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SOLENOID RELAY

2,852,637

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2 Sheets-Sheet 1

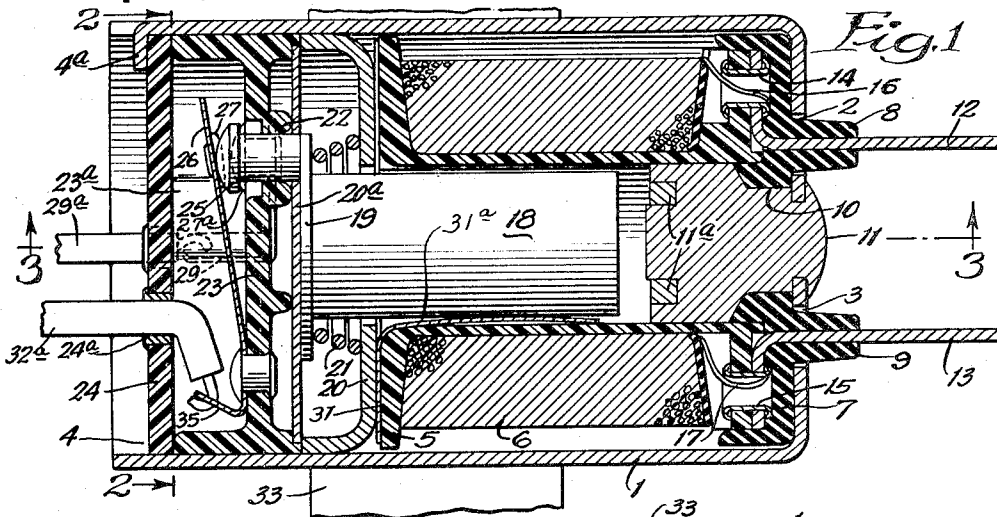


Fig. 3

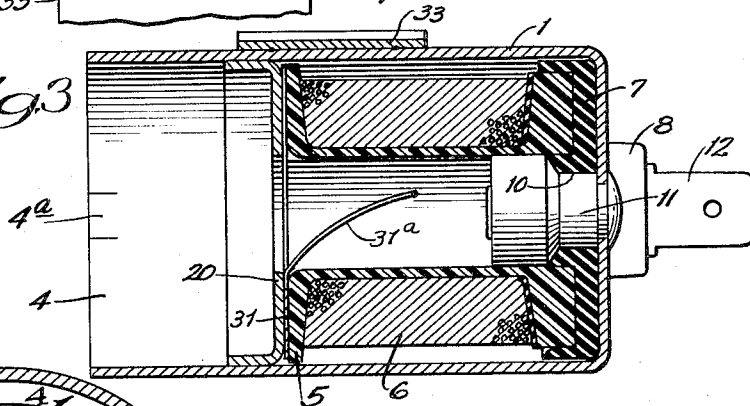


Fig. 2

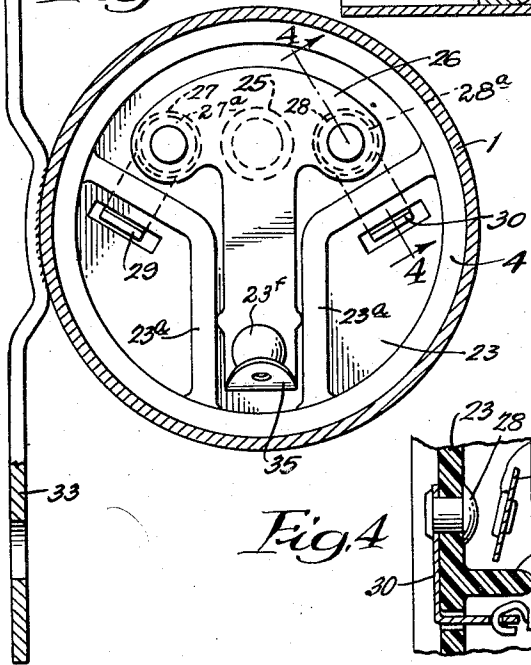


Fig. 5

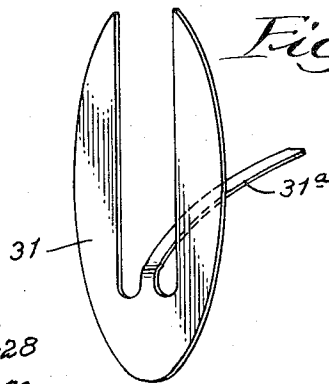
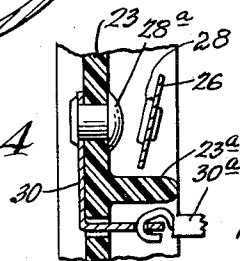


Fig. 4



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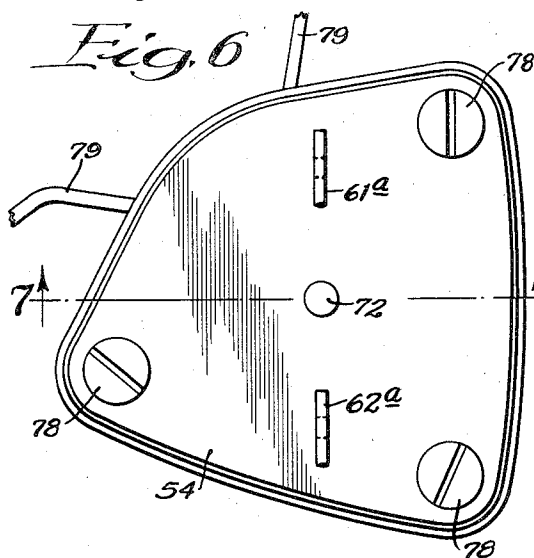
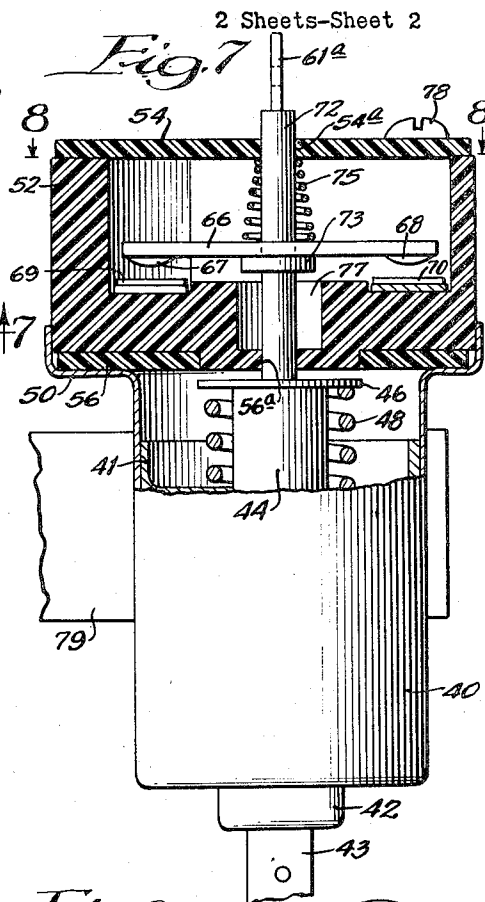
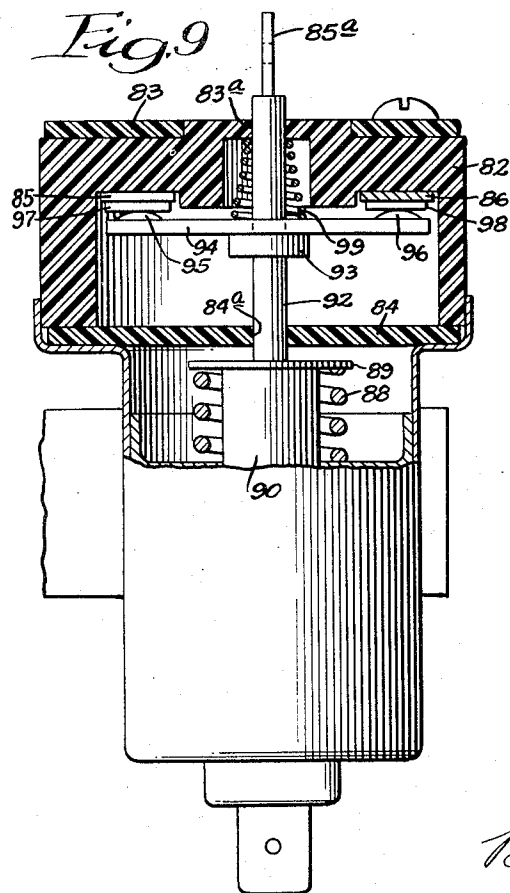
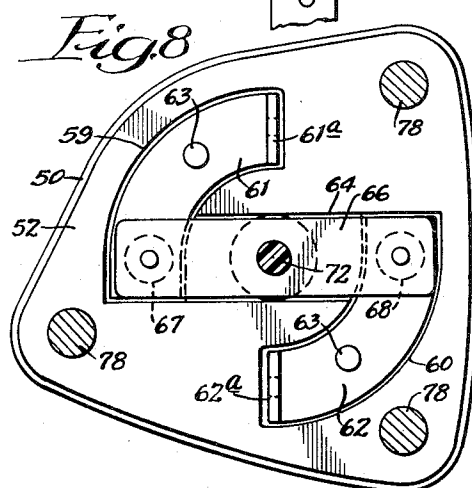
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2 Sheets-Sheet 2



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2,852,637

SOLENOID RELAY

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Application April 2, 1956, Serial No. 575,604

12 Claims. (Cl. 200—37)

This invention relates in general to electrical relays and, more particularly, to electrical relays of the solenoid type.

In the art of electrical control, the solenoid relay wherein a switch is actuated by the movement of a plunger in response to the energization of the solenoid coil has found widespread acceptance. For example, in many major electrical appliances, such as refrigerators, washing machines, vending machines, and the like, relays have been generally accepted and used for the performance of cyclical control functions. Due to the nature of such control circuit applications, however, these relays frequently are exposed to an environment of dust, moisture and physical damage due to impact. Consequently, constant effort is being made in the art to provide these relays with greater protection from such hazards and thereby not only increase their useful operating lives but also provide greater safety for the machines being controlled.

Further, it is known that the plunger of these relays have a marked tendency towards vibration and A. C. hum when the solenoid is energized. Manifestly, this is an undesirable condition since, in addition to giving rise to noisy operation, it results in decreased efficiency, increased operating costs, and possibly a shortening of the life of the relay.

Therefore, it is a general object of this invention to provide an improved solenoid relay.

Another object of this invention is to provide an improved solenoid relay which is substantially free from the deleterious effects of impact, dust and moisture, as well as damage or mal-adjustment of contacts incident to physical handling.

A further object of this invention is to provide an improved solenoid relay which is compact, dependable and relatively inexpensive to manufacture.

It is another object of this invention to provide a solenoid relay which may be completely sealed and protected from moisture, thereby eliminating the necessity of impregnating the solenoid coil.

A still further object of this invention is to provide an improved solenoid relay having practically no contact bounce, of small size, economical to manufacture, and which is adapted to make, break, and/or switch higher currents at various voltages than is normally practical with components of comparable size and cost of manufacture.

Still another object of this invention is to provide a solenoid relay with a simple and inexpensive means for minimizing plunger vibration and A. C. hum.

These and other objects are realized in a specific illustrative embodiment of this invention in which a solenoid assembly including a coil, a plunger having a lifter connected thereto, and a plurality of switch contacts operated by the lifter, are incorporated within a compact casing. In accordance with an aspect of this invention, the casing advantageously has at its terminal end a silicone rubber seal which is of such shape and construction as to prevent water and dirt particles from entering the

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casing at said terminal end while, at the same time, providing access for a pair of power terminals.

At the other end of the casing the solenoid assembly advantageously has a sealed chamber formed by a housing of di-electrical material within which is placed a switch assembly, including a switch blade or bar and one or more switch contacts. In one construction, the contacts are adapted to be placed in contacting relation with the blade or bar by the actuation of the plunger in response to the energization of the solenoid coil through the terminals. In another construction, the contacts are adapted to be contacted by the blade or bar by the actuation of the plunger incident to deenergization of the solenoid coil. Connection is made to the switch blade and contacts by conductors which enter the switch chamber through apertures provided in the insulated end plate. In accordance with an aspect of this invention, the solenoid assembly may be hermetically sealed at its contact end by filling the spaces in the end plate, between the conductors and the marginal edge of each aperture, and around the periphery of the end plate, with a sealing compound, such as a resin. In this manner, the adjustment of the solenoid contacts is protected during the handling and mounting of the relay, in addition to the subsequent protection provided against moisture and dust.

In accordance with a further aspect of this invention a damper spring, which advantageously may comprise a support having a resilient finger connected thereto, is inserted into the core of the coil assembly. When, due to the energization of the coil, the plunger is drawn further within the coil assembly, the resilient finger of the damper spring exerts tension against the side of the plunger in a direction transverse to the direction of travel of the plunger. The tension provided by the damper spring is sufficient to minimize A. C. hum and vibration of the plunger when the solenoid is energized, but is not heavy enough to interfere with the free movement of the plunger along the axis of the coil assembly.

It is also a feature of this invention to waterproof the terminal end of a solenoid relay by enclosing the solenoid assembly thereat with an insulating seal, including a plurality of lugs having apertures therein for the passage of a plurality of power terminals.

It is a further feature of this invention to enclose the contact assembly of a solenoid relay with a sealed chamber defined by a plurality of insulator members to protect the adjustment of the relay contacts from moisture, dust and damage due to impact.

It is a still further feature of this invention to reduce the cost of manufacture of a solenoid relay by enclosing the solenoid assembly within a compact metal casing in a manner to provide an air-tight seal.

It is a still further feature of this invention to insert a damper spring between the coil assembly and plunger of a solenoid relay in order to minimize A. C. hum and vibration of the plunger.

A complete understanding of this invention, together with the above-noted and other features thereof, may be gained from consideration of the following detailed description and the accompanying drawing, in which:

Figure 1 is an axial sectional view of the novel solenoid relay;

Figure 2 is an end view, part in section, taken along line 2—2 of Figure 1;

Figure 3 is an axial sectional view of the coil and casing assembly, taken along line 3—3 of Figure 1;

Figure 4 is a sectional view through a portion of the contact assembly of the invention, taken along line 4—4 of Figure 2; and

Figure 5 is a perspective view of the damper spring of the invention.

Figure 6 is a top plan view of the solenoid relay embodying a modified form of a switch assembly.

Figure 7 is an axial sectional view of the solenoid relay embodying the modified switch assembly, taken as indicated at line 7—7 on Figure 6.

Figure 8 is a transverse sectional view, taken as indicated at line 8—8 on Figure 7.

Figure 9 is a view similar to Figure 7, showing a switch arrangement wherein the switch is normally closed when the solenoid coil is de-energized.

Referring now to the construction disclosed in Figures 1 to 5 of the drawings, Figure 1 depicts an embodiment of the invention comprising a cup-shaped casing 1, having apertures 2 and 3 at its terminal end and the opposite end being open, as indicated at 4. The casing 1 is of unitary cylindrical construction and is inexpensively fabricated by the use of an eyeletting type machine in preference to the more costly stamping technique.

A spool 5, having a coil 6 wound thereon, is positioned within the casing. Between spool 5 and the terminal end of casing 1, is a terminal sealing and insulator member 7 which has a pair of lugs 8 and 9 and an axial opening 10. Fitted within the axial opening 10 of insulator member 7 is a plug 11, having its outer end rigidly secured to the terminal end of the casing 1, and the inner end of said plug is provided with a copper shading ring 11a. Lugs 8 and 9 of insulator member 7 each have a narrow slot extending therethrough to accommodate power terminals 12 and 13, to which the coil energizing current is applied. Terminals 12 and 13 are fastened to spool 5 by means of eyelets 14 and 15 respectively. One end of coil 6 is connected to terminal 12 by a conductor 16 threaded through eyelet 14 and the other end of coil 6 is connected to terminal 13 by a conductor 17 threaded through eyelet 15.

It is to be noted that the component parts comprising the terminal end of casing 1 are fitted together in a snug manner to prevent moisture and dust from entering the casing. In accordance with an aspect of the invention, the terminal seal is rendered highly efficient for this purpose by the use of a resilient, and waterproof composition, such as silicone rubber, for the insulator member 7. This serves to waterproof the terminal end and thereby eliminates the need for impregnating the coil assembly itself with a waterproofing composition, as provided in the prior art.

A plunger 18, comprising a cylinder, with a flange 19 at the outer end thereof, is placed within the core of spool 5 and is in slidable relation therewith. A cup-shaped coil retaining member 20 is press-fitted within the casing, in abutting relation with the end of the spool 5. A compression spring 21 is located between the flange 19, of the plunger 18, and the coil retaining member 20, and serves to urge the plunger in a direction away from plug 11.

An annular stop member 22, which advantageously may be made of a dielectric material, is positioned adjacent the retaining member 20, with a disc 20a of electrical insulating material disposed therebetween. By this arrangement the contacts are separated from other parts of the assembly to insure against possible impairment of operation of the device. The stop member 22 limits the outward movement of the plunger 18 during the time coil 6 is in its non-energized state.

Also included within casing 1 is an insulated chamber for housing the switch assembly. This chamber is defined by contact support member 23 and an end plate 24, each of which advantageously is formed of a dielectric material. Stop member 22 and contact support member 23 are formed as a unitary molded article having a common aperture through which extends a headed lifter 25, connected to flange 19 of plunger 18, which lifter extends through said common aperture of members 22 and 23, into the switch chamber for controlling the operation of switch contacts. The end plate 24 is provided with aper-

tures for each of the switch lead-in conductor wires. The switch assembly may be sealed in the casing 1, by applying a sealing compound, such as resin, as indicated at 24a, in each of the apertures after the conductor wires, hereinafter described, are threaded therethrough. If desired, a similar sealing compound may be applied around the exposed periphery of the end plate 24, to provide an air-tight, hermetic seal at the switch end of the assembly. Thus, the solenoid relay is totally enclosed within the casing, and both the solenoid assembly and the switch assembly are completely protected from moisture and dirt.

The switch assembly comprises a T-shaped switch blade 26, carrying a pair of spaced apart contact members 27 and 28. The switch blade is mounted on the contact support member 23 by means of a rivet 23f. Movable contact members 27 and 28 cooperate respectively with fixed contacts 27a and 28a to which are connected spade lugs 29 and 30 respectively, to which lugs the switch conductor wires 29a and 30a are connected. Switch blade 26 has at its terminal a lug 35 for connection to a conductor wire 32a. Figure 2 of the drawing shows more clearly the construction of the switch blade 26, including lug 35, and the spade lugs 29 and 30 of contact members 27a and 28a. Figure 4 is a view taken on line 4—4 of Figure 2 and shows in detail the construction of spade lug 30 and the means by which it is fastened to the contact support member 23.

The switch blade is a resilient spring member which is held in a non-contacting relation with respect to contact members 27a and 28a, by the lifter 25, engaged by plunger when the solenoid is de-energized. In this condition the switch is open and the conductors are not connected to each other. When the switch is to be closed by the operation of the solenoid relay, current is applied across terminals 12 and 13 to energize coil 6 and the resultant magnetic field created thereby causes plunger 18 to be drawn towards the terminal end of the coil, and the lifter 25 is caused to follow the movement of the flanged end 19, of the plunger, by the spring pressure of the switch blade 26. These parts remain in such following engagement until the switch blade engages the contact members 27a and 28a, at which time the switch blade is no longer in pressure contact with the lifter 25. This action enables the resilient switch blade 26 to move into contact with contact members 27a and 28a, and close the circuit formed by the switch conductors.

Because of the discontinuance of the follow up movement of the switch blade relative to the movement of the plunger, when the coil is energized, the rate of movement of the switch blade is kept slow because of the fact that actuation of the switch blade is permitted to occur during the first portion of the total range of movement of the plunger, which is relatively slow as compared to the final portion of the range of movement of said plunger. The rate of movement of the plunger is further retarded to a small extent by the damper spring 31a, hereinafter described. In prior art constructions the moving contact blade or member is attached permanently to the plunger and the shock or impact resulting from seating of the plunger is transmitted directly to the movable contact blade or member causing contact bounce. Furthermore, due to the heavy mass of the plunger and associated parts, and the high rate of travel of the plunger when it arrives at its seat in the coil, further results in producing a high degree of contact bounce.

By virtue of the novel switch assembly, "contact bounce" is substantially non-existent because of the small contact gap, the small mass of the switch blade 26 and its contacts, the disassociation of the switch blade from the follower when the plunger arrives at its seated position in the energized coil, and the comparatively slow movement of the switch blade which results in a low inertia

factor when the coil 6 is energized or de-energized. Hence, it is possible to switch inductive loads of an order far greater than those associated with units of comparable size, or units of comparable contact size, while maintaining a high degree of reliability and long contact life.

The support member 23, is formed with ribs 23a to divide up the switch chamber into three separate areas for further insuring against possible impairment of the electrical circuits being controlled. It will be noted that the respective terminal lugs 29, 30 and 35 are positioned in separate compartments or areas.

It is known in the art that a plunger of a solenoid relay, when operated by alternating current, will have a tendency to vibrate during the energized period of the solenoid. In accordance with an aspect of the invention, this problem is eliminated in an inexpensive yet efficient manner by the provision of a damper spring between the coil and the plunger. Figure 5 illustrates the details of the damper spring which comprises a thin disc-shaped support 31 having an arcuately formed resilient finger 31a connected thereto.

As shown more clearly in Figure 3, the damper spring is held in place between the end of the coil spool 5 and the coil retaining member 20 so that the resilient finger 31a extends into the solenoid core, and is always spring pressed against the side of the plunger 18. The damper spring exerts tension against the side of the plunger in a direction transverse to the direction of travel of the plunger, and when the coil is energized and the plunger drawn into the core of the coil, the damper spring acts to minimize A. C. hum and vibration of the plunger without interfering with the free movement of the plunger along the axis of the solenoid. Due to the fact that the spring finger 31a is arcuately formed in longitudinal direction, it provides a beam-like structure with two spaced apart portions engaging the wall of the core of the coil. It has been found that such a construction exerts greater tension than a straight finger against the plunger and permits closed and more uniform control of the tension on the plunger, as well as tending to retard the rate of movement of the plunger.

A mounting means, such as bracket 33, shown partially in Figures 1 and 3 and completely in Figure 2, may be spot-welded to the casing 1 of the solenoid relay for conveniently mounting the solenoid in any desired position.

When the switch assembly is mounted in position, within the casing 4, a plurality of lugs, 4a, formed at the marginal edge of the casing, are bent over, in firm contact with the end plate 24, which in turn is firmly pressed against switch mounting member 23, to provide an effective seal for the switch chamber. This arrangement tends to exclude dust, dirt and moisture from the switch contacts.

While I have herein shown a construction, in Figures 1 to 5 of the drawings, wherein the switch unit is normally open when the solenoid coil is de-energized, it is to be understood that if desired the switch unit may be constructed and arranged to be normally closed when the coil is de-energized. In this latter event, contact bounce will be under control of the pressure exerted by the coil spring 21.

In the modified construction disclosed in Figures 6 to 8 of the drawings, the switch assembly is attached to one end of the solenoid casing, as distinguished from being totally contained within the casing as disclosed in the construction shown in Figures 1 to 5 of the drawings. In this construction, the solenoid coil and assembly may be understood to be identical to that disclosed in Figures 1 to 5 of the drawings, and includes a casing 40, having a cupped-shaped member 41, press fitted therein against the spool of the coil. The closed end of the casing is provided within openings through which protrude insulating lugs as indicated at 42, surrounding

power terminals as indicated at 43. The plunger, indicated at 44, is provided at its outer end with a flange or head 46, and a coil spring 48 surrounds this end portion of the plunger, with one end thereof seating against the cupped-shaped member 41 and the opposite end seating beneath the flange or head 46.

The end of the casing, opposite the terminal end, is formed with an outwardly extending flange 50, to which is mounted a switch assembly. The switch assembly comprises a housing or body 52, preferably formed, as a molded element, of suitable electrically insulated material, and seated against opposite faces of said housing are end plates or discs 54 and 56, of suitable insulating material. The housing is provided with two oppositely disposed, arcuately formed cavities 59 and 60, in which are fixedly mounted arcuately formed terminals 61 and 62, secured in place by rivets 63. Each of the terminals 61 and 62, are formed with terminal lugs 61a and 62a, which extend outwardly through the outer disc 54, as seen in the drawings. The two cavities 59 and 60 in the housing 52, are interconnected by a centrally located, elongated cavity 64, in which is mounted an axially movable, elongated contact bar 66, the outer ends of which are provided on their underside with contact buttons 67 and 68, adapted to cooperate respectively with fixed contact buttons 69 and 70, carried on the respective terminals 61 and 62, at the ends thereof opposite their terminal lugs.

The contact bar is loosely supported upon a lifter element 72, of electrical insulated material, which lifter is of generally circular cross-section, having opposite end portions mounted for guided slidable movement in apertures 54a and 56a of the respective end discs 54 and 56. The lifter is provided with a flange 73, against which the contact bar 66 is seated. Said contact bar is yieldingly pressed against said flange by a coil spring 75, surrounding one end portion of the lifter 72, with one end of said spring seated against said contact bar and the opposite end seated against the under side of the end disc 54. The housing 52 is provided with a cavity 77 for accommodating the flange 73 of the lifter, when the latter is moved longitudinally as hereinafter referred to.

It will be noted that the inner end of the lifter is, when the solenoid coil is de-energized, positioned in abutting engagement with the flange 46 on the solenoid plunger, and when the coil of the solenoid is energized, the lifter 72, together with the contact bar 66, tend to follow the movement of the plunger until the contacts 67 and 68 of the contact bar come into engagement with the terminal contacts 69 and 70. Thus, after the plunger has moved a short distance, due to energization of the coil of the solenoid, the contact bar ceases to follow the movement of the plunger. The inertia already imparted to the lifter is such that the lifter continues to follow the movement of the plunger. When the coil of the solenoid is de-energized, the spring 58 urges the plunger outwardly with respect to its seat, causing the flange 46 to abut against the end of the lifter 72, and thereby moving the contact bar 66, against the pressure of the spring 75, so as to separate the movable contacts 67 and 68 with respect to the stationary contacts 69 and 70.

By virtue of this construction, 'contact bounce' is substantially eliminated by reason of the relatively slow rate of movement of the contact bar 66, occurring during the first portion of the range of movement of the plunger and, further, by reason of the lifter, together with the contact bar being totally disconnected from the plunger by the time that the plunger becomes seated. By virtue of this construction, it is possible to make, break, and/or switch higher currents at various voltages than is normally practical with components of comparable size while, at the same time, maintaining a high degree of reliability of operation, as well as long contact life.

The switch assembly is fixedly attached to the casing 40 by means of three bolts 78, which extend through

the end disc 54, the housing 52, the end disc 56, and the casing flange 50, with the nut of the bolts seated against the outer surface of said flange 50. For convenience in securing this form of solenoid relay to a mounting, a suitable bracket 79, attached to the casing 40, is provided with apertured extensions, for the reception of bolts or other suitable fastening means.

Figure 9, discloses a further modified form of solenoid relay which is similar to the construction seen in Figures 6 to 8 of the drawings, and differs therefrom in that the contact arrangement is such that the switch is normally closed when the solenoid coil is de-energized. In this construction, I employ a switch housing 82, which is similar to the housing 52 of the construction seen in Figure 7, except that it is reversed in end-wise direction, and having end discs 83 and 84, corresponding in general with the end discs 54 and 56, arranged in reversed relation. Suitable passageways (not shown) are provided in the outer end wall of the housing 82, through which the terminal lugs, one of which is indicated at 85a, of the terminal strips 85 and 86 extend. Corresponding openings are likewise provided in the end disc 83.

In this construction, the switch is maintained closed, when the coil of the solenoid is de-energized by the pressure of the plunger coil spring 88, acting against an end flange 89 of a plunger 90, which flange exerts pressure against the inner end of a lifter 92 of insulating material. The lifter 92 is provided with a flange 93, against which is seated a contact bar 94, carrying contacts 95 and 96, for engaging contacts 97 and 98 on the terminal strips 85 and 86 respectively. Movement of the contact bar to closed contact position, occurs in opposition to the pressure of a spring 99, which surrounds the outer portion of the lifter 92, one end of which spring is seated against the contact bar 94, and the opposite end of said spring seats against the underside of disc 83. It is to be understood that when the solenoid coil is energized the spring 99, acting on the contact bar 94, moves it and the lifter 92 inwardly, separating its contacts 95 and 96 from the terminal contacts 97 and 98. The lifter 92, is guided in its movements in openings 83a and 84a of the discs 83 and 84, and the lifter and the contact bar 94 follow the movement of the plunger throughout its entire stroke. When the coil of the solenoid is again de-energized, spring 88 withdraws the plunger 90, causing the flange 89 to move the lifter and the contact bar 94 so as to cause contacts 95 and 96 to engage the terminal contacts 97 and 98. By reason of spring 99 tending to oppose spring 88, this arrangement provides a cushion engagement of said contacts.

While this invention has been disclosed in several particular embodiments for the purpose of illustration, it will be appreciated by those skilled in the art that various modifications may be made in shape, construction and materials to practice the invention. I do not, therefore, wish to be understood as limiting this invention to the precise embodiments herein disclosed, except as I may be so limited by the appended claims.

I claim:

1. A solenoid relay comprising an electrically energizable coil having a plunger opening therewithin, a plunger positioned through one end of said plunger opening and adapted for travel therein towards the other end of said plunger opening in response to the energization of said coil, and damping means including a base and an elongated resilient finger integral with said base and extending therefrom, said base being positioned adjacent said one end of said coil at the plunger opening and said elongated resilient finger extending from said base into said plunger opening in the path of travel of said plunger for exerting tension on said plunger in a direction transverse to its direction of travel to minimize vibration of the plunger when the coil is energized.

2. A solenoid relay comprising in combination an electrically energizable coil having an opening adapted

to receive a plunger therein, a plunger positioned through one end of said coil and adapted to travel towards the other end of the coil in response to the energization of said coil, a damping member adjacent said coil at said one end, said damping member comprising a thin metal disc-shaped support having a portion cut away therefrom for enabling the plunger to pass through said support and an elongated resilient finger integral with said support and extending therefrom into the coil opening in the path of travel of said plunger, said resilient finger being arcuately formed over its entire length and exerting sufficient tension against the side of the plunger when depressed by the latter to minimize vibration of the plunger without interfering with the free movement of the plunger in response to energization of the coil.

3. A solenoid relay in accordance with claim 2, wherein said damping member is formed of resilient nonferrous material.

4. A solenoid relay in accordance with claim 2, wherein said resilient finger is of bowed formation in longitudinal direction to provide a beam-like resilient support for said plunger which comprises two spaced apart portions engaging the wall of the opening in said coil to the end that a desired tension and a more uniform control of the tension on the plunger are attained.

5. A relay of the solenoid type comprising a casing, means in the casing providing a pair of compartments within said casing, said means including an insulating member having a transverse wall inserted within said casing, a coil, a cup-shaped member positioned adjacent said coil for retaining the latter in position within its casing compartment, a plunger actuated in response to the energization of said coil and extending through said cup-shaped member, a flange at the end of said plunger remote from said coil, and a spring positioned intermediate said cup-shaped member and said flange so as to be compressed therebetween for urging the plunger to extended position out of the coil when the latter is de-energized, positioned within one of said compartments, terminal means connected to said coil for applying energizing power thereto including lugs extending through one end of said casing, sealing means positioned between said coil and said one end of said casing and having extensions surrounding said terminals for preventing moisture or dust from entering said casing at said one end, a switch assembly in the other compartment including a blade and a plurality of contacts, said blade and said contacts engaging each other in response to the actuation of said plunger, a plurality of conductors connected to said blade and contacts extending through said other end of the casing, and sealing means applied to said conductors for preventing moisture and dust from entering said other end of the casing.

6. A solenoid relay comprising a closed casing insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil, when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within the other compartment and comprising a pair of stationary, spaced apart contacts positioned in said other compartment, a generally T-shaped switch blade of resilient material having its upright leg fixedly secured to said transverse wall portion and having its cross leg positioned for registration and engagement with said pair of spaced contacts, and a lifter having a head of insulating material engaging the cross leg of said switch blade and a stem portion extending through an aperture in said transverse wall with the end of said stem positioned to be engaged by abutment with the end of

said plunger for moving the switch blade in response to movement of the plunger in one direction.

7. A relay of the solenoid type comprising a casing, means in the casing providing a pair of compartments within said casing, said means including an insulating member inserted within said casing, a coil, a plunger actuated in response to the energization of said coil, and a spring urging the plunger to extended position out of the coil when the latter is de-energized, positioned within one of said compartments, terminal means connected to said coil for applying energizing power thereto including lugs extending through one end of said casing, sealing means positioned between said coil and said one end of said casing and having extensions surrounding said terminals for preventing moisture or dust from entering said casing at said one end, a switch assembly in the other compartment, including a blade and a plurality of contacts, said blade and said contacts engaging each other in response to the actuation of said plunger, a plurality of conductors connected to said blade and contacts extending through said other end of the casing, and sealing means applied to said conductors for preventing moisture and dust from entering said other end of the casing, said transverse wall of said insulated means having a recess for accommodating said head of the lifter when the cross leg of the switch blade engages said switch contacts.

8. A solenoid relay comprising a closed casing, insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within said other compartment and comprising stationary contact means positioned within said other compartment, a contact member positioned within said other compartment and movable into and out of engagement with said stationary contact means, and a lifter having an enlarged portion of insulating material engageable with said movable contact member and a stem portion extending through an aperture in said transverse wall with one end thereof positioned for abutment by the end of said plunger for moving said movable contact member relative to the stationary contact means in response to movement of the plunger in one direction.

9. A solenoid relay comprising a closed casing, insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within said other compartment and comprising stationary contact means positioned within said other compartment, a contact member positioned within said other compartment and movable into and out of engagement with said stationary contact means, and a lifter having an enlarged portion of insulating material engageable with said movable contact member and a stem portion extending through an aperture in said transverse wall with one end thereof positioned for abutment by the end of said plunger for moving said movable contact member relative to the stationary contact means in response to movement of the plunger in one direction, said contact member being resiliently movable to cause said lifter to follow the movement of said plunger in its opposite direction of movement.

10. A solenoid relay comprising a closed casing, insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within said other compartment and comprising stationary contact means positioned within said other compartment, a contact member positioned within said other compartment and movable into and out of engagement with said stationary contact means, and a lifter having an enlarged portion of insulating material engageable with said movable contact member and a stem portion extending through an aperture in said transverse wall with one end thereof positioned for abutment by the end of said plunger for moving said movable contact member relative to the stationary contact means in response to movement of the plunger in one direction, said contact member being resiliently movable to cause said lifter to follow the movement of said plunger in its opposite direction of movement, said stem portion and enlarged portion of the lifter being dimensioned and arranged to limit such following movement to a range less than the full range of movement of the plunger in said opposite direction.

11. A solenoid relay comprising a closed casing, insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within said other compartment and comprising stationary contact means positioned within said other compartment, a lifter having a stem portion extending through an aperture in said transverse wall with one end positioned for abutment by the end of said plunger and having a flange of insulated material, a contact bar mounted on said flange of the lifter, and movable into and out of engagement with the stationary contact means, and a spring urging said contact bar and lifter as a unit for movement in a direction to cause the stem of the lifter to yieldingly engage the plunger and follow the movement of the plunger in one direction, for moving said contact bar relatively to the stationary contact means.

12. A solenoid relay comprising a closed casing, insulated means associated with the casing to provide a pair of compartments, a solenoid assembly positioned within one of the compartments and comprising a coil, a plunger actuated in response to energization of the coil, and a spring for urging the plunger to extended position out of the coil when the latter is de-energized, said insulated means being formed to provide said other compartment and includes a transverse wall, and a switch assembly positioned within said other compartment and comprising stationary contact means positioned within said other compartment, a lifter of insulated material having a stem portion guided for movement in said transverse wall and having an enlarged portion, intermediate the length of the stem, a contact bar loosely mounted on the stem and seated against said enlarged portion, and a spring for urging the lifter and contact bar in a direction to cause one end of the stem to abut the end of the plunger and cause the lifter and contact bar to follow the movement of the plunger in one direction of movement of the plunger.

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