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Continuation-in-part of application Ser. No. 854,691, Sept. 2, 1969.

3,331,042 7/1967 Erickson et al. 335/262
 3,451,021 6/1969 Atherton 335/260

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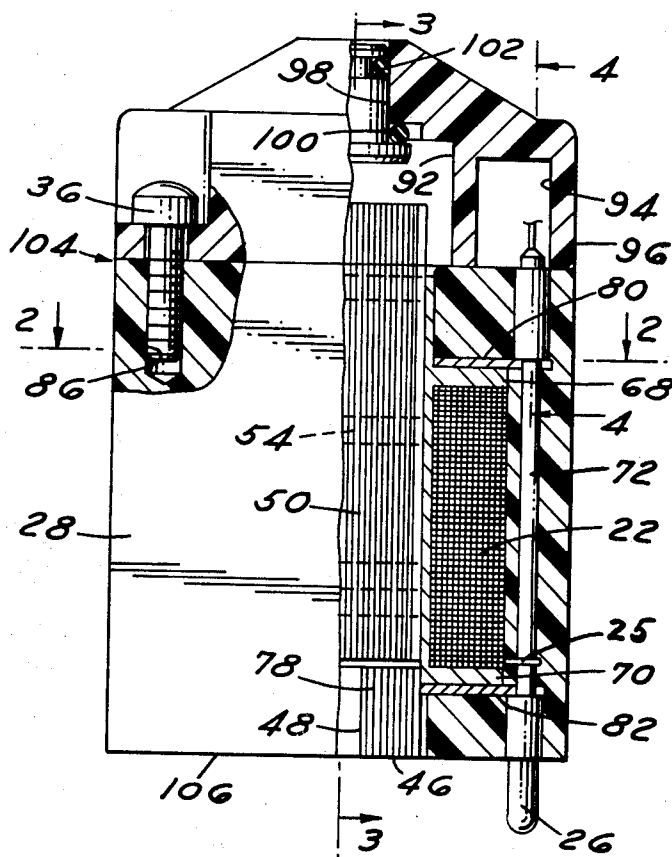
[54] **ENCAPSULATED ALTERNATING CURRENT SOLENOID**
 14 Claims, 9 Drawing Figs.

[52] U.S. Cl. 335/243,
 335/257, 335/260
 [51] Int. Cl. H01f 7/10
 [50] Field of Search 335/202,
 243, 247, 248, 249, 257, 260, 262, 278

[56] **References Cited**
UNITED STATES PATENTS

2,803,789	8/1957	Stanton	335/257
2,975,340	3/1961	Jencks et al.	335/248
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ABSTRACT: This disclosure relates to alternating current solenoids of the commercial industrial type, including a C-stack, a solenoid coil disposed within the C-stack and a plunger having a shank portion received within the coil passage, and wherein the conventional sideplates, baseplate, cover, backstop, assembly bolts or rivets and even the flanged coil bobbin may be eliminated. The C-stack and coil are encapsulated in a thermosetting resin block extending from the right portion to the pole faces of the C-stack and between the C-stack and the coil, and the pole faces of the C-stack are exposed to allow abutment by the plunger. A cap encloses the operating spaced for the plunger head at the pole faces of the C-stack and is secured to the thermosetting resin block providing a completely enclosed solenoid unit. Vacuum encapsulation may be facilitated by utilizing an encapsulating cup which forms an integral part of the final product. The coil assembly is shown as having means for retaining, during the encapsulated process, electric terminals which are exposed in the final product for connecting the coil to a source of current.



SHEET 1 OF 4

FIG.1

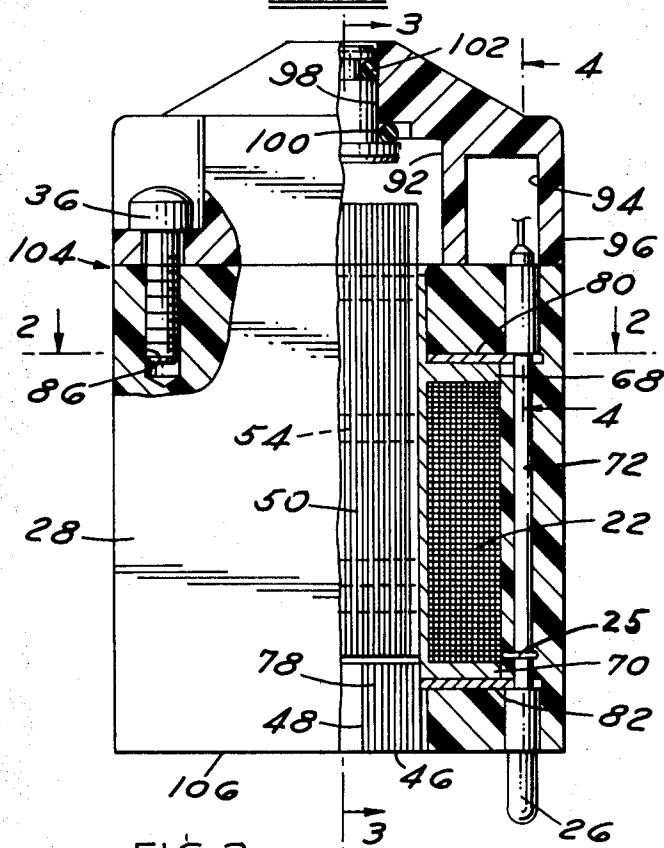
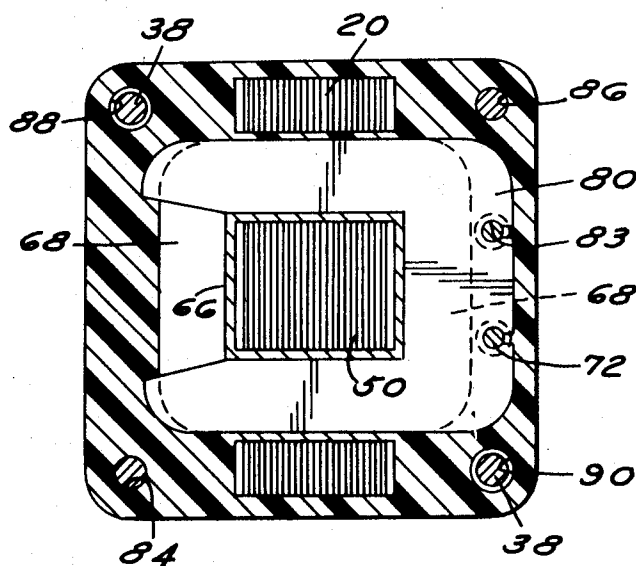


FIG. 2



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FIG 3

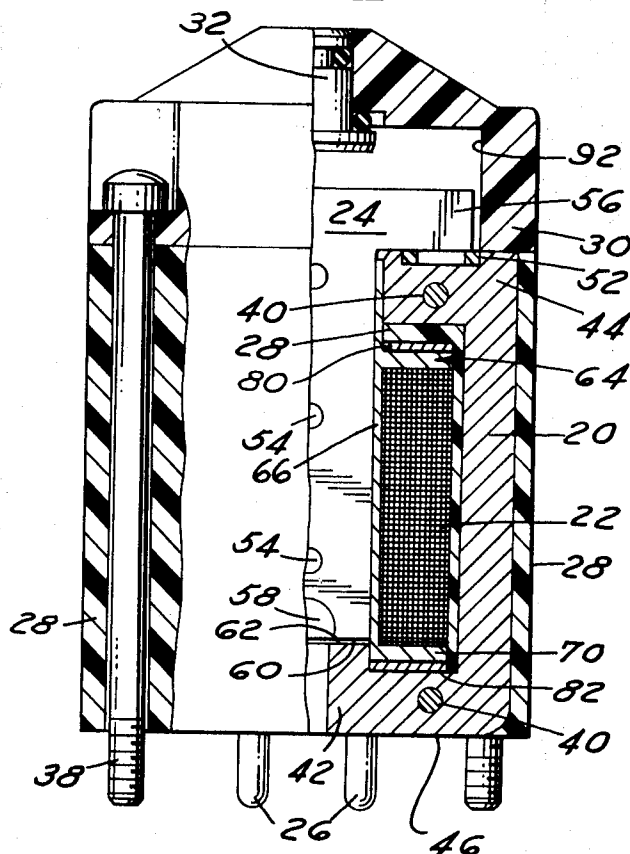
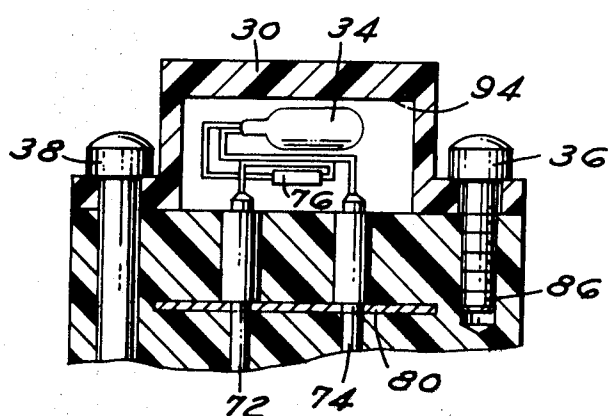
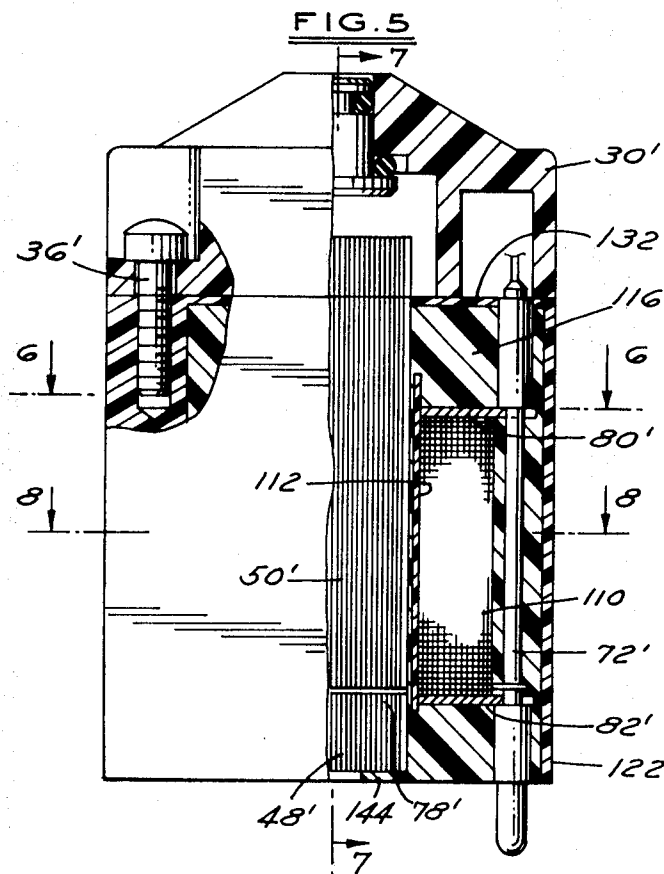
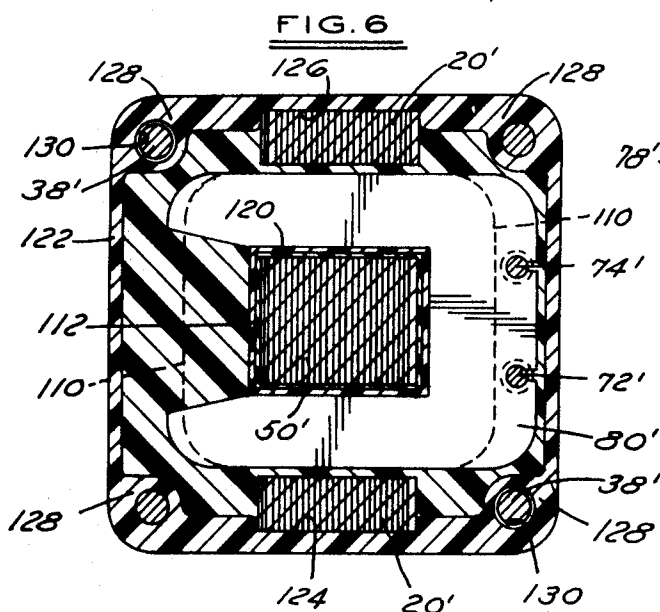
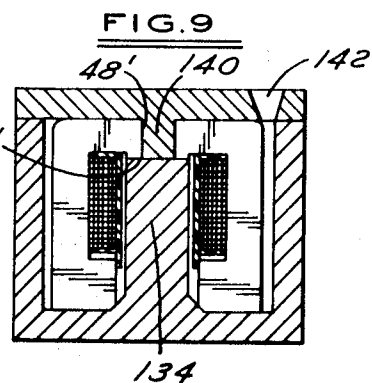


FIG. 4



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FIG. 7

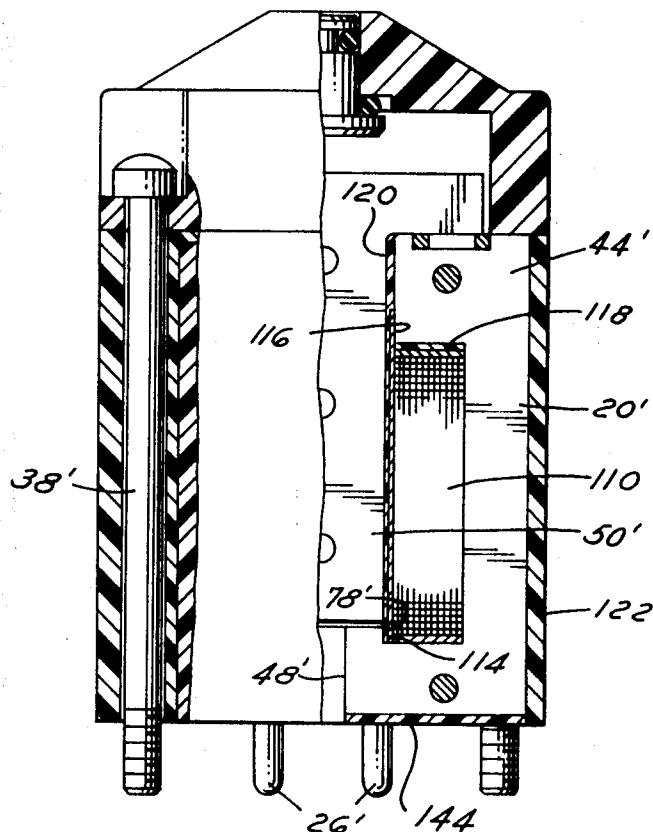
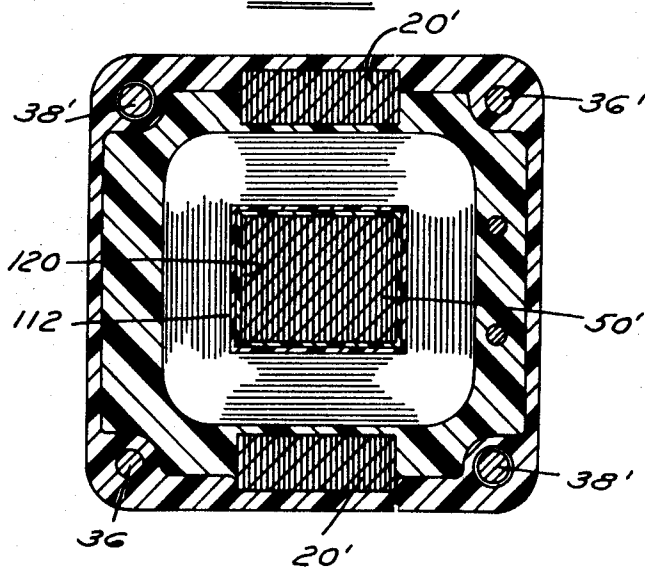


FIG. 8



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ENCAPSULATED ALTERNATING CURRENT SOLENOID

FIELD OF INVENTION

This invention relates to alternating current solenoids. This application is a continuation-in-part of application Ser. No. 854,, 691, filed Sept. 2, 1969.

DESCRIPTION OF THE PRIOR ART

Conventional industrial alternating current solenoids include a laminated C-stack, a coil received within the C-stack, and a plunger having a shank portion received for reciprocation in a passage in the coil. The plunger includes laterally extending arm portions adapted to overlie and repeatedly impact the pole faces of the C-stack, tending to make the solenoid a self-destructing device. It has therefore been an object of many improvements in the design of alternating current solenoids to increase the useful life of the solenoid by improving its structural integrity. Dust, moisture, and other foreign matter in the solenoid tend to decrease solenoid life, and therefore many suggested improvements have been directed to the problem of sealing the solenoid assembly.

A conventional industrial solenoid includes a base member which supports the C-stack, sideplates overlying opposite sides of the laminated C-stack, a backstop for the plunger resiliently connected to the sideplates, and a cover which may be secured directly to the device to be actuated, or to the base member of the solenoid. The cover is normally a metal enclosure, spaced from the solenoid assembly and adapted to prevent entry of foreign matter; but the cover generally increases the operating temperature of the solenoid, as it prevents free circulation of air about the solenoid, thereby contributing to its ultimate failure. The solenoid coil conventionally comprises an assembly of a flanged plastic bobbin upon and between the flanges of which the coil wire is wound. The bobbin confines the coil turns and holds the coil to its proper shape while at the same time providing a means for mounting and retaining the coil in the C-stack. It should be noted that each of the foregoing structural elements, viz., the sideplates, base, cover, assembly bolts or rivets, and the flanged bobbin, not only adds to the cost of the solenoid assembly, but requires additional assembly costs.

Therefore it is an object of the alternating current solenoid of this invention to eliminate a number, if not all of these parts, and thereby reduce cost, while providing a solenoid of improve structural integrity and as long or longer life than the prior art solenoids.

The prior art also discloses the utilization of dust closures or caps for direct current solenoids, and the advantages of potting or encapsulating various electrical elements, including transformers, direct current solenoid coils, electromagnetic cores, and the stylus of a phonograph. The problems inherent in an alternating current solenoid are however substantially different than in these devices, and the solutions suggested by the prior art are not considered analogous. In direct current solenoids, for example, the coils have been individually encapsulated and the purpose has been to seal the coil assembly, and this does not improve substantially the structural integrity of the entire unit. Alternatively, in a transformer, there are no moving parts, and the assembly may be completely encapsulated without departing from the teaching of the prior art. Examples of these devices are shown in the following U.S. Pat. Nos.: 342,881, 2,731,607, 2,749,393, 2,858,487, 3,082,359, 3,226,606, 3,341,939, 3,377,046.

SUMMARY OF THE INVENTION

The alternating current solenoid of this invention eliminates the requirement for a separate cover member, and secures the laminated C-stack and coil in a unitary integral assembly, without the requirement of a separate base plate, sideplates and related fasteners. The conventional flanged coil bobbin

may also be eliminated. One embodiment of the alternating current solenoid of this invention includes a conventional laminated C-stack having a bight portion and opposed pole faces adjacent the distal ends, a solenoid coil disposed within the C-stack, and a conventional plunger having opposed arm portions overlying the pole faces of the C-stack and a shank portion received within the passage provided in the coil. It will be understood however, that modifications may be made to the C-stack, coil and plunger without departing from the purview of this invention.

The C-stack and coil in the alternating current solenoid of this invention are encapsulated in a thermosetting resin block which extends from the bight portion to the pole faces of the C-stack and between the coil and the C-stack. The thermosetting resin block is therefore in intimate heat transfer contact with the C-stack and coil and secures the C-stack and coil in integral fixed relation. The pole faces of the C-stack are exposed at the end of the thermosetting resin block permitting the plunger to abut directly the pole faces. A passage is provided in the thermosetting resin block between the pole faces of the C-stack and the bight portion, which is coaxially aligned with the passage in the coil to receive the solenoid plunger. A cap member received over the end of the plunger and secured to the thermosetting resin block provides a backstop for the plunger and results in a completely enclosed solenoid unit for mounting on the device to be actuated. In the preferred embodiment of the invention, the thermosetting resin block has sufficient structural integrity to permit direct securement of the solenoid, by securing the block to the device to be actuated.

The thermosetting resin rigid block therefore strengthens the laminated C-stack to substantially increase the life of the solenoid. Further, in the preferred embodiment, the thermosetting resin block permits heat transfer between the solenoid and the environment, eliminating the increase in operating temperature resulting from the conventional metal enclosure. The fact that the laminated C-stack and the coil are encapsulated as a single unit, with the thermosetting resin provided both around and between the C-stack and the coil, prevents relative movement between these elements. The thermosetting resin block also eliminates the necessity for a baseplate in that the block may be directly secured to the device to be actuated, and replaces the sideplates without the requirement of additional bolts or securing means. The cap is secured directly to the block, and functions as a backstop for the plunger as described above.

In the disclosed embodiment of the alternating current solenoid of this invention, the cap includes a translucent portion, and the solenoid includes a light connected in parallel with the coil, which indicates when the solenoid is energized. The cap is secured to the thermosetting resin blocks by bolts, two of which extend through the end of the block, adjacent the bight portion of the C-stack, to secure the solenoid to the device to be actuated. In one embodiment of the invention a pair of U-shaped clips are provided at opposite ends of the coil, and encapsulated with the C-stack and coil, to retain the electrical leads during encapsulation, and the leads are encapsulated within the thermosetting plastic block. A manual actuator pin is also provided, within the cap, to permit manual actuation of the plunger without removal of the cap. Other advantages and meritorious features will more fully appear from the following description and claims, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of one embodiment of an alternating current solenoid of this invention, partially cross sectioned to show the internal structure;

FIG. 2 is a top cross-sectional view of the embodiment of the invention disclosed in FIG. 1, in the direction of view arrows 2-2;

FIG. 3 is a cross-sectional view of the embodiments shown in FIG. 1, in the direction of view arrows 3-3, including a breakaway section;

FIG. 4 is a partial cross-sectional view of the embodiment of the solenoid shown in FIG. 1, in the direction of view arrows 4—4;

FIG. 5 is a side elevation of another embodiment of an alternating current solenoid of this invention, partially cross sectioned to show the internal structure;

FIG. 6 is a cross-sectional view taken on the line 6—6 of FIG. 5;

FIG. 7 is another side elevation of the embodiment of FIG. 5 partially broken away and partially in cross section, the sectional view being taken on the line 7—7 of FIG. 5; 8 of

FIG. 8 is a cross-sectional view taken on the line 8—8 of FIG. 5; and

FIG. 9 is a cross-sectional schematic view of a mold for illustrating a method of making a solenoid according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment of the solenoid disclosed in FIGS. 1—4 includes a conventional stator or C-stack 20, a conventional field coil 22 disposed within the C-stack, and a conventional solenoid armature or plunger 24. Generally representative of these elements are the C-stacks, coils and plungers disclosed in U.S. Pat. Nos. 2,466,592, 2,665,397 and 2,671,187 to which reference may be made to supplement the description which follows. In addition to these conventional elements, the solenoid includes electric connector prongs 26 for connecting the coil to a source of electric power (not shown), a thermosetting resin block 28, a cap 30 provided with a manual actuating pin 32, a light bulb 34 in the cap electrically connected in parallel with the coil 22, means 36 securing the cap to the housing, and means 38 for securing the entire solenoid to the device to be actuated (not shown) such as a hydraulic valve.

The C-stack, formed of a plurality of soft iron laminations secured together by rivets, two of which are shown at 40, includes a bight portion 42 and opposed distal end portions 44. The bight portion is provided with locating surface portions 46 which may simply comprise the lower outer surface of the bight portion as shown in FIGS. 1 and 3. Such surface portions are adapted to abut a surface of the device to be actuated to accurately locate the solenoid on such device. The bight portion is also provided with a central aperture 48 for the reception of a pushpin or other actuatable member (not shown) which is adapted to abut the lower end of the shank portion 50 of the plunger, as is conventional, with the opposite end of the pushpin or actuatable member adapted to cooperate with the device to be actuated for transmitting motion from the plunger to such device. U.S. Pat. Nos. 2,975,340 and 2,991,399 show representative pushpins in association with devices to be actuated and which may be referred to for further description of this aspect of the present disclosure.

The distal ends 44 of the C-stack overlie in spaced relation the bight portion 42 and are provided at their upper surfaces, if desired, with shading coils 52, one of which is shown in FIG. 3. These upper surfaces provide pole faces which the plunger abuts when the solenoid is energized and the plunger has been drawn fully into the coil 22.

The plunger 24 comprises a plurality of soft iron laminations secured together by a plurality of rivets 54, four of which are shown in FIG. 3. In addition to the shank portion 50 the plunger includes oppositely and laterally extending arm portions 56 together comprising a head which is adapted to overlie and abut the pole faces at the distal ends of the C-stack. While the plunger shown is generally T-shaped plungers of different configuration may be utilized without departing from the scope of the invention. The lower end of the shank portion is provided with a hardened steel insert 58 providing a wear surface to abut the pushpin or actuatable member heretofore mentioned. The lower surface 60 of the shank is spaced slightly from the opposed surface 62 of the bight of the C-stack when the plunger head abuts the pole faces to provide the usual airgap.

The coil 22 is wound on a bobbin 64 which includes a central rectangularly shaped barrel portion 66 provided with laterally extending flanges 68 and 70, the flange 68 being spaced from the upper end of the barrel as shown in FIGS. 1 and 3, and with the coil wrapped about the barrel between the flanges.

To connect the solenoid into an energizing circuit, prongs 26 are provided. These prongs are adapted to be telescopically received in complementary female sockets on the device to be actuated similar to the arrangement shown in FIGS. 13 and 14 of U.S. Pat. No. 2,975,340. Such prongs comprise the downwardly projecting ends of a pair of pins 72 and 74, which are connected to the ends of the wire of coil 22 in any suitable fashion, such as by soldering. One end of the coil wire is shown in FIG. 1 connected at 25 to the pin 72. The other end of the coil wire (not shown) is connected in like fashion to the pin 74. The upper ends of the pins are connected to opposite sides of the circuit for the light bulb 34 as shown in FIG. 4, such connection being effected in any suitable fashion such as by soldering. The circuit for the light bulb may include a current-limiting resistor 76. The bulb indicates by its illumination that the coil is energized thereby helping to trace malfunctions of the system in which the solenoid is used.

The interior of the barrel 66 of the bobbin provides a passageway for receiving the shank of the plunger and it will be observed that such passageway extends from the pole faces of the C-stack to the bight portion thereof. If desired the bight portion of the C-stack may be provided with a raised step 78 over which the lower end of the barrel is telescoped as shown in FIG. 1.

The C-stack, coil and bobbin, and the pins 72 and 74 are encapsulated in a thermosetting resin block 28. The resin of the block intimately engages the surfaces of the C-stack, coil and bobbin as well as the pins and serves to integrate such parts into a solid, integral, blocklike unit. The encapsulation of the C-stack, coil, bobbin, and pins may be effected by transfer molding, vacuum molding or simple casting, utilizing a conventional epoxy resin which may be either a casting resin or molding resin utilizing a mineral filler. Either type resin gives good thermal conductivity and adequate structural strength for the purpose involved. However, other thermosetting resins may be found suitable. As continuous operation of the solenoid may involve temperatures of approximately 105° C., the resin should be capable of adequately withstanding such temperatures. When vacuum molding is employed for encapsulation the resin material tends to impregnate the coil and enter between the laminations of the C-stack, and as a consequence results in a stronger construction than provided by the relatively low-pressure transfer molding operation or simple casting. With the bobbin 64 formed of nylon, the epoxy resin comprising the housing will adhere to and become substantially integral therewith.

To hole the pins 72 and 74 in proper location prior to encapsulation, a pair of generally C-shaped retaining members 80 and 82 may be utilized which lie adjacent the bobbin flanges and embrace respectively the barrel 66 of the bobbin, as shown in FIG. 2, and the step portion 78 of the C-stack as indicated in FIG. 3. These retaining members are provided with pin-retaining notches 83 into which the pins are snapped at the time of assembly of the components. The retaining members may be formed of any suitable sheet plastic lamination material. In lieu of the retaining members, the bobbin flanges 68 and 70 may be provided with extensions having pin-retaining notches similar to the notches 83 and the retaining members 80 and 82 thereby eliminated.

In the disclosed embodiment the thermosetting resin block is provided with a pair of tapped holes 84 and 86 at two opposite corners for receiving screws 36 which extend through suitably provided holes in the cap 30 to retain the cap on the block. The block is also provided at the other opposite corners with through passages 88 and 90 for the reception therethrough of the screws 38 which are adapted to be threaded into the device to be actuated to mount the solenoid

thereupon. While only the two screws 38 are shown for securing the solenoid to the device to be actuated, it will be understood that four screws may be provided for this purpose, the two screws 36 being replaced by screws corresponding to screws 78 and suitable through passages therefor being provided in the block. However, by providing the screws 36 the cap may be retained on the block during handling of the solenoid apart from the device to be actuated.

The cap 30 may be formed of any suitable material. In the disclose embodiment the cap is formed of a material such as Delrin or Nylon which may be reinforced by suitable fillers if desired. The cap is interiorly shaped to provide a plunger-head-receiving pocket 92 and an adjacent light bulb receiving pocket 94 with an exterior wall 96 of the pocket being translucent or provided with a translucent window to allow the light from the bulb to shine therethrough. The cap is further provided with a cylindrical counterbore aperture 98 for the reception of the manual actuator pin 32. The pin may be provided with resilient O-rings 100 and 102 with the latter serving to seal the pin in the aperture and with the former serving to provide a resilient compressible member cushioning the shock of the backstroke of the plunger head as it strikes the pin during upward movement. It will be understood that when the coil 22 is energized the plunger is drawn to the position shown in FIGS. 1 and 3 and when the coil is deenergized the device to be actuated, operating through the pushpin or actuatable member, shifts the plunger upwardly with it striking the manual actuator 32. Cushioning this backstroke of the plunger reduces the self-destructive action of the solenoid.

While not shown, a suitable gasket may be provided at the interface 104 between the cap and the block to provide a fluidtight enclosure, and another gasket may be provided at the bottom surface 106 of the block to seal it against the device to be actuated, whereby oil may flow from the device to be actuated into the block and fluidtight integrity will be maintained.

The resin block 28 extends from the bight portion locating face 46 to the distal ends 44 of the C-stack with the locating face 46 and the pole faces at the opposite end of the C-stack being exposed such that the solenoid may be accurately mounted on the device to be actuated and so that the plunger head may directly abut the pole faces.

In FIGS. 5-8 another embodiment of the invention is shown. Such embodiment differs from the one of FIGS. 1-4 essentially in that the flanged coil bobbin has been eliminated thereby allowing a greater number of coils turns and as a consequence greater force output for the size of the solenoid is attainable. In this embodiment the solenoid is potted in the resin block by vacuum casting and the finished product includes an integral part of the block, the cup within which the block is cast. As many parts in this embodiment correspond with parts hereinbefore described and a description thereof need not be repeated, such corresponding parts are identified by primed reference numerals.

The coil 110 is wound on a tube 112 and during the winding operation the wire may be coated, as is conventional during coil-winding operations, with a binder that holds the turns in position during the manufacturing operation. The tube 112 may be of phenolic impregnated paper or the like, whose length is such that one end 114 is received over the step 78' at the bight portion of the C-stack 20' and the opposite end 116 extends upwardly somewhat between the opposed surfaces of the distal ends 44 of the C-stack. The C-shaped retaining members 80' and 82' are snapped onto the tube above and below the coil to hold the pins 72' and 74' as shown in FIGS. 5-8.

The potting material forming the block 116 intimately engages the surfaces of the C-stack and surrounds the coil 110 and flows between the coil and the C-stack, as at 118 in FIG. 7, and forms a liner 120 through the tube extending from the step 78' of the C-stack up between the distal ends 44 thereof to guide the plunger. As a consequence, in the embodiment of FIGS. 5-8 the block not only extends about the outside of the

coil but also through the plunger-receiving passageway through the coil and between the distal ends 44' of the C-stack and serves to better integrate the coil and C-stack. By selecting as the resin from which the block is formed, one characterized by its lubricity and long wearing qualities, the liner 120 extending through the coil will accommodate the reciprocation of the plunger shank without the necessity of a separate coil liner as is often utilized in the prior art.

Forming the embodiment of FIGS. 5-8 by vacuum casting improves structural integrity as the casting resin will better penetrate the small cracks or spaces of the C-stack and coil assembly. In this connection it is advantageous to perform the casting utilizing a cup 122 within which the casting operating is performed and which will become an integral part of the final product. The cup is a performed part which may be made of any suitable material such as phenolic resin. It may be internally shaped to provide longitudinal pockets 124 and 126 for receiving and centering the C-stack therein. The cup may also be provided at each of its inside four corners with a fillet 128, with one pair of diagonally opposite fillets provided with longitudinal through-apertures 130 through which the bolts 38' may extend, and the remaining fillets threaded or adapted to threadedly receive the screws 36' for retaining the cap 30'. The bottom 132 of the cup extends across the top or end of the block 116 adjacent the pole faces of the stator, but with the pole faces exposed to the plunger, and the cap rests on the cup bottom as shown in FIG. 5. The bottom 132 of the cup may be provided with cutouts to receive the distal ends, or pole faces, of the C-stack and also a molding plug, similar to the plug 134 of FIG. 9. Cutouts are also provided in the cup bottom for receipt and location of the upper ends of the pins 72' and 74'.

In the vacuum casting manufacture of the FIGS. 5-8 embodiment, the coil 110, and pin retainers 80' and 82' holding the pins, are assembled in the C-stack. Such assembly is then inserted in the cup. The cup with the solenoid parts therein is next placed in a mold and a plug is inserted through the cup bottom and into the plunger passageway spaced slightly from the inner wall surfaces of the tube 112, such as shown in FIG. 99. The end of the plug abuts the step 78' of the C-stack. Another portion 140 of the mold extends through the pushpin aperture 48' and into abutment with the plug 134. A vacuum is applied to the mold and to the cup and parts therein and the resin is introduced as at 142 to fill the cup and the interstices of and around the parts therein. Upon solidification of the resin the mold is opened and the cup-encased block is removed.

As shown in FIGS. 5 and 7, the resin block may extend beneath the bight portion of the C-stack as at 144. In such event the lower surface of the resin block in relation to the C-stack must be held within close tolerances as such surface will become the locating face of the solenoid on the part to be actuated.

The molding process schematically shown in FIG. 9 is not intended to be limited to the use of the cup 122, in fact the cup is not specifically shown in such Figure. Rather the Figure is intended to illustrate the interfitting of the plug 134 in the plunger passageway as well as the mold part 140 entering the actuating pin aperture 48 and 48'. Where a flanged bobbin as in FIG. 1 is utilized, the plug may fit the plunger passageway in the bobbin sufficiently tightly so that the casting resin is completely excluded therefrom.

It is to be understood that while a flanged bobbin is not shown in the FIGS. 5-8 embodiment, such a bobbin may be utilized if desired. In other words, if the solenoid is to be manufactured utilizing the cup 122, a bobbin of the character of bobbin 64 of FIGS. 1-4 may be employed. Whether a conventional bobbin, or a bobbin such as shown in FIGS. 1-4 is utilized in the encapsulation operation or whether one omits a flanged bobbin and utilizes a tube such as the phenolic tube of FIGS. 5-8 will depend upon various factors including the encapsulation temperature, the material of which the resin block is cast, the operating temperature of the solenoid, etc.

The use of cup 122 is particularly advantageous in the vacuum casting or encapsulation method as the cup effectively forms a liner for the mold thereby substantially reducing mold cleanup time. In addition, the interior configuration of the cup for centering and positioning the C-stack and positioning the connector pins ensures accurate relationship of the components of the final product in a simple and inexpensive fashion, and by utilizing different color cups color coding of the end product is attainable without the need of varying the color of the casting resin.

What is claimed is:

1. An alternating current solenoid comprising, in combination: a solenoid C-stack having a bight portion and opposed pole faces adjacent the distal ends, a solenoid coil disposed within the C-stack including a central plunger-receiving passage, said C-stack and said coil encapsulated in a thermosetting resin block extending from the bight portion to the pole faces of said C-stack and between the coil and C-stack, said thermosetting resin block in intimate heat transfer contact with and holding said coil and C-stack in integral fixed relation, said pole faces of said C-stack being exposed for contact by a plunger, said thermosetting resin block having a passage between the pole faces of the C-stack and the bight portion coaxially aligned with the passage in said coil, a plunger having opposed arm portions overlying said pole faces and shank portion received in said passage in said coil for reciprocating movement therein, and a plunger-enclosing cap on the thermosetting resin block overlying the passage in said block and providing a backstop for said plunger, said thermosetting resin block and cap constituting a completely enclosed solenoid unit for mounting on a device to be actuated, and said thermosetting resin block having sufficient structural integrity to permit direct securement of the solenoid by securing said block to the device to be actuated.

2. The solenoid defined in claim 1, characterized in that the end of the bight portion of said C-stack has locating face portions exposed to permit accurate mounting of the solenoid on the device to be actuated.

3. The solenoid defined in claim 1, characterized in that said cap is translucent and said solenoid includes illuminating means within said cap connected to said coil and indicating when the solenoid is energized.

4. The solenoid defined in claim 1, characterized in that said cap is secured to the thermosetting resin block by bolts, at least two of which extend through the end of the thermosetting resin block adjacent the bight portion of the C-stack to secure the solenoid to the device to be actuated.

5. The solenoid defined in claim 1, characterized in that said solenoid includes a pair of electrical conductor retaining members encapsulated within said thermosetting resin block, securing the electrical conductors of said solenoid during encapsulation.

6. The solenoid defined in claim 5, characterized in that said retaining members are generally C-shaped including a pair of arms disposed within the thermosetting resin block and a bight portion including an aperture receiving the electrical conduc-

tors.

7. The solenoid defined in claim 6, characterized in that said retaining members are disposed adjacent the opposed ends of the coil, generally perpendicular to the axis of the coil.

8. The solenoid defined in claim 1, characterized in that said cap includes an aperture generally coaxially aligned with the passage in said coil, and a manual actuator pin disposed in said aperture which may be manually reciprocated to engage said plunger.

9. The invention of claim 8 characterized further in that the manual actuator pin includes a head portion disposed between the plunger and an opposed surface of the cap, and a resilient element encircling the pin and disposed between the head thereof and said surface of the cap to cushion shock of the plunger striking the pin.

10. The invention defined by claim 1, characterized in that a portion of the thermosetting resin block extends along the plunger-receiving passage and defines the walls thereof.

11. The invention as defined in claim 1, characterized in that said coil is wound on a flangeless tube, and said resin block encases the ends of the coil and extends along the plunger-receiving passage through the coil defining the walls of such passage.

12. The invention defined in claim 1, characterized in that said thermosetting resin block is surrounded by and contained in a cup within which the block is cast and to which the block is intimately secured by the casting operation.

13. A self-contained alternating current solenoid comprising, in combination: a solenoid C-stack, a solenoid coil in the C-stack, a plunger having a shank portion projecting into the coil and lateral arm portions for abutting pole faces of the C-stack, an aperture in the bight portion of the C-stack for reception of a pushpin for operative engagement with the plunger, electric connectors for connecting the coil to an energizing circuit, and a housing comprising a thermosetting resin block encapsulating and structurally integrating the C-stack, coil and electrical connectors as an operative assembly with the electrical connectors exposed for connection to an external energizing circuit and with the housing including an interiorly recessed end portion enclosing the head of the plunger and providing clearance for reciprocation thereof, and means for connecting the housing to a device to be actuated.

14. A solenoid comprising, in combination: a C-stack, a solenoid coil in the C-stack, a plunger having a shank portion received in the coil and an end portion projecting out of the coil between the distal ends of the C-stack, a housing enclosing the C-stack, coil and plunger and having a wall portion spaced from said end portion of the plunger when the plunger is sucked into the coil, a manual actuating pin reciprocally mounted in said wall portion of the housing and having a head disposed between such wall portion and said end portion of the plunger to be abutted thereby upon a backstroke of the plunger, and a resilient element encircling said pin between the head and said wall portion to cushion the shock of the backstroke of the plunger striking the pin.