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L. FUCHS

2,415,739

SOLENOIDS

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Fig. 1.

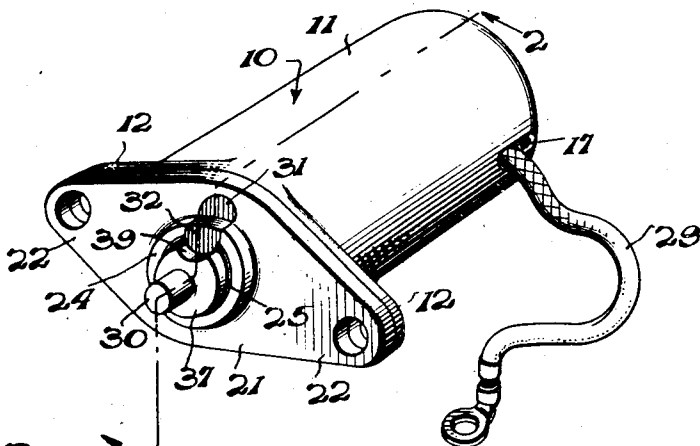


Fig. 2.

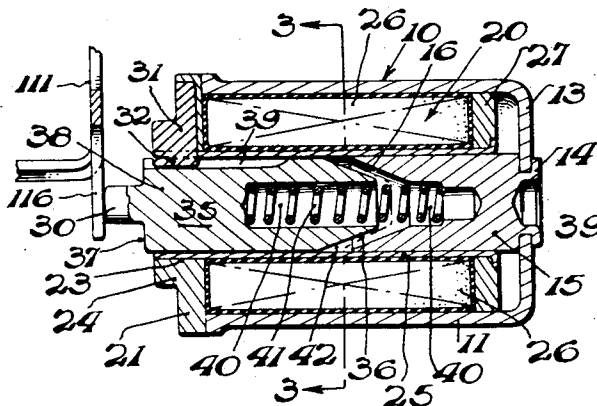


Fig. 3.

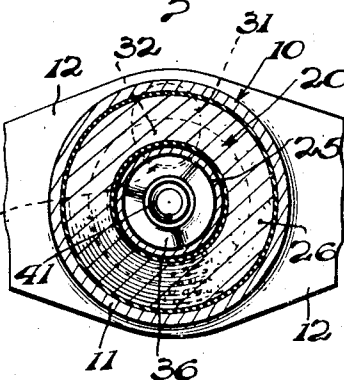
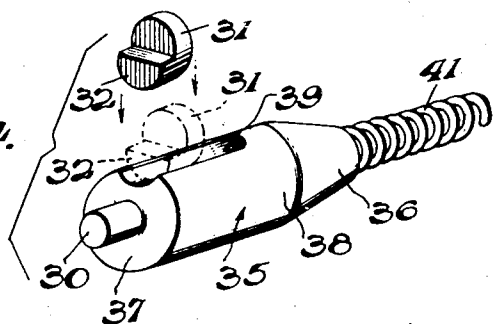


Fig. 4.



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SOLENOID

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1

My invention relates to electromagnetic apparatus, and more particularly to the mechanical construction thereof.

Electromagnets of the solenoid type are used extensively in installations of a character involving associated parts wherein vibrational and other disturbances are set up, which disturbances, when communicated to the solenoid assembly, tend to cause corresponding, but quite objectionable vibration and sometimes equally objectionable reciprocatory and/or rotary movements of the solenoid plunger with the result that the sleeve, in which the plunger is mounted, becomes unduly worn within a relatively short period thereby necessitating replacement.

One of the objects of my invention is to provide a solenoid equipped with means for counteracting the aforementioned tendency and for controlling the effect thereof upon the solenoid plunger whereby wear on the plunger sleeve is maintained at a minimum.

Another object of my invention is to provide a solenoid wherein the inter-relationship and the operation of the various components serve to preclude noise or chatter.

A further object of my invention is to provide a solenoid of the foregoing described character which is so constructed and arranged as to preclude removal, discharge or displacement of the plunger from within the solenoid while the latter is in assembled relation.

An important object of my invention is to provide a solenoid of the foregoing described character which is simple in construction, durable in use, efficient in operation, economical in manufacture and relatively silent when deenergized.

With the above and other objects in view, as will hereinafter appear, the invention consists in the combination, and arrangement of parts hereinafter set forth and illustrated in the accompanying drawing, from which the several features of the invention and the advantages attained thereby will be readily understood by those skilled in the art.

Referring to the drawing wherein like reference characters designate like parts throughout the several views,

Figure 1 is a perspective view of my invention.

Figure 2 is a sectional view taken on the line 2—2 of the Figure 1.

Figure 3 is a sectional view taken on the line 3—3 of Figure 2.

Figure 4 is a disassembled perspective view of the plunger and interlocking pin.

In teaching my invention, as illustrated in the

2

drawing, I utilize a casing unit 10 comprising a cylindrical metallic shell or casing 11 having an open end and provided with radially disposed flanges 12 adjacent said open end. The opposite end of the casing is integrally formed with an end wall 13 provided with a central aperture in which is disposed a shank 14 formed on the adjacent radial outer end face of a fixed pole-piece or magnetic plug 15 disposed axially within the casing and provided with a recessed frustum-shaped inner end face 16. The shank 14 is formed on its outer end with a circumferential lip coacting with the outer end face to secure the plug to the end wall 13 and in fixed relation therewith. The circumferential face of the casing, adjacent the margin of the end wall 13, is provided with a hole 17, the purpose of which will hereinafter become apparent.

A coil assembly unit 20 is arranged within the casing and is introducible therein as a unit, and which comprises a closure plate 21 transversing the open end of the casing and provided with flanges 22 engaging flanges 12 and formed with a centrally disposed opening 23 and an outwardly disposed rib 24 surrounding the opening, the latter having fixed therein one end of a nonmagnetic guide sleeve 25 on which is mounted an exciting coil 26. The opposite end of the sleeve 25 is provided with a collar 27 coacting with the plate 21 to maintain the coil 26 therebetween, said collar being connected to one lead wire (not shown) of the coil 26 and engaging the casing 10 to establish a ground connection between the coil and casing. The other lead wire 29 of the coil is insulated and extends through a notch (not shown) formed in the periphery of the collar and out of the casing through the hole 17 as depicted in the drawing.

The aforementioned opposite end of the sleeve 25 tightly embraces the plug 15 and forms a seal therewith to preclude the escape of air therebetween from within the sleeve for a purpose hereinafter made apparent. By thus disposing the plug within the sleeve, the plug serves to maintain centralization of the unit 20 within the casing. An interlocking element or pin 31 is disposed in parallel relation with the sleeve and extends axially through the rib 24 and plate 21 and the adjacent end face of the sleeve 25 for securing the sleeve to the plate against relative rotation, a side portion 32 of the pin projects and extends longitudinally within the bore of the sleeve 25.

A movable pole-piece or magnetic plunger 35 is slidably mounted within the sleeve and is pro-

vided with inner and outer end faces 36 and 37 respectively, the outer face 37 having a diametrically reduced projecting end section 38. The circumferential face 38 of the plunger is formed with a longitudinal groove 39 terminating in spaced relation to the inner frustum-shaped end face 36 and which groove 39 receives the side portion 32 of the pin 31 whereby rotation of the plunger relative to the sleeve 25 is precluded. The confronting inner end faces 16 and 36 of the plug 15 and plunger 35 are formed with aligned sockets 40 receiving therein opposite ends of a coil spring 41 which functions to urge the plunger away from the plug when the solenoid is deenergized thereby establishing an air chamber 42 between the plunger and plug as clearly illustrated in Figure 2 of the drawing. Obviously, when the solenoid is energized, the plunger is actuated in a direction towards the plug and air contained in the chamber 42, between the plunger and plug, is forced outwardly therefrom about and between the sleeve 25 and plunger 35 as hereinafter fully disclosed, it being borne in mind that the plug 15 and sleeve 25 are tightly fitted to form a seal therebetween.

The diameter of the plunger 35 is such as to establish a relatively close fit of the plunger with the sleeve 25 and thus provide a relatively small circumspace or ring-like passage between the plunger and sleeve for the escape of air from the chamber 42. The inner end face of the plunger is of a continuous circular contour, due to the groove 39 terminating inwardly thereof, and which face serves to evenly displace air escaping from the chamber 42 through the passage with the result that the plunger is urged towards centralization within the sleeve during its movement towards the plug. Owing to the relatively small size of the passage, retarding the escape of air from the chamber, the plunger tends to compress air therein, to the extent of establishing a fluid resistance which reacts to counteract vibratory reciprocation of the plunger when the solenoid is deenergized. By thus counteracting vibratory reciprocation of the plunger together with the aforementioned centralization thereof and the precluding of rotation by the interlocking pin, wear on the sleeve by the plunger is appreciably minimized thereby prolonging the effective use or life of the sleeve and eliminating noise or chatter heretofore occasioned by vibration.

The flanges 12 and 22 are provided with registering openings 43 for the reception of screws (not shown) whereby the solenoid may be secured to another device (not shown) with which it may be operatively associated, for example, an engine starter of the character wherein the end section 40 of the plunger 35 engages a radially outstanding lug 116 of a brush ring 111 for maintaining the ring 111 in a latched position after the ring has been tripped and the end 40 disposed in sidewise engagement with the lug 116.

Without further elaboration the foregoing will so fully explain the invention that others may, by applying current knowledge, readily adapt the same for use under various conditions of service. Moreover, it is not indispensable that all the features of the invention be used conjointly since they may be employed advantageously in various combinations and sub-combinations.

It is obvious that the invention is not confined to the herein described use therefor as it may be utilized for any purpose to which it is adaptable. It is therefore to be understood that the invention is not limited to the specific construction as

illustrated and described as the same is only illustrative of the principles of operation, which are capable of extended application in various forms, and that the invention comprehends all construction within the scope of the appended claims.

What is claimed is:

1. In a solenoid construction, a casing, a magnetic plug disposed within and fixed to said casing, a coil assembly disposed within said casing and comprising a closure plate for said casing and being formed with a centrally disposed opening, a nonmagnetic sleeve having an open end extending into said opening and fixed to said plate and the other end removably embracing said plug to effect a seal therebetween, an interlocking pin disposed in parallel relation with the axis of the casing and extending through said plate and the end face of said sleeve at the open end thereof to preclude relative rotation therebetween and having a side portion projecting within the bore of the sleeve, a magnetic cylindrical spring-pressed plunger having an inner end face disposed in confronting relation with said plug and movable within said sleeve towards said plug when said assembly is rendered effective, and urged away from said plug when said assembly is rendered ineffective and to thus provide an air chamber between said plunger and plug, the circumferential face of said plunger being formed with a longitudinal groove terminating inwardly of said inner end face and receiving said portion of said pin to preclude relative rotation of said plunger and sleeve, said inner end face being of a diameter and of a circular contour to establish a relatively small passage between said plunger and sleeve for retarding the escape of air from said chamber occasioned by vibratory reciprocation of said plunger when said coil assembly has been rendered ineffective and for urging centralization of said plunger within said sleeve by the action of the escaping air during movement of the plunger toward said plug when said coil assembly has been rendered effective.

2. In a solenoid construction, a casing having an open end and formed at the opposite end with an end wall, a magnetic plug axially disposed within said casing and fixed to said wall, a coil assembly disposed within said casing and comprising a closure plate transversing said open end of said casing and being formed with a centrally disposed opening and an outwardly disposed rib surrounding said opening, a nonmagnetic sleeve having an open end extending into said opening and fixed to said plate and the other end removably embracing said plug to effect a seal therebetween, a coil mounted on said sleeve, an interlocking pin disposed in parallel relation with the axis of the casing and extending through said rib and the face of said open end of said sleeve to preclude relative rotation therebetween, said pin having a side portion projecting within the bore of the sleeve, a magnetic cylindrical plunger having an inner end face disposed in confronting relation with said plug and movable within said sleeve towards said plug when said assembly is rendered effective, a spring interposed between said plunger and plug for urging said plunger away from said plug when said assembly is rendered ineffective and to thus provide an air chamber between said plunger and plug, the circumferential face of said plunger being formed with a longitudinal groove terminating inwardly of said inner end face and receiving said portion of said

5

pin to preclude relative rotation of said plunger and sleeve, said inner end face being of a diameter and of a circular contour to establish a relatively small passage between said plunger and sleeve for retarding the escape of air from said chamber occasioned by vibratory reciprocation of said plunger when said coil assembly has been rendered ineffective and for urging centralization of said plunger within said sleeve by the action of the escaping air during movement of the plunger toward said plug when said coil assembly has been rendered effective.

3. In a solenoid construction, a casing; a plug of magnetic material axially disposed within said casing and secured at one end to the latter; a coil assembly disposed within said casing and comprising a plate at one end of said casing, said plate having a central opening in axial alignment with said plug and an outwardly projecting opening encircling boss; a sleeve of non-magnetic material axially disposed within said coil assembly, said sleeve having one end projecting into the central opening and secured to said plate while the other end is removably mounted on the free end of said plug to effect relative centralization; an energizing coil mounted on said sleeve; a plunger of magnetic material slidably mounted in the other end of said sleeve and movable towards said plug when said assembly is rendered effective; a spring interposed between said plug and plunger for urging the latter away from said plug when said assembly is rendered ineffective, said plunger and sleeve being formed relatively of such diameters as to decelerate the flow of air therebetween for dampening vibratory reciprocations of said plunger when said coil assembly is rendered ineffective; and a locking pin disposed in parallel relation to the axis of said casing and extending longitudinally through the encircling boss on said plate, said pin having one portion secured to the latter and another portion projecting through said sleeve into said boss, the circumferential face of said plunger being formed with a longitudinal groove terminating inwardly from the outer end of said plunger and receiving said pin projecting

6

portion to preclude relative rotation of said plunger and sleeve.

4. In a solenoid construction, a casing; a plug of magnetic material in said casing and secured at one end to the latter; a coil assembly in said casing including a plate at one end of said casing, said plate having a central opening; a sleeve of non-magnetic material disposed within said coil assembly, said sleeve having one end projecting into the central opening and secured to said plate while the other end is removably mounted on the free end of said plug to effect relative centralization; an energizing coil mounted on said sleeve; a plunger of magnetic material slidably mounted in the other end of said sleeve and movable towards said plug when said assembly is rendered effective; a spring interposed between said plug and plunger for urging the latter away from said plug when said assembly is rendered ineffective, said plunger and sleeve being formed relatively of such diameters as to decelerate the flow of air therebetween for dampening vibratory reciprocations of said plunger when said coil assembly is rendered ineffective; and a locking pin disposed in parallel relation to the axis of said casing and extending longitudinally through said plate, said pin having one portion secured to the latter and another portion projecting through said sleeve into said boss, the circumferential face of said plunger being formed with a longitudinal groove terminating inwardly from the outer end of said plunger and receiving said pin projecting portion to preclude relative rotation of said plunger and sleeve.

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