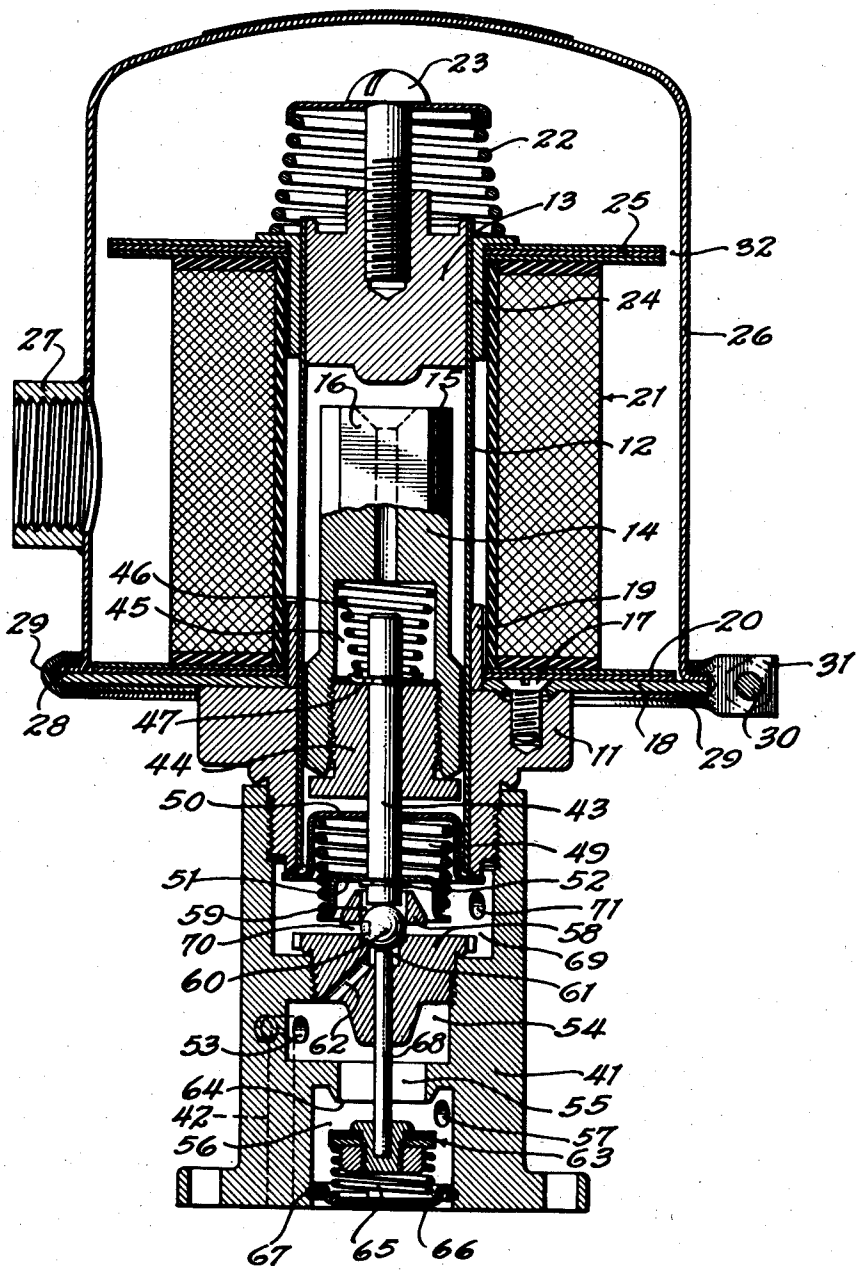
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PLUNGER TYPE SOLENOID WITH CASING

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PLUNGER TYPE SOLENOID WITH CASING

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My present invention relates to solenoid structures, and more particularly to one of the solenoid-valve type.

A conventional solenoid operator for a valve comprises a tube, encircled by an energizing coil and wherein the plunger is reciprocable, which is secured in an opening in a base to whose underside the valve casing is attaching. The wall of the plunger tube is necessarily very thin to avoid electrical losses, so that the tube is easily bent or deformed if subjected to stress. A deformed plunger tube may cause the plunger to stick in valve-closed or valve-open position, and the consequences of such sticking may be very serious. For example, if the valve is employed for controlling supply of fluid fuel to a burner for heating a boiler, and if due to a bent plunger-tube the valve were to remain open, burn-up of the boiler probably would occur.

To protect the solenoid from accidental injury it is customary to provide it with a cup-shaped housing covering the plunger-tube and coil. It is common practice to mount this housing by securing its end wall to the plunger tube, or to the plug at the top of the tube which forms a stop for the plunger when attracted, so that the housing can be rotated to place the electrical conduit fitting (in the side wall of the housing) in a position convenient for wiring. A typical example of such an arrangement is shown in my Patent No. 2,291,599.

It frequently occurs that the installer of a solenoid valve will apply undue force to the housing when screwing the valve on a fluid-supply pipe, or when connecting the electrical conduit, so that the fragile plunger-tube, through its connection with the housing is bent or deformed.

It is therefore an object of this invention to provide means for so attaching the housing to a solenoid operator that, while rotary adjustment of the housing is permitted, the possibility of injury of the plunger-tube, when force is accidently or carelessly applied to the housing, is greatly reduced.

For full understanding of the invention, and further appreciation of its features and advantages, reference is to be had to the following detailed description and accompanying drawing, and to the appended claims.

The single figure of the drawing is a longitudinal sectional view of a solenoid valve embodying this invention.

In the drawing, the numeral 11 indicates a base, of hexagonal contour and commonly termed a "nut," in whose central bore a thin-walled

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plunger-tube 12 is rigidly and sealingly secured, as by sweating with solder. The tube 12 is closed at its upper end by a plug or head 13, sweated in the tube, which forms a stop limiting upward movement of a plunger 14 reciprocable in the tube. The large space, as seen in the drawing, between the tube and the sides of the upper portion of the plunger is due to the fact that this portion is generally-square in cross-section (having rounded corners 15) and the view is taken with a flat side 16 of the plunger at front.

Secured to the base 11, by a plurality of screws 17, is a circular plate 18 having a central opening wherein a sleeve 19, fitting around the plunger-tube 12, is secured as by welding. The plate 18 and sleeve 19 are of magnetic material and serve as flux-conducting means; also serving the same purpose is a pair of washers 20, preferably of silicon-iron alloy, which rest on plate 18. Encircling the plunger-tube is a coil assembly 21 which is held in place by the force of a spring 22; the top end of the spring being connected to the plunger-tube head 13 by a screw 23, and its bottom end pressing against the flange of a sleeve 24, slidable on the plunger-tube, which, through washers 25, bears against the top of the coil assembly. The sleeve 24 and washers 25 are of the same materials as sleeve 19 and washers 20, and serve a similar purpose.

Covering the solenoid is a cylindrical cup-shaped housing 26 having in its side wall a conduit fitting 27 for electrical connections to the coil. This housing is of sheet metal and is formed at its mouth to provide a circular flange 28 whose diameter is substantially the same as that of the base-plate 18. The housing is secured or clamped to the base-plate by a transversely-divided channeled ring or band 29 which is closed around the margins of flange 28 and plate 18 by a screw-and-nut arrangement 30 cooperating with the flattened bent-out end portions 31 of the ring. By loosening the screw 30 the housing can be rotated to place the conduit fitting 27 in the most convenient position, and by removing the screw the ring 29 can be spread-apart sufficiently to permit removal of the housing for changing the coil.

The ring 29 is preferably V-shaped in cross-section, as shown, so that it effects a positive clamping action despite possible variation of thickness of flange 28 and plate 18. It will be observed that the housing is spaced widely from the top of the solenoid and by a substantial distance from the rim of the top end-washers 25, so that even if considerable force is carelessly applied to the housing it cannot yield sufficiently to

engage the solenoid and thereby apply stress to the plunger-tube. The housing is preferably of magnetic material so that it contributes to close, through gap 32, the outer flux-path between the end-washers 20 and 25.

Threaded on a reduced lower portion of the base 11 is a cylindrical valve casing 41 which is adapted to be mounted by its bottom on the flat surface of a structure having a fluid passage in register with a vertical passage 42 in the casing. For the operation of three-way valve mechanism in the casing (to be described) the solenoid plunger 14 is provided with a stem 43. This stem is a sliding fit in an opening through a plug 44 threaded in a cavity 45 in the lower part of the plunger and is normally held in downwardly projected position by the force of a spring 46 compressed between the top wall of the cavity and a washer 47 snapped in a groove in the stem. The plunger 14 is downwardly biased by the force of a spring 49 compressed between a pair of cupped washers 50 and 51 which bear, respectively, against the bottom edge of base 11 and against a ring 52 snapped in a groove at the lower end of plunger-stem 43.

The plunger is, of course, attracted upwardly against the force of spring 49 when the solenoid is energized; the upper spring 46 serving to cushion the downward impact of the plunger-stem when the solenoid is deenergized.

Intersecting the valve-casing passage 42 at its upper end is a short horizontal passage 53 (plugged at its outer end) which leads to a chamber 54 in the casing. With the parts in the positions shown in the drawing, the chamber 54 is in communication, by way of a port 55, with a lower chamber 56 which is closed at its bottom by the surface of the structure on which the casing is mounted when in use. The chamber 56 has in its side an opening 57 which leads to a pipe-fitting (not shown) at the rear of the valve casing. Forming the top wall of chamber 54 is a threaded member 58 having in its upper portion a vertical bore 59 freely receiving a spherical closure or ball 60. The bore 59 is reduced at its lower end, as indicated at 61, to provide a valve-seat for the ball 60; the reduced bore 61 being connected with chamber 54 by an inclined passage 62. The ball 60 is normally held in seated position by the force of the plunger spring 49 acting on it through stem 43.

Within the lower chamber 56 is a closure member or assembly 63 which cooperates with a seat 64 formed around the bottom end of port 55. This closure member is biased upwardly toward its seat by a spring 65 compressed between it and a disk 66 which is retained in place by a snap-ring 67. Carried by closure member 63 is a rod 68 which is slidable in an opening in member 58 aligned with the bores 59 and 61 so that the top of rod 68 bears against the bottom of ball 60; the closure member 63 thus being normally retained in unseated position inasmuch as the force of its bias spring 65 is considerably less than that of the plunger bias spring 49. When the solenoid is energized and the plunger stem 43 consequently raised out of engagement with ball 60, the force of spring 65 is then effective to raise the closure member 63 into engagement with seat 64 and, through rod 68, to unseat the ball 60. Communication between the chambers 54 and 56 is therefore interrupted, and communication is established between chamber 54 and a chamber 69, above member 58, by way of

the inclined passage 62, bores 61 and 59, and notches 70 cut through the sides of the reduced upper part of member 58 and intersecting the bore 59. In the side wall of the upper chamber 69 is an opening 71 which leads to another pipe-fitting (not shown) at the rear of the casing.

The specific embodiment of my invention herein shown and described is obviously susceptible of modification without departing from the spirit of the invention, and I intend therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a solenoid structure: a base; a solenoid mounted on said base and comprising a plunger tube, projecting from the base and secured in a generally-central opening therethrough, and an energizing coil encircling the plunger tube; a cup-shaped housing spacedly covering said solenoid and free from connection therewith, said housing having in its side wall an opening through which the leads of said coil can be passed for connection to an external controlling circuit, said housing having a circular flange extending outwardly from its mouth; said base having a relatively-thin circular margin whose diameter is substantially the same as that of said flange; and means for clamping said housing to said base, with the housing rotated to a position suitable for connection of said coil leads, comprising a transversely-divided channeled ring, and means for closing said ring around the margins of said flange and said base.

2. In a solenoid structure: a base; a solenoid mounted on said base and comprising a plunger tube, projecting from the base and secured in a generally-central opening therethrough, and an energizing coil encircling the plunger tube; a cup-shaped housing, of sheet metal, spacedly covering said solenoid and free from connection therewith, said housing having in its side wall an opening through which the leads of said coil can be passed for connection to an external controlling circuit, said housing being flanged outwardly at its mouth to define a circular rim; a circular plate secured to said base, said plate having a diameter substantially the same as that of said flange and being apertured to receive said plunger tube; and means for clamping said housing to said base, with the housing rotated to a position suitable for connection of said coil leads, comprising a transversely-divided channeled ring, and means for closing said ring around the margins of said flange and said base-plate.

3. A solenoid structure as defined in claim 2, and wherein said channeled ring is generally V-shaped in cross-section.

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