Sept. 20, 1966 R. L. VALLEAU 3,274,525

SOLENOID DEVICE HAVING A NON-ROTATABLY MOUNTED COIL BOBBIN

Filed Aug. 28, 1964

Fig. 1

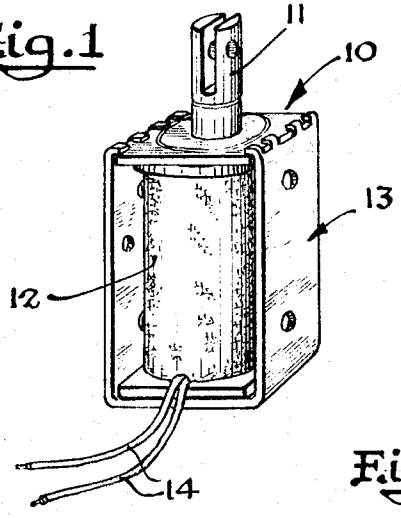


Fig. 2

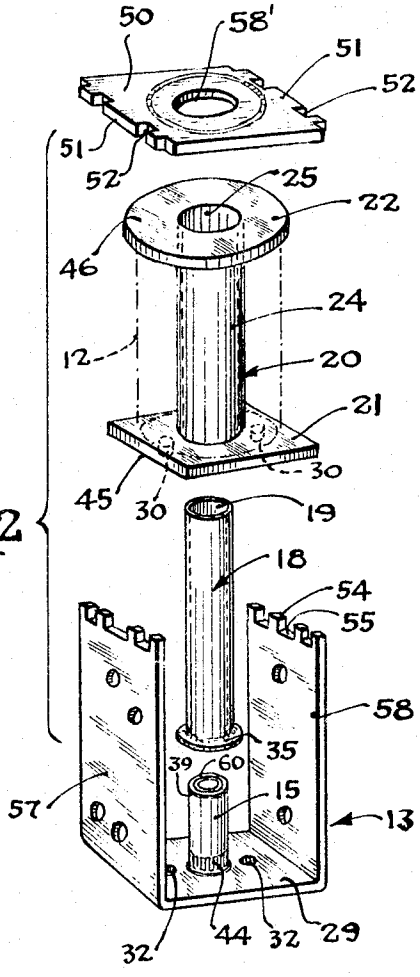
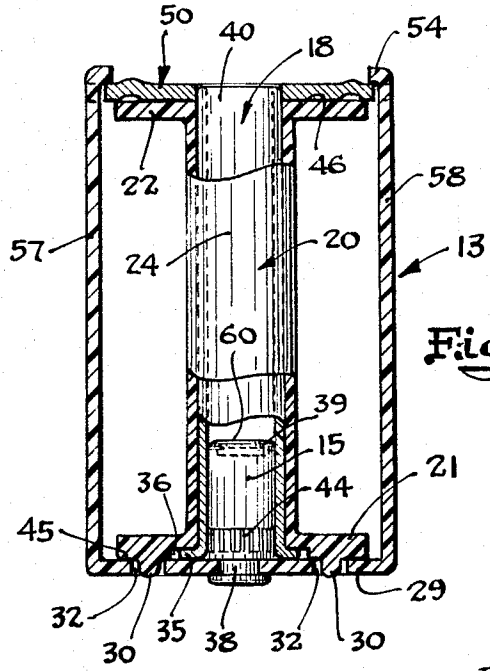


Fig. 3



Inventor
Robert L. Valleau
By Wallace, Kinzer and Dorn
Attorneys

United States Patent Office 3,274,525 Patented Sept. 20, 1966

3,274,525

SOLENOID DEVICE HAVING A NON-ROTATABLY MOUNTED COIL BOBBIN

Robert L. Valleau, Morton Grove, Ill., assignor to Comar Electric Company, Chicago, Ill., a corporation of Illinois

Filed Aug. 28, 1964, Ser. No. 392,697
4 Claims. (Cl. 335—255)

This invention relates to the construction of a solenoid and to a method of fabricating a solenoid.

A common form of solenoid manufactured in large quantities, and over which the present invention is an improvement, has a frame, a coil assembly secured to said frame, and a plunger guide tube within the coil for guiding the reciprocatory movement of the plunger within the coil. The coil assembly includes a central coil wound on a cylindrical tube and a pair of opposed insulating headers disposed at opposite ends of the coil between the coil and the frame. In fabricating this prior art coil assembly, the headers and cylindrical tube for the coil are forced on the plunger tube and this sometimes results in distortion of the plunger tube so that the plunger binds therein.

Another problem with solenoids of the aforementioned construction is the likelihood of the coil to turn or to twist relative to the plunger tube and thereby lose its orientation with respect to the solenoid frame, the coil being oriented and held against turning only by the frictional force between the coil and its supporting plunger tube. Accordingly, an object of the present invention is to construct a solenoid in a novel manner so as to eliminate the forcing of headers for a coil on a plunger tube and the resulting distortion of the plunger tube for the solenoid plunger.

Another object of the invention is to secure the coil of a solenoid in a definite position with respect to the plunger tube by interlocking the supporting coil structure or bobbin with the frame.

According to a more specific object of the present invention, a coil is wound on a one-piece bobbin having integrally formed header portions thereon and the bobbin fits loosely over the plunger tube, which tube is adapted to be forced on the plunger stop. Under this object of the invention one of the headers is provided with interlocking elements which register with mating elements on the frame to hold the bobbin and coil against twisting relative to the frame.

In accordance with the preferred embodiment of the present invention, the solenoid is constructed by staking a plunger stop to a U-shaped frame member. An integral one-piece bobbin having a coil wound thereon is positioned on a thin-walled plunger tube prior to forcing the plunger tube onto the staked stop for the plunger. The lower header has projections on its outer surface. The projections fit into corresponding openings in the U-shaped frame member to hold the bobbin and coil against rotation. A top frame element is disposed over the top header and a projecting end of the plunger tube, and the top frame element is clenched to the U-shaped frame member.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawing which, by way of illustration, shows preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention.

In the drawings:

FIG. 1 is a perspective view of a solenoid constructed in accordance with the preferred embodiment of the invention;

FIG. 2 is an expanded view showing the elements, except the plunger, comprising the solenoid of FIG. 1; and

FIG. 3 is a sectional view taken through the frame, bobbin and metal tubing.

Referring now to the drawing, and more particularly to FIG. 1, there is illustrated a solenoid **10** constructed in accordance with the preferred embodiment of the invention and having a vertically reciprocal plunger **11** movable within the interior of a coil **12** disposed in a frame **13**.

When the coil **12** is energized through electrical leads **14**, the plunger **11** is pulled into the coil **12** and comes into engagement with a solenoid stop **15** which limits the inward movement of the plunger **11**. The solenoid plunger **11** slides easily within the hollow interior of a metal tube or tubing **18**, the interior bore **19** of the tube **18** serving to guide the cylindrical plunger **11** during its reciprocal movement. The plunger **11** is closely dimensioned to the size of the bore **19** of the plunger tube **18** so that distortions of the tube **18** may not cause stopping or frictional interference with the easy sliding of the plunger **11**.

As an important aspect of the present invention, the coil **12** is wound on an integral, one-piece bobbin **20** which has a pair of opposed headers or flanges **21** and **22** integrally formed at opposite ends of a center cylindrical member **24**. The bobbin **20** has an interior bore **25** which is adapted to have a loose sliding fit with the exterior surface of the plunger tube **18**. That is, cylindrical member **24** is not forced under pressure over a plunger tube as was the prior art practice. Hence, an easy sliding fit of the bobbin **20** with plunger tube **18** affords no appreciable frictional force preventing turning of the coil relative to the plunger tube **18** as was present with the prior construction.

In lieu of this frictional force, the lower header **21** of the present invention is adapted to be interlocked to a base portion **29** of the frame **13** by integrally formed and downwardly extending projections **30** spaced to fit is spaced receiving openings **32** formed in the base portion **29** of the frame **13**. When the solenoid is assembled, as illustrated in FIG. 3, the projections **30** prevent rotation of the bobbin **20** relative to the frame **13** and plunger tube **18** and thereby a positive mechanical lock is achieved in lieu of the frictional locking force employed heretofore.

In fabricating prior art solenoids, it has been common practice to have individual and separate header portions (corresponding to the headers **21** and **22** of the present invention) and to force-fit these header portions on the thin-walled, plunger tubing adapted to receive a solenoid plunger. More specifically, the lower header would be forced on the tubing and then a bobbin wound on a cylindrical tube would be forced over the tubing and finally an upper header would be forced over the upper portion of the tubing. With such a method of fabrication, the tubing was often distorted so that portions of its originally circular bore assumed a noncircular configuration and caused rubbing or frictional contact with the plunger.

In accordance with the preferred embodiment of the present invention, the one-piece bobbin **20** is loosely fitted over the tubing **18** to receive the lower flared portion **35** of the tubing within an annular recess **36** formed in the bottom of the bobbin. The pluger stop **15** having been previously riveted or staked by its end portion **38**, FIG. 3, to the base portion or wall **29** of the frame **13**, the

flange portion **35** of the tube **18** is positioned over the rounded upper edge **39** of the plunger stop **15**. Considerable force is then applied to the upper end **40** of the tube **18** to force the tubing **18** downwardly over the staked plunger stop **15**. The outside diameter of the plunger stop **15** and the inner diameter of the metal tubing **18** are so related to one another than a force-fit or "interference fit" results between the tubing **18** and the plunger stop **15** at the engaged surfaces. As shown in FIGS. 2 and 3, the lower portion of the plunger stop has a knurled surface **44** over which the plunger tubing **18** is forced to prevent relative twisting between the plunger tubing **18** and the plunger stop **15**.

The plunger tubing **18** is longer in length than the distance between the outer surfaces **45** and **46** of the bobbin **20** so that the pressure for forcing the tubing on the plunger stop **15** can be exerted solely on the upper end **40** of the plunger tubing **18** without the application of any force to the upper flange **22** on the bobbin **20**. When forcing the tubing **18** downwardly on the plunger stop **15**, the projections **30** are aligned with and inserted into the receiving apertures **32** in the base portion **29** of the frame **13**. In final position, the flared end **35** of the tubing **18** engages the top surface of the base **29** and the lower header **21** has its lower surface **45** in engagement with the upper surface of the base portion **29**, and the projections **30** are disposed in the openings **32**.

A top plate or frame portion **50** affording a second base wall opposite the first base wall **29** of the frame **13** has a plurality of projections **51** and slots **52** which are adapted to be engaged with complementary projections **54** and slots **55** respectively, formed on the upper edges of spaced legs **57** and **58** which afford the opposed side walls of the frame.

The top plate **50** has a circular opening **58'** therein adapted to receive the upper end portion **40** of the metal tube so that the bottom of the top plate **50** can rest on the upper surface **46** of the upper header **22** when the top plate **50** is inserted on the tube **18**.

As best seen in FIGS. 1 and 3, the projections **54** on the tops of the side frame **57** and **58** are clenched or bent over to clamp the top plate **50** tightly against the upper surface **46** of the header **22**. As seen in FIG. 3, the upper end **40** of the tube **18** extends into the circular opening **58** and is held against lateral movement by the top plate **50**.

The plunger **11** is fitted into the bore **19** of the tubing **18** and the plunger is brought into engagement with the top surface **60** of the plunger stop **15** to complete assembly of the solenoid.

From the foregoing it will be seen that the present invention is fabricated with and employs a novel one-piece bobbin construction having integral headers which fit loosely over the plunger tubing **18** so as not to distort the plunger tubing. At least one of the headers of the bobbin has interlocking parts with the frame of the solenoid to prevent twisting of the bobbin relative to the frame which was heretofore resisted only by frictional engagement between a cylinder supporting the coil and the tubing for the plunger.

Hence, while I have illustrated and described preferred embodiments of the present invention, it is to be understood that these are capable of variation and modification.

I claim:

1. A solenoid comprising a frame having a base wall and a pair of interconnecting side walls extending from and joined at respective ends to said base wall, a cylindrical plunger stop secured to said base wall, a bobbin having a hollow central body and a pair of attached headers at the opposite ends thereof, said bobbin having a coil, an elongated guide tube fitted over said plunger stop, said central body of said bobbin being loosely fitted over and said guide tube with one header thereof disposed adjacent said base wall, a solenoid plunger arranged within said guide tube for sliding movement, and said one header and the base wall having interlocked projections and openings to secure said bobbin against rotation.

2. A solenoid according to claim **1** wherein said plunger stop is fixedly secured to said base wall and is provided with a knurled exterior surface, and said guide tube being force-fitted over said knurled surface.

3. A solenoid according to claim **2** wherein the frame includes a separate second base wall, there being cooperating projections and slots between the side walls and said second base wall clenching the second base wall to said side walls.

4. A solenoid according to claim **3** wherein the other header of the bobbin is adjacent said second base wall, with an end of said guide tube extending beyond said second header and disposed in an opening in said second base wall.

References Cited by the Examiner

UNITED STATES PATENTS

2,585,684	2/1952	Roggenstein	29—155.58 X
2,964,837	12/1960	Harris	29—155.58
2,965,954	12/1960	Baker	29—155.58
2,987,655	6/1961	McCurdy	317—158
3,010,055	11/1961	Nicolaus	317—191
3,017,547	1/1962	Jencks	317—191

BERNARD A. GILHEANY, *Primary Examiner.*

G. HARRIS, JR., *Assistant Examiner.*