Oct. 7, 1941. A. G. STIMSON 2,258,228

SOLENOID DEVICE

Filed Nov. 8, 1939

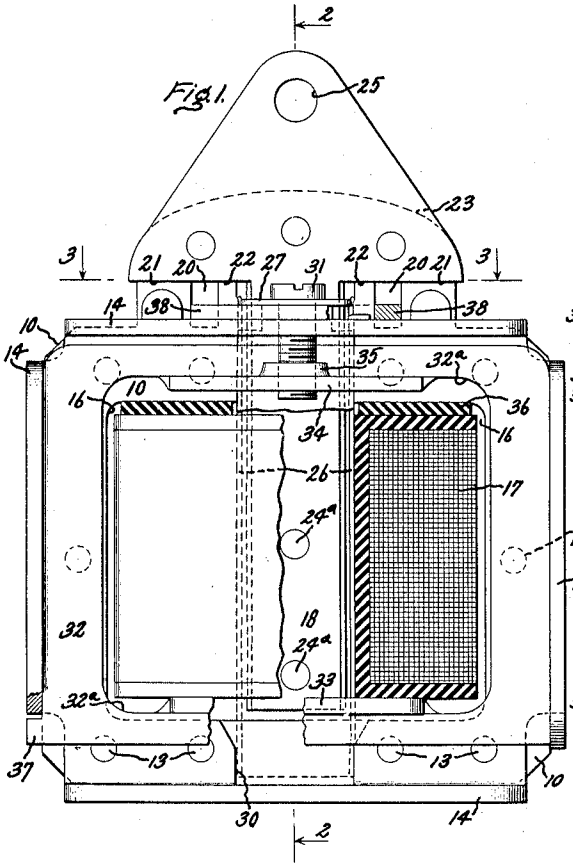


Fig. 1.

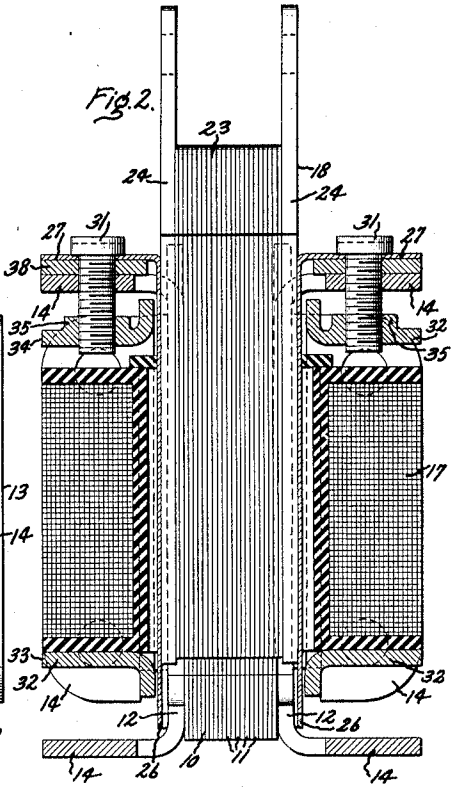


Fig. 2.

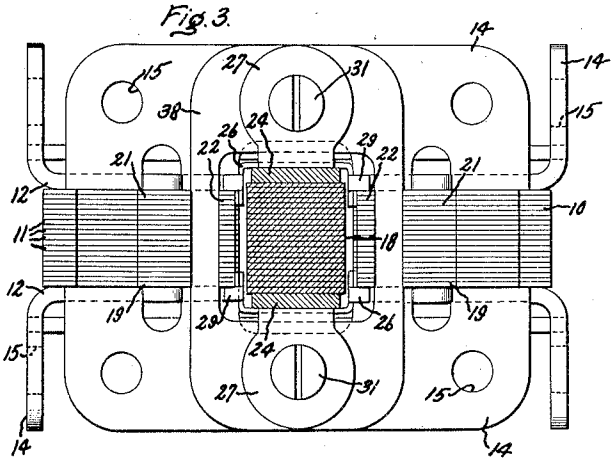


Fig. 3.

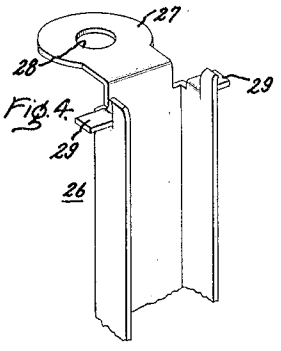


Fig. 4.

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SOLENOID DEVICE

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7 Claims. (Cl. 175—338)

My invention relates to solenoid devices, more particularly to magnetic solenoids having a plunger arranged for movement when the solenoid is energized, and has for an object an improved device of this character which is easy to assemble and inexpensive to manufacture.

Another object of my invention is the provision of an improved shading means, preferably in the form of a single conducting element which simultaneously serves magnetically to shade two spaced apart hole faces.

Further objects and advantages of my invention will become apparent from the following specification, and for a more complete understanding reference should be had to the accompanying drawing in which Fig. 1 is an elevational view partly in section of a solenoid device embodying my invention; Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 looking in the direction of the arrows; Fig. 3 is a plan view of the device of Fig. 1 showing a section taken along the line 3—3 of Fig. 1 looking in the direction of the arrows; and Fig. 4 is a fragmentary perspective view of a plunger slide guide for the solenoid device according to my invention.

Referring now to the drawing, I have shown my invention in one form provided with a substantially U-shaped magnetizable frame 10, preferably fabricated from a plurality of laminations 11, mounted between a pair of side plates 12, the plates and laminations being secured together by the rivets 13. As shown, the side plates 12 have the bent-over outwardly extending flanges 14, each provided with the bolt-holes 15 through which bolts may be inserted conveniently to mount the frame on any of its four sides desired. Although I have shown a flange structure on each side plate consisting essentially of four separate flanges 14, these separate flanges may be joined together by welding to form a continuous peripheral flange, or if desired, portions of the flanges 14 or some of these flanges may be omitted entirely without departing from the scope of my invention. Within the U-shaped frame 10 is a substantially rectangular opening or window 16 in which an energizing winding 17 for the frame 10 and a plunger 18 are mounted as more fully described hereinafter. It will be noted that the magnetic frame 10 is rectangular in shape with its upper side or leg, as seen in the drawing, centrally discontinuous to form spaced core ends, each of which is provided with an external pole face 19. The surface areas of these two pole faces are in the same plane and are each divided by a groove 20 into an outer section 21 and an inner section 22.

Best seen in Figs. 1 and 2, a T-shaped magnetic plunger 18 is provided for the frame 10. As shown, the plunger 18 is of the pull type and is in its position of magnetic attraction with its oppositely extending arms or cross-head 23 abutting the pole faces 19 and its elongated body portion extending downwardly within the window 16 of the frame to a point adjacent the inner surface of the bottom of the U-shaped frame, the body portion of the plunger being encircled by the coil 17 but freely slidable therein. The plunger 18 is preferably fabricated from a plurality of laminations of magnetic material and is provided with a pair of magnetic side plates 24 secured together by the rivets 24a. The side plates 24 of the plunger 18 extend upwardly beyond the laminations to provide suitable extensions to which an operating member (not shown) may be connected at the apertures 25. As seen in section in Fig. 3, the lower body portion of the plunger 18 which is slidable between the pole faces and extends downwardly within the frame is of substantially rectangular cross-section. The edges of the inner pole face sections 22 adjacent the plunger 18 are preferably cut away slightly to prevent these edges from rubbing against the plunger should they mushroom over during repeated operation of the plunger.

In order to guide the sliding movement of the plunger 18 between its upper unattracted and lower attracted positions, I provide a pair of opposed guide members 26 which are easily assembled and secured within the frame 10 to form an elongated slot or recess that conforms to the shape of the plunger therein and guides it during the sliding movement. As shown in Fig. 4, the guides 26 are formed by a pair of trough-shaped or three-walled angular stampings of suitable non-magnetic material, such as stainless steel, to prevent the plunger from sticking to the side walls during its movement, a bent projection 27 having a central hole 28 being provided at the upper end of each of the guide members. The side walls of the guide members 26 are also provided with the outwardly extending tangs 29 which, as shown in Fig. 3, are seated on portions of the flanges 14 adjacent the inner sections 22 of the pole faces 19 to position the guide members with respect to the frame when assembled. The lower ends of the guide members 26 fit into suitable recesses 30 in the side plates 13 of the frame 10 near the bottom of the frame. As will become apparent from the description of assembly here-

inafter, the opposed guide members 26 are secured in position, each by a single screw 31 extending through a hole 28. The pair of guide members forms a hollow rectangular structure within which the plunger 18 is slidable while at the same time forming a central post encircled by the energizing coil 17.

The energizing coil 17 besides having its longitudinal axis centrally positioned within the window 16 of the frame 10 by the guide members 26 is also secured in position by a pair of separate mounting members or brackets 32. As shown in Fig. 1, the mounting members 32 comprise a pair of rectangular stampings each having a central opening 32a substantially as large as the opening 16 in the frame 10 for receiving the coil 17 therein. At the top and bottom of the openings 32a in the mounting members 32, I provide a pair of outwardly extending flanges 33 and 34, the lower flange 33 of each mounting member 32 forming a support or platform on which the bottom surface of the coil 17 is seated. The upper flange 34 of each mounting member is provided with an internally threaded fastening lug 35 for receiving the screw 31. Each mounting member 32 is placed within a recess formed by the flanges 14 at either side of the frame 10. By tightening the screws 31, the rectangular mounting member 32 are drawn upwardly to press the top of the coil 17 against the upper inside surface of the frame 10, the bottom of the coil 17 resting on flanges 33. Preferably, a pair of insulating spacers 36 are inserted between the top of the coil 17 and the frame 10 to distribute the pressure over the top of the coil and form a resilient compression member between the coil and frame. To further secure the mounting members 32 with respect to the frame 10, I provide on each mounting member a pair of ears 37 that are slidable upwardly in vertical notches in the side flanges 14 as the mounting members are drawn up into the coil-securing position shown. In this manner, the mounting members 32 also assist in retaining the lower ends of the guide members 26 in position on the frame within the recesses 30.

In order to shade magnetically a portion of the pole faces 19, I provide a single shading means that is readily assembled and conveniently secured by the screws 31. This shading means comprises an annular or hoop-shaped shader 38 of suitable conducting material, such as copper, that fits into the grooves 20 in each of the pole faces 19 and encircles both of the inner sections 22 of the pole faces and also the plunger 18. Since the shader 38 simultaneously encompasses each of the inner sections 22 of the pole faces and the plunger 18 which completes the magnetic path for these inner sections, the inner sections 22 are relatively unshaded and the magnetic flux flowing therein is substantially in-phase. This is true since the magnetic path for the inner sections 22 lies within the shader 38 and doubles back on itself therein. What is had, therefore, is a magnetic loop encircled by a conducting loop, and no shading results. The outer sections 21 of the pole faces 19, however, are magnetically shaded and the flux therein is out-of-phase with respect to the phase of the flux in the inner sections 22, since in this case the plunger 18 is surrounded by the shader 38 and forms a common path for the flux in the outer pole face sections 21, whereby the flux travels in a path both through and around the shader 38. What is had, therefore, is the usual linking wherein the shader loop encircles the magnetic path and the magnetic path encircles the shader, and shading of the flux results. Thus a single shader 38 effectively shades a pair of spaced apart pole face sections 21. The shader 38, furthermore, is secured on the frame 10 by the screws 31 which, as explained above, also secure the guide members 26 and the mounting members 32. In this manner, the usual swaging of the shader in the grooves is eliminated.

To assemble the device from the completed parts, the shader 38 is mounted in the grooves 20 as shown. Thereafter the coil 17 and the inserts 36 are placed in the window 16 of the frame 10 and the guide members 26 are inserted in the frame and within the coil 17. The lower ends of the guide members 26 fit into the recesses 30 in the frame and the tangs 29 rest on the flanges 14 at the sides of the pole face sections 22. Next, the mounting brackets 32 are inserted around the coil 17 at either side, the ears 37 passing below the lower ends of the vertically extending flanges 14 to a point ready for entrance into the vertical notches in these flanges. The screws 31 are then passed through the holes 28 in the guide members 26, through suitable holes in the shader 28 and through the holes 15 in the upper flanges 14 to be received by the threaded lugs 35. By tightening the screws 31, the mounting brackets 32 and the coil 17 are pulled upwardly until the ears 37 are in the notches provided therefor and the coil 17 with its inserts 36 (if used) are held against upper edge of the frame window 16.

At this time, all parts of the frame 10 are secured and the frame is ready to receive the plunger 18. Should it be desired to change to the push type of plunger, it is only necessary to remove the pull-plunger 18 shown and replace it with a plunger having side plates 24 that extend downwardly out through the bottom of the frame in addition to the top as shown. Thus it is apparent that I have provided a solenoid device having a very small number of parts designed for easy and rapid assembly, a simple shading means, a simple fastening means for securing the parts together, as well as an improved guide means for the plunger.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with one side discontinuous to form spaced ends having a pair of pole faces, outwardly extending clamping flanges on each side of said frame adjacent said spaced ends, a pair of coil supporting members respectively slidably secured on opposite sides of said frame for movement toward said spaced ends, each of said coil supporting members being provided with an opening communicating with the opening in said magnet frame and substantially as large as the opening in said magnet frame, an outwardly extending flange on the end of each of said coil supporting members remote from said spaced ends and adjacent the opening in said member, a magnet coil supported by said supporting member flanges in the opening in said magnet frame and pro-

jecting through the openings in said coil supporting members, and means securing said coil supporting members to said clamping flanges on said frame thereby to secure said coil against said discontinuous frame side.

2. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with one side centrally discontinuous to form spaced ends having a pair of pole faces each provided with a slot, outwardly extending clamping flanges on each side of said frame adjacent said spaced ends, a pair of rectangular coil supporting plates respectively slidably secured on opposite sides of said frame for movement toward said spaced ends, each of said coil supporting plates being provided with an opening communicating with the opening in said magnet frame, an outwardly extending flange on the end of each of said coil supporting plates remote from said spaced ends and adjacent the opening in said plate, a magnet coil supported by said supporting plate flanges in the opening in said magnet frame, an annular pole shader member having portions lying in said slots and portions adjacent said upper flanges on said frame, and clamping members for securing said coil supporting plates to said clamping flanges on said frame so as to secure said coil against said discontinuous frame side and for securing said pole shader member to said clamping flanges.

3. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with a side centrally discontinuous to form spaced ends having a pair of external pole faces each provided with a slot, outwardly extending flanges on each edge of said side frame, a pair of rectangular coil supporting plates respectively adjacent opposite sides of said frame, each of said coil supporting plates fitting loosely between a pair of said frame flanges so as to be slidably secured by said flanges for movement toward said spaced frame ends and each of said coil supporting plates being provided with an opening communicating with the opening in said magnet frame, an outwardly extending flange on the end of each of said coil supporting plates remote from said spaced ends, said flange being adjacent the opening in said plate, a magnet coil supported on said supporting plate flanges in the opening in said magnet frame, a plunger guide member on each side of said magnet frame adjacent said spaced ends and extending through said winding, a flange on each of said guide members overlapping a clamping flange on said frame adjacent said spaced ends, an annular pole shader member having portions lying in said slots and portions overlapping said clamping flanges on said frame, and a clamping member on each side of said magnet frame for securing the adjacent guide member and said pole shader member to the adjacent frame clamping flange and securing its adjacent coil supporting plate to said adjacent frame clamping flange so as to secure said coil against said discontinuous frame side.

4. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with an upper side centrally discontinuous to form spaced ends having a pair of external pole faces each provided with a slot, outwardly extending flanges on each edge of said side frame, a pair of rectangular coil supporting plates respectively adjacent opposite sides of said frame, each of said coil supporting plates fitting loosely between an upright pair of said flanges so as to be vertically slidably secured by said flanges and each of said coil supporting plates being provided with an opening embracing the opening in said magnet frame, an outwardly extending flange on the lower end of each of said coil supporting plates adjacent the aperture in said plate, a magnet coil supported on said supporting plate flanges in the opening in said magnet frame, a plunger guide member on each side of said magnet frame adjacent said spaced ends and extending through said winding, an upper flange on each of said guide members overlapping an upper flange on said frame, an annular pole shader member having portions lying in said slots and portions overlapping said upper flanges on said frame, and a clamping screw on each side of said magnet frame extending through apertures in the adjacent guide member, pole shader member and upper frame flange and extending into a tapped aperture in an upper flange on the adjacent coil supporting plate, said screws clamping said coil against said upper frame side and clamping said guide members, and said pole shader members to said upper frame flanges.

5. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with an upper side centrally discontinuous to form spaced ends having a pair of external pole faces each provided with a slot, a pair of rectangular side plates secured to said frame on opposite sides thereof and provided with central openings substantially coincident with the rectangular opening in said magnetic frame, outwardly extending supporting flanges on each edge of each of said side plates, the lower ends of opposite upright flanges each being provided with a vertical slot, a pair of rectangular coil supporting plates respectively adjacent said side plates, said coil supporting plates fitting loosely between upright flanges of said side plates so as to be vertically slidably secured by said flanges and each of said coil supporting plates being provided with an opening substantially coincident with the opening in its adjacent side plate, an outwardly extending flange on the lower end of each of said coil supporting plates adjacent the opening in said plate, a magnet coil supported on said supporting plate flanges in the opening in said magnet frame, extensions on the lower ends of each of said supporting plates slidably fitting in said slots to provide for movement of said coil supporting plates toward and away from said upper frame side, a channel-shaped plunger guide member on each side of said magnet frame adjacent said spaced ends and extending through said winding, an upper flange on each of said guide members overlapping the upper flange on its adjacent side plate, an annular plate pole shader member having portions lying in said slots and portions overlapping said upper flanges on said side plates, barrier members on top of said coil extending through the opening in said magnet frame, and a clamping screw on each side of said magnet frame extending through apertures in the adjacent guide member, pole shader member and upper side plate flange and extending into a tapped aperture in the upper flange of the adjacent coil supporting plate, said screws being turned to move said coil supporting plates upward thereby to clamp said coil and said insulating barrier members against said upper frame side and to clamp said guide members, and said pole shader members to the upper flanges on said side plates.

6. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening, outwardly extending clamping flanges secured to opposite sides of a leg of said frame, a pair of rectangular coil supporting members, means slidably securing said coil supporting members on opposite sides of said frame for movement toward and away from said clamping flanges, said coil supporting members being each provided with an opening communicating with the opening in said magnet frame and substantially as large as the opening in said magnet frame, an outwardly extending flange on the end of each of said coil supporting members remote from said clamping flanges and adjacent the opening in said magnet frame, a coil in the opening in said magnet frame projecting through the openings in said coil supporting members, and screw means on each of said clamping flanges cooperating with the adjacent coil supporting member for drawing said coil supporting members slidably toward said clamping flanges thereby to clamp said coil against said leg.

7. A solenoid device comprising a rectangular magnetic frame provided with a rectangular opening and with one leg discontinuous, outwardly extending clamping flanges secured to opposite sides of said discontinuous leg, a pair of rectangular coil supporting members, means slidably securing said coil supporting members on opposite sides of said frame for movement toward and away from said clamping flanges, said coil supporting members being each provided with an opening communicating with the opening in said magnet frame, an outwardly extending flange on the end of each of said coil supporting members remote from said discontinuous leg and adjacent the opening in said magnet frame, a coil in the openings in said magnet frame and said coil supporting members, a pair of oppositely disposed guide members extending through said coil and between the ends of said discontinuous leg, said guide members each having a flange overlapping one of said clamping flanges, and screw clamping means extending through each of said clamping flanges for securing said guide members to said clamping flanges and for drawing said coil supporting members slidably toward said clamping flanges thereby to clamp said coil against said discontinuous leg.

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