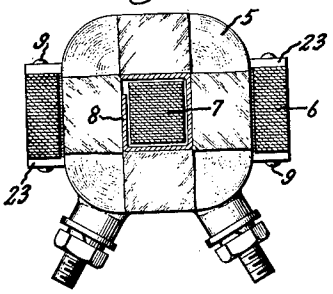
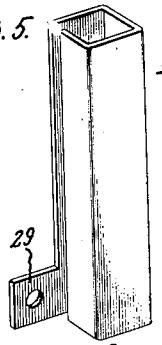


Fig. 5.



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UNITED STATES PATENT OFFICE

2,182,685

SOLENOID

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Application August 14, 1937, Serial No. 159,120

1 Claim. (Cl. 175—341)

My invention relates to solenoids, and more particularly to a means for steadying the operation of the moving armature within the solenoid.

One object of my invention is to provide a braking action in the solenoid so that upon actuation, the armature will glide to its end position and stay at that position without oscillation.

For a better understanding of my invention together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claim.

In the accompanying drawing, Fig. 1 illustrates a solenoid built in accordance with my invention applied to a switch-drum ratchet mechanism; Fig. 2 is a cross-sectional elevation through the center of the coil; Fig. 3 is a front elevation of a core lamination; Fig. 4 is a cross-sectional view looking in the direction of arrows 4—4 of Fig. 2; and Fig. 5 is a perspective view of the armature guide sleeve used within the solenoid.

Referring to the drawing in detail, Fig. 1 discloses a solenoid comprising a coil 5, a closed type of core 6, and an armature 7 movable through the coil in a guide sleeve 8. When the coil 5 is energized, the armature moves into the position illustrated in Fig. 2, and when the coil is deenergized, it drops into the position shown in Fig. 1.

In Fig. 1, a solenoid is illustrated as being used to rotate, step-by-step, a switch operating drum comprising a shaft 10, a series of disks 11, and a ratchet wheel 12, the shaft 10 being mounted for rotation in a pair of lugs 13, of which only one is illustrated. A ratchet arm 14 carrying a pawl 15 is mounted for rotation on the shaft 10 by its sleeve 16. The arm 14 is pivoted to the end of the armature 7 by a pin 17. An upward movement of the armature, therefore, rotates the arm 14 clockwise as viewed from the left, Fig. 1, and permits the pawl 15 to slide over the teeth on the ratchet wheel, the pawl being held in contact with the ratchet wheel by a spring 18. When the armature drops due to the deenergization of the coil, the pawl engages a tooth and advances the drum counterclockwise.

In applications of the type above described, it is desirable to have the armature move to its upper position in one continuous movement, and stop at that position without rebound or other oscillatory movements. In solenoids of the type disclosed, however, the movement is such that the armature is raised to a central or intermediate position between the arms of the iron core, and when so raised, it first moves above its ultimate position, and then moves through several oscillations above and below this position before it finally stops. These oscillations are objectionable in an application of this sort, for the reason that it is possible for the armature to oscillate sufficiently for the pawl to engage an extra tooth on the ratchet wheel, and thereby move the drum farther than is intended for a single energization of the solenoid coil. In accordance with my invention, these oscillatory movements are eliminated by providing a magnetic brake which becomes automatically effective at the end of the movement, or stroke, of the armature and causes it to slide into its final position and stay there until the armature is deenergized. In order to carry out my invention in the simplest manner, I modify the core of the solenoid so that the moving armature may contact the stationary core during a part of its travel and by magnetic attraction encounter sufficient friction to cause it to glide to its ultimate position and stop without rebound.

One embodiment of my invention is illustrated in Figs. 2 and 3. Fig. 2 illustrates a cross-sectional elevation of a closed type of core which is built up of two bundles of laminations shaped as illustrated in Fig. 3. The lamination illustrated in Fig. 3 comprises two horizontal legs 20 and 21 connected by a vertical leg 22. The bundles are arranged opposite to each other and spaced by end pieces 23 and 24, so as to provide room for the armature 7 between the ends of the horizontal legs. The end pieces 23 are arranged on opposite sides at the bottom of the core, and the end pieces 24 are arranged on opposite sides at the top of the core, the rivets 9 project through the laminations and end pieces and form a solid structure. The end pieces 24 are provided with tabs 25 by means of which the core may be supported. In Fig. 1, for example, the core is pivotally supported from a lug 26 by a pin 27, projecting through the lug and the tabs 25, so as to permit the necessary lateral movement of the lower end of the armature, during the arcuate movement of the ratchet arm 14.

As pointed out above, the armature 7 is guided by a non-magnetic sleeve 8 which projects through the coil and between pairs of opposite legs of the core laminations. In order to provide a magnetic brake in accordance with my invention, I mount the non-magnetic sleeve so that its upper end projects only partially between the end surfaces of the upper horizontal legs of the core and I further provide the upper

leg of the one bundle of the laminations with projections **28**. The projection **28** is somewhat longer than the thickness of the metal in the sleeve **8**, so that the end surface thereof projects slightly into the sleeve. When the laminations are assembled, these projections form a wall which projects across the full width of the sleeve, and has a length which is approximately equal to one-half of the core leg width. When the armature moves upwardly due to the energization of the coil, it is attracted toward this exposed and projecting portion of the core and slides over the surface of it, encountering considerable friction during such movement. The amount of this friction is regulated by the area of the surface of the projections and depends further upon the intensity of the magnetic flux. A length of surface equal to one-half of the core leg end surface is found to be sufficient to permit the armature **7** to glide to its ultimate position without overshooting this position.

Fig. 4 is a horizontal sectional view through the core **6** and the coil **5**, indicating the relative position of the sleeve and the armature, and Fig. 5 discloses the sleeve **8** which is made of a non-magnetic material such as brass, and is provided with a tab **29** by means of which it is attached to the end plate **23** of the core by means of a screw **30**.

What I claim as new and desire to secure by Letters Patent of the United States is:

In combination, a solenoid coil, a magnetic core surrounding said coil and comprising vertical legs adjacent the outer surface of said coil and horizontal legs integral with said vertical legs respectively and projecting towards each other along the ends of said coil, the ends of said horizontal legs being spaced from each other to receive an armature, a non-magnetic sleeve extending through said coil transverse of the lower horizontal legs of said core and partly transverse of the upper horizontal legs of said core, an armature movable axially into said coil upon the energization thereof into an upper position wherein the upper end of said armature substantially fills the space between the ends of said upper horizontal legs and a projection on one of said horizontal legs extending over the end of said sleeve and having an end surface substantially flush with the inner surface of said sleeve whereby said armature when moving to its upper position is attracted and frictionally retarded by said magnetic projection for only a portion of its upward movement and only at the end of its stroke.

CHARLES N. WEILER.