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 [21] Appl. No. **805,472**
 [22] Filed **Mar. 10, 1969**
 [45] Patented **July 13, 1971**
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[54] **SOLENOID STRUCTURE HAVING SINGLE SHEET METAL PLUNGER AND/OR YOKE**
7 Claims, 3 Drawing Figs.

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[52] **U.S. Cl.**..... **335/249,**
335/261, 335/281

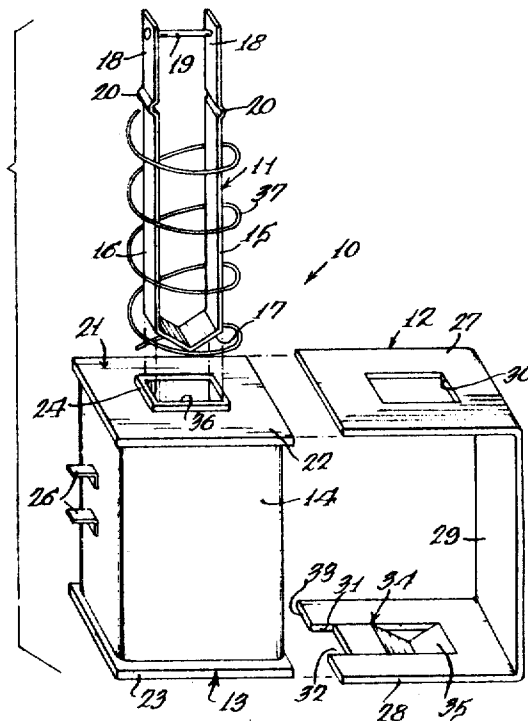
[51] **Int. Cl.**..... **H01F 7/12**

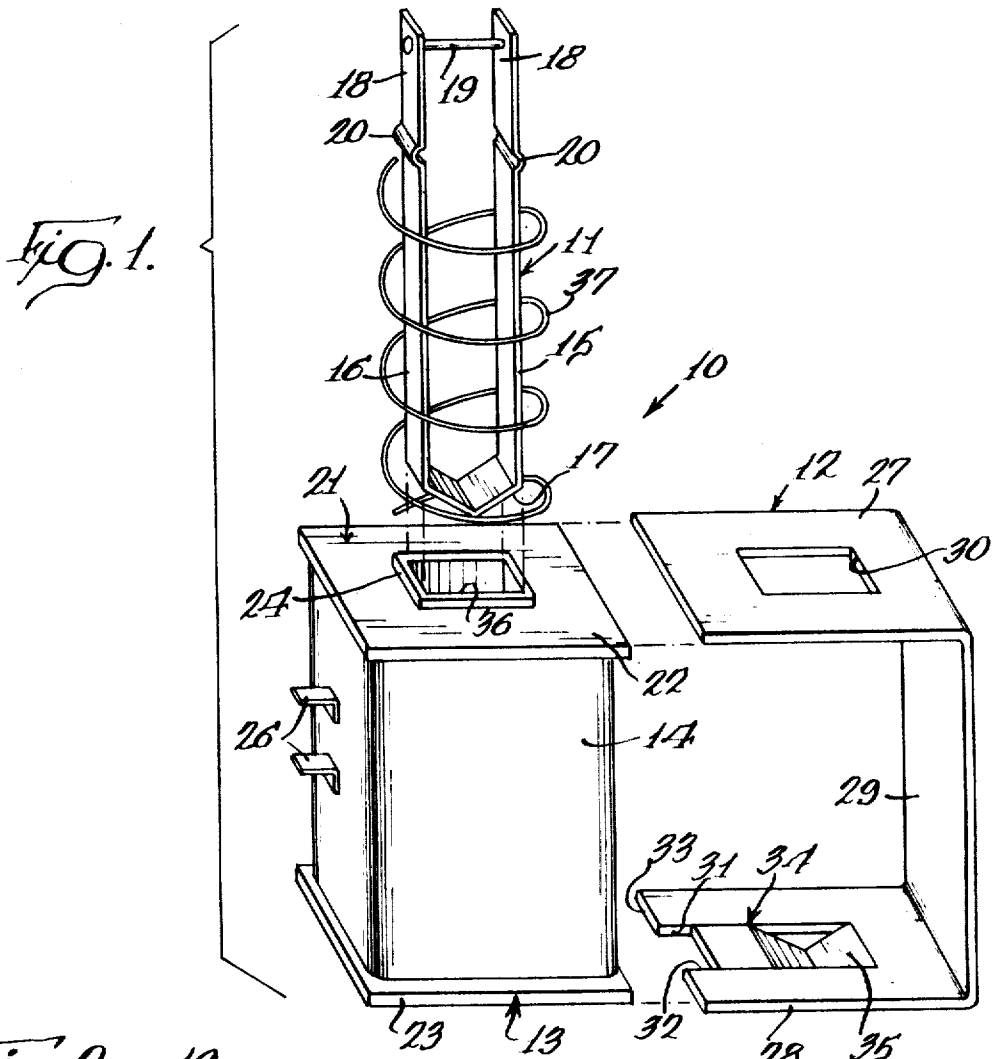
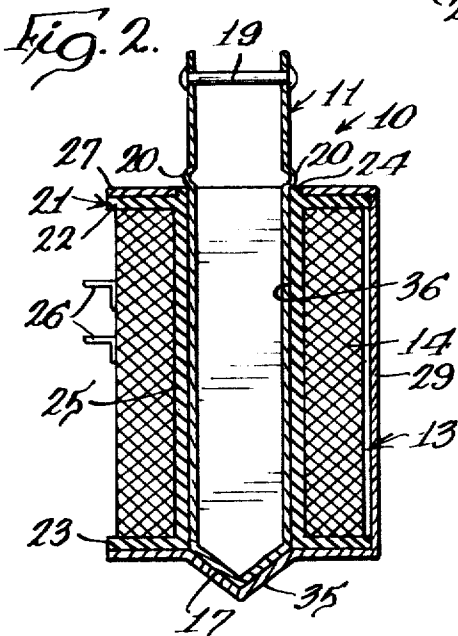
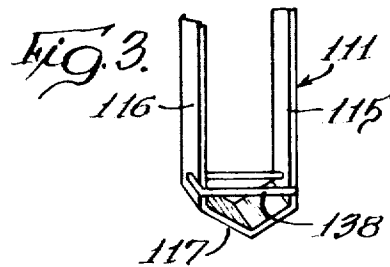
[50] **Field of Search**..... **335/243,**
251, 249, 255, 258, 260—262, 279, 281

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ABSTRACT: An electrical solenoid structure of extremely simple and economical construction. The plunger is stamped from sheet metal and includes an attaching portion unitary therewith. The inner end of the plunger defines a bight portion and the yoke includes a complementary formed portion to provide high magnetic pull as a result of the reduced magnetic gap. The plunger may have ribs arranged to reduce the airgap between the plunger and yoke.





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SOLENOID STRUCTURE HAVING SINGLE SHEET METAL PLUNGER AND/OR YOKE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electromagnetic devices and in particular to electrical solenoids.

2. Description of the Prior Art

In one form of conventional electrical solenoid, a plunger is provided having an attaching bracket attached to one end thereof, as by riveting, for connection of the plunger to the apparatus to be controlled thereby. Such attachment of the bracket is relatively expensive and provides a possible source of failure as by subsequent loosening of the attaching means.

Further in conventional solenoids, means are attached to the yoke, as by riveting, to define a yoke portion complementary to the inner end of the plunger to provide minimum air-gap therebetween. Illustratively, the plunger end and complementary means may be conical. Such yoke-attached means again presents the problem of increased cost and possible source of failure as by loosening.

Thus, in the conventional solenoid construction, a substantial number of separate parts must be assembled and secured together to provide the desirable functioning. Such construction is undesirable from a cost and maintenance consideration.

SUMMARY OF THE INVENTION

The present invention eliminates the above-discussed disadvantages of the conventional solenoid structures in a novel and simple manner. The solenoid structure of the present invention utilizes a single unitary plunger structure and a single unitary yoke structure while yet providing integral therewith the desirable connection means, stop means, and complementary high flux gap means.

The invention comprehends the forming of the elements of the solenoid structure in an extremely simple manner as by stamping thereof from sheet metal stock. The plunger may be formed as a bifurcated stamping having a pair of leg portions defining unitarily therewith stop means and means for connection to the outer end thereof of the associated apparatus. Further, the stamped plunger defines a bight portion illustratively having a tapered configuration such as a U- or V-shaped cross section. The yoke includes a formed portion having a complementary U- or V-shaped cross section to provide for a long mechanical plunger stroke with suitable magnetic forces. The yoke portion may be suitably formed such as by stamping the V-shaped portion, slitting a portion of the sheet metal yoke and folding the slit portion to define the complementary configuration, etc.

By virtue of the simplified stamping method of forming the plunger and yoke, the resultant solenoid structure is extremely economical while yet providing the desirable features of and eliminating the disadvantages of the conventional solenoids. The solenoid structure of the present invention is ideally suited for use in operating dispensing devices and the like, such as in clothes washers, dishwashers, etc.

More specifically, the invention comprehends the provision of a solenoid structure including a yoke, a plunger formed of a sheet material and having an attaching portion unitary therewith, and a coil electromagnetically coupled to the yoke for electromagnetically positioning the plunger relative to the yoke. The plunger may comprise a sheet metal stamping and the yoke may similarly comprise a sheet metal stamping. The coil may be wound on a bobbin which defines a collar portion extending through the yoke for guiding movement of the plunger.

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is an exploded isometric view of a solenoid structure embodying of the invention;

FIG. 2 is a vertical section thereof with the plunger in the fully inserted position; and

FIG. 3 is a partial view of an alternating current solenoid plunger embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the exemplary embodiment of the invention as disclosed in the drawing, a solenoid structure generally designated 10 is shown to comprise a plunger 11, a yoke 12, and a coil assembly 13. As in the conventional installation, the plunger may be biased to a withdrawn position (not shown) by the associated apparatus (not shown).

As indicated briefly above, the invention comprehends the forming of solenoid structure 10 in a simple and economical manner. Thus, the plunger 11 may be formed of a sheet material and more specifically, may comprise a sheet metal stamping. As best seen in FIG. 1, the plunger 11 defines a pair of legs 15 and 16, and a V-shaped bight portion 17 whereby the plunger has an effectively generally U-shaped configuration. The associated apparatus may be connected to the distal ends 18 of the legs 15 and 16 as by a suitable connecting rod 19 secured therebetween. Further, the legs may define formed outwardly projecting ribs 20 which act to bridge collar 24 to reduce the airgap and to increase the flux as shown in FIG. 2. Furthermore, the ribs may cooperate with a biasing means, such as a spring 37, to provide a support for the biasing means, as shown in FIG. 1. In the illustrated embodiment, the coil assembly 14 includes a bobbin 21 having end plates 22 and 23. The upper end plate 22 may be provided with a collar 24 adapted to guide plunger 11 into the coil assembly 14, as shown in FIG. 2. Further as seen in FIG. 2, the bobbin includes a tubular midportion 25 about which the coil 14 is concentrically disposed. The coil may be provided with suitable terminals 26 for electrical connection thereto.

The yoke 12 similarly may be formed of sheet material and herein comprises a sheet metal stamping illustratively having a C-shaped cross section as shown in FIG. 1 with an upper horizontal leg 27, a lower horizontal leg 28 and an upright bight portion 29. The upper leg may be provided with a suitable opening 30 for snugly receiving collar 24 of the coil assembly 13 to be disposed substantially flush therewith, as shown in FIG. 2, in the assembled arrangement of the solenoid structure 10. The lower leg 28 may be formed as by providing parallel slits 31 and 32 extending from the distal end 33 of the leg to a point spaced from the bight 29. The enclosed portion generally designated 34 may then be suitably formed as by stamping to be folded as shown in FIG. 1 to define a V-shaped portion 35 complementary to bight portion 17 of the plunger 11. The yoke and plunger are formed of a suitable magnetic material, such as steel, to define the desirable low reluctance flux path to effect a positive forceful movement of the plunger. In the illustrated embodiment of FIGS. 1 and 2, the coil 14 is arranged to be energized by direct current to effect the electromagnetic solenoid operation. Where the power supply comprises an alternating current supply, a suitable rectifier (not shown) may be used to provide the necessary direct current energization.

As shown in FIG. 2, when the coil 14 is energized, the plunger 11 is drawn into the central opening defined by the bobbin wall 25 until the V-shaped portions 17 and 35 are in positive contact thereby limiting further inward movement. The complementary yoke portion 35 and plunger portion 17 provide a narrow flux gap and a wide travel path relatively high magnetic-force pull of the plunger is obtained over a long stroke of travel. Thus, a mechanical advantage is obtained which obviates the need for further linkages to provide a large degree of motion to the device to be operated. Heretofore solenoid operated devices have required the use of mechanical linkages to provide a large amount of motion in response to a small amount of solenoid motion.

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FIG. 3 shows an alternating current embodiment of the invention. Thus, the plunger 111 is provided with a shading coil 138 which surrounds part of the flux path through plunger 111. Alternately, the shading coil may be added to the bight portion 35 of yoke 12. The unitary construction of the plunger and the unitary construction of the yoke effectively minimize the manufacturing operations required to form these elements whereby the solenoid structure 10 is extremely simple and economical of construction. As seen in FIG. 1, the yoke 12 and the plunger 11 may be formed by folding the stamped sheet material to define the illustrated U-section configuration. As separate attaching brackets, stop washers, yoke wells, and the like requiring securing means, such as riveting, are eliminated. Solenoid structure 10 provides a long, trouble-free life as well as minimum original cost. The bobbin 21 may be formed of a suitable material, such as plastic, providing a low friction guiding of the plunger 11 further assuring long, trouble-free life.

While I have shown and described one embodiment of my invention, it is to be understood that it is capable of many modification. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A solenoid structure comprising: a yoke; a U-shaped plunger formed of a single piece of sheet material and having substantially spaced legs and an attaching portion unitary therewith; and a coil electromagnetically coupled to said yoke for electromagnetically positioning said plunger relative to said yoke.

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2. The solenoid structure of claim 1 wherein said plunger comprises a formed sheet metal stamping.

3. The solenoid structure of claim 1 wherein said U-shaped plunger includes a convex bight end portion, and said yoke includes a concave portion complementary to said plunger bight portion for providing a narrow flux gap with a long travel stroke of the plunger when said coil is energized.

4. The solenoid structure of claim 1 wherein said plunger further includes a rib portion formed unitary therewith for decreasing the airgap in the flux path between the yoke and the plunger when said plunger is fully inserted into said yoke as a result of energization of said coil.

5. The solenoid structure of claim 4 wherein said plunger includes an inner end juxtaposed to said yoke as a result of energization of said coil, and a spring is provided engaging said ribs to bias said plunger from its fully inserted position.

6. A solenoid structure comprising: a unitary stamped sheet metal yoke folded to define a U-section having a pair of spaced legs, one of said legs including a stamped portion; a plunger extending movably through the other of said legs to adjacent said stamped portion; and a coil electromagnetically coupled to said yoke for electromagnetically positioning said plunger relative to said yoke, said plunger including an inner end portion complementary to said stamped portion for providing a narrow flux gap and a long travel stroke of the plunger when said coil is energized.

7. The solenoid structure of claim 6 wherein said stamped portion comprises a folded portion having slit side edges.

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