March 4, 1958 H. SAUER 2,825,783

POLARIZED RELAY

Filed July 18, 1955 2 Sheets-Sheet 1

FIG. 1.

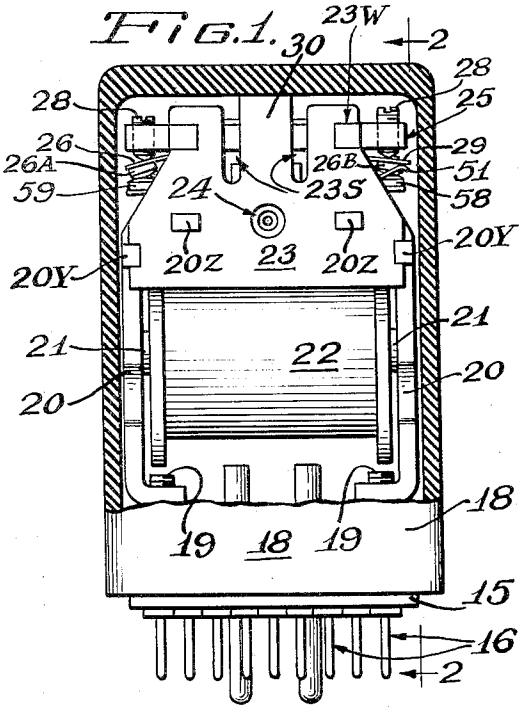


FIG. 2.

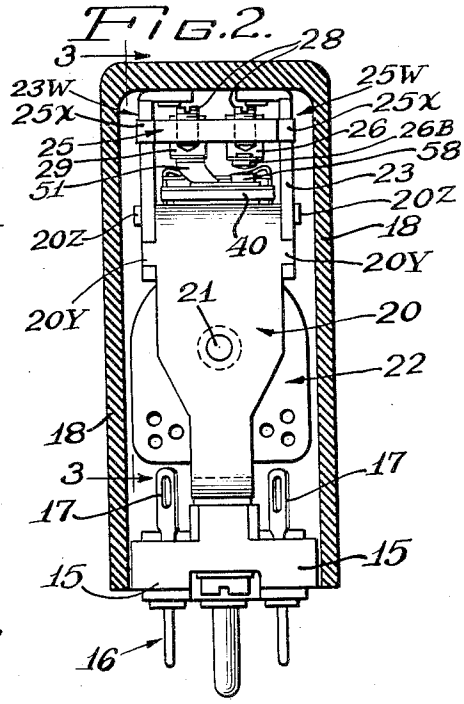


FIG. 3.

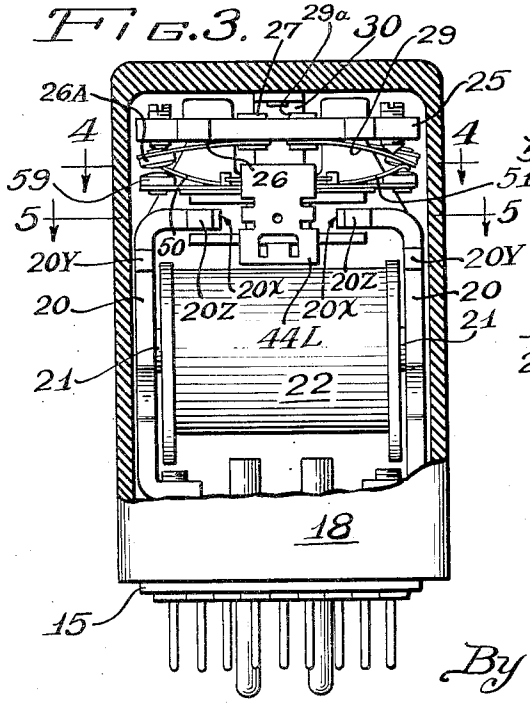


FIG. 4.

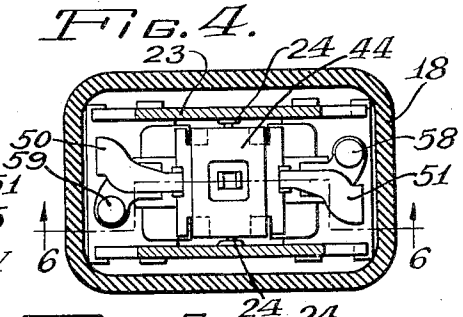
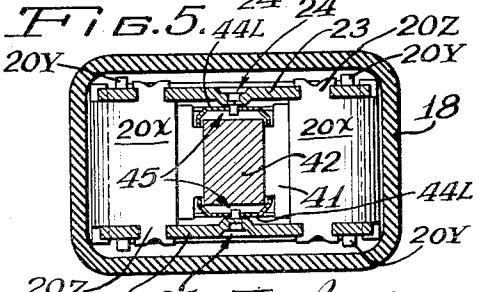


FIG. 5.



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FIG. 6.

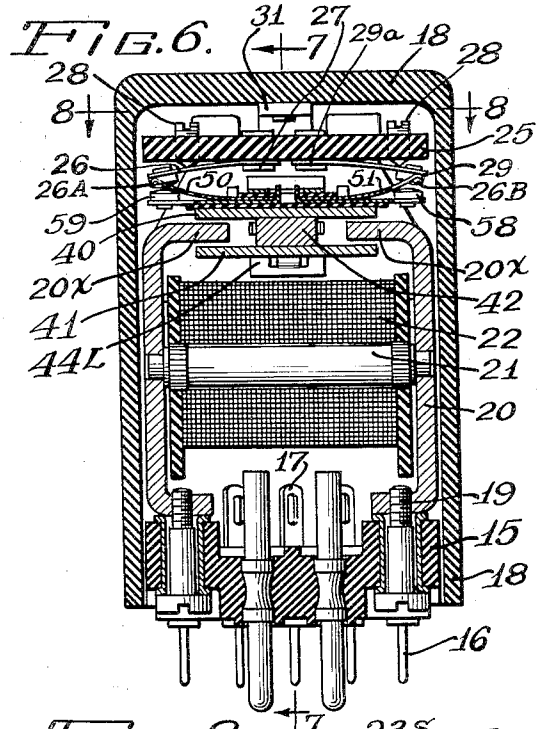


FIG. 7.

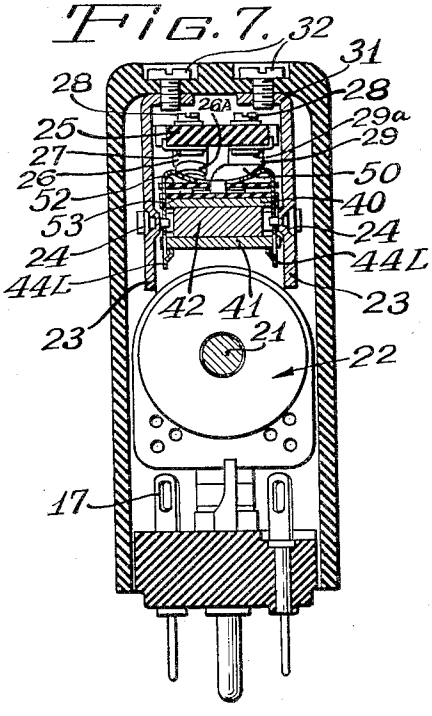


FIG. 8.

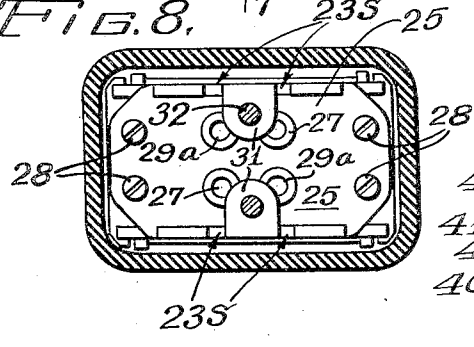


FIG. 9.

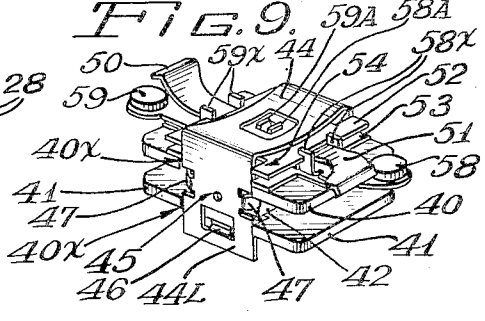


FIG. 10.

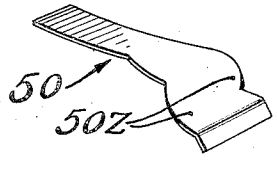
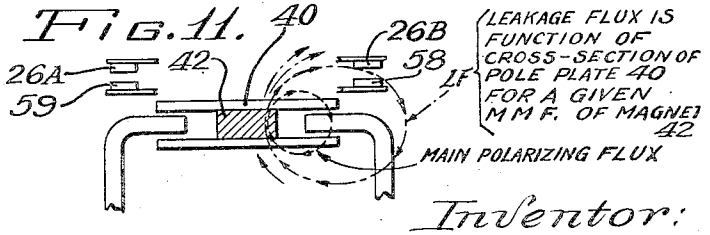


FIG. 11.



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POLARIZED RELAY

Hans Sauer, Chicago, Ill., assignor, by mesne assignments, to Raymond T. Moloney, Chicago, Ill.

Application July 18, 1955, Serial No. 522,538

9 Claims. (Cl. 200—93)

This invention relates to electromagnetic relays, particularly the polarized variety, and has as its principal object the provision of a polarized relay characterized by an exceptional sensitivity which is achieved by certain constructions pertaining especially to the form, mounting, and spring loading of the moving elements, and the particular arrangement of parts constituting the magnetic circuits for both the permanent and induced magnetic fluxes.

Additional objects relate to the provision of a polarized relay which is rugged and highly shock resistant, has fast pull-in and release response with suppressed contact flutter and arcing, and which can be economically manufactured for all applications requiring extreme sensitivity, stability, and reliability, as will more fully appear hereinafter.

Still more detailed objects pertain to the provision, in a device of the class described, of a novel subassembly constituting the main moving system of the relay and comprising a novel carrier unit including bearing, spring-loading, polarizing, and contact means, all comprising a compact, dynamically balanced, easily integrated and adjusted subassembly, making possible the manufacture of an exceptionally sensitive precision instrument on a production basis at a moderate cost.

Additional aspects of novelty and utility relate to details of the construction and operation of the device described hereinafter in view of the annexed drawings, in which:

Fig. 1 is a front elevation of the new relay with portions of the casing cut away and relay parts shown in elevation;

Fig. 2 is a vertical section through the casing along lines 2—2 of Fig. 1 with relay elements shown in elevation;

Fig. 3 is a sectional view partly in elevation similar to Fig. 1 but taken at lines 3—3 of Fig. 2;

Fig. 4 is a horizontal section taken in the direction of lines 4—4 of Fig. 3;

Fig. 5 is another horizontal section taken at lines 5—5 of Fig. 3;

Fig. 6 is a full vertical median section;

Fig. 7 is a full vertical cross section taken along jogged lines 7—7 of Fig. 6;

Fig. 8 is a horizontal top section through the housing shell taken along lines 8—8 of Fig. 6 and looking down in plan upon the moving system or carrier subassembly;

Fig. 9 is a perspective detail of the moving system or carrier subassembly;

Fig. 10 is a perspective of one of the variable characteristic springs;

Fig. 11 is a diagram of the arc suppressing action.

Referring to Fig. 1, the relay consists of a molded base member 15 of suitable insulating properties and into which are embedded terminal prongs 16, having internal lugs 17, as required (Fig. 2).

Fitted onto the base is a suitable housing, cannister, or shell 18 which may be sealed onto the base hermetically, or as required.

Secured to the base, as at 19, are a pair of ferromagnetic pole pieces 20, the upper ends of which (Fig. 3) are offset toward each other to provide spaced pole faces 20X (see Fig. 5 also).

A coil core 21 (Figs. 1–3) is staked into the two pole pieces and carries the coil bobbin or winding 22 (see Fig. 6 also) from which suitable energizing leads (not shown) are carried to the lugs 17 in the usual way.

One each of a pair of bridge and bearing plates 23 (Fig. 1) is secured on the opposite sides of the pole pieces by means of lugs 20Z (Figs. 1 to 5) which are staked into said plates to rigidify the entire frame structure and afford both a bearing means and support for a contact carrier, as will appear, it being noted that additional lug means 20Y are provided on pole pieces 20 to interfit with said bridge plates; and the latter are extruded inwardly to provide aligned bearing means or pivots 24 for the movable system hereinafter described.

The frame structure is completed by application of a contact carrier in the form of an insulated plate 25 (Figs. 6, 7, 8) carrying a pair of divergent spring contact arms 26 riveted to the plate as at 27, and a pair of opposite upper blade springs 29 likewise riveted to the plate as at 29a, Fig. 8.

As viewed best in Fig. 8, the contact plate is provided with four adjustment screws 28 each overlying one of the blades 26 or 29 for adjustment to tension each of the same more or less for the purpose of regulating the contact gap as well as response characteristics of the moving system.

The contact plate 25 is rigidly seated between, and secured by, the pair of bridge plates 23 in the manner shown in Figs. 1 and 2 by means of cut-outs 25X on the plate interfitting with complementary cut-outs 23W on said plates so that when the latter are staked home the contact plate is rigidly secured in position.

As viewed especially in Figs. 1 and 8, each of the two bridge plates 23 has a pair of slots 23S defining a tongue 30 which is upset to provide a lug 31 (Fig. 8); and these lugs are tapped to receive cover screws 32 (Fig. 7) in the embodiment shown.

A very important feature of the new construction is the so-called moving system by which is meant a pivoted armature element to be displaced by the two magnetic working forces acting from time to time (i. e. the permanent and applied forces), this moving system being constructed as a very compact subassembly such as depicted in Fig. 9.

The moving system comprises a pair of spaced-apart pole plates 40, 41 having clamped therebetween a permanent magnet 42 (Figs. 5 to 7 also) by means of a combination bearing and retainer clamp 44 in the form of a U-shaped piece of Phosphor bronze or like spring metal having its opposite vertical legs 44L pierced to provide bearings 45 respectively receiving the pivot pins 24 on the bridge plates, as in Figs. 5 and 7.

The U-shaped bearing and retaining strap 44 is punched to provide a plurality of offset tongues 46, 47 (Fig. 9), the former being set beneath the lower pole plate 41 (both front and rear) and the latter being set in on opposite sides of the permanent magnet at the two ends thereof, it being observed that both pole plates 40, 41 are notched as at 40X, 41X, respectively, to interfit snugly with this combinaton bearing and clamp strap 44.

Also a part of the subassembly are a pair of spring-blade contacts 58, 59 and a pair of armature springs 50, 51, all of the same being clamped between a pair of insulating wafers 52, 53 which are notched, as at 54, to interfit or key with the bearing strap 44, and as at 55 to key into a pair of upstanding ears 58X, 59X respec-

tively struck up from contact springs 58 and 59 carried between the set of insulating wafers.

The two blade contacts 58, 59 each have a tail portion 58A, 59A (Fig. 9) struck up and fitted through a slot formed near the center of the uppermost insulating wafer 52, the U-shaped bearing strap having a square clearance hole punched through its bight to clear these tail projections, which serve as soldering lugs.

The springs 50, 51 are especially shaped (e. g. as in Fig. 10) to produce a variable or dynamic characteristic which is predetermined to match the dynamic response curve for the armature system in question, in accordance with principles analogous to those disclosed in my copending application, Serial No. 492,451, filed March 7, 1955.

From the shape of the spring 50 depicted in Fig. 10, it will be observed that the blade is not of uniform width throughout its length, but on the contrary is peculiarly shaped and widened in a graduated manner toward its free end 50Z with a certain increment calculated to produce an increasing tension which is proportionate to the rate of increase of the magnetic pull on the armature as the air-gap reluctance diminishes when the armature moves from a normal or rest position toward a fully attracted position, taking into account the magnitude of the initial and final air gaps and the magnitudes and directions of the magnetomotive forces acting on the armature in the energized and deenergized states of the winding.

Another feature of the invention relates to the arrangement of the contact means in relation to the source of permanent magnetic flux to diminish arcing, reference being had to the diagrammatic showing of Fig. 11, wherein the normal low-reluctance magnetic circuit for the flux of the permanent magnet 42 is shown in dotted lines to be substantially through and confined to the mass of the two pole plates 40, 41, with a designated "Leakage Flux" shown in dash-dot lines as cutting across the zone occupied by the relay contacts.

Since the sets of contacts (e. g. 26A, 59) are disposed close to the upper pole plate 40 and the direction of the polarizing-leakage flux acts in a path cutting transversely through the contact gap, a magnetic field exists in the latter region which can oppose ionization in the contact gap in accordance with the magnitude of the stray flux available or caused to traverse the contact zone, more specifically the contact meeting and parting line, by which is meant that imaginary line at which the contacts 26B, 58, for instance, normally would meet and separate.

Assuming a given coercive or magnetomotive force for the permanent magnet 42, the amount of leakage flux LF in a given construction of the subassembly is a function of the cross-sectional areas of the pole plates, particularly the upper plate 40, such that if the latter is saturated by a suitably strong polarizing flux, there will be a considerable leakage flux through the air path in the region adjoining the upper side of the upper pole plate, and this leakage flux will have an important spark-suppressing effect on the relay contacts disposed in its path in the manner illustrated.

While it is known in the art to utilize a magnetic field to influence arcing, the presently disclosed constructions are considered novel with respect to the support and location of the contact assembly and a polarizing magnet in relation to spaced pole plates with intermediate pole faces in such manner as to provide a predictable and in a certain sense adjustable, leakage flux and circuit therefore largely confined to the contacting zone for the purpose of diminishing arcing.

The exceptional sensitivity and efficiency of the new relay is in large measure due to the construction and arrangement of parts constituting the polarized subassembly or moving system, so-called herein because it comprises all of the essential moving parts of the relay including the contact elements which are positively moved relative to a stationary contact means.

In this connection, the importance of the combination retaining strap and bearing piece 44 must be emphasized as to the dual functions suggested, in addition to the fact that it makes unnecessary adhesives or like expediencies for holding the polarizing magnet in position, and thereby increases the permeability of the magnetic circuit.

I claim:

1. In a polarized relay, a movable armature and contact assembly comprising: a pair of pole plates; a linear permanent magnet disposed between said plates; a non-magnetic strap passing around at least one of said plates past the polar ends of said magnet and having portions offset for locked-in engagement with the other said plate to secure said magnet, plates and strap in assembled relation; said strap having bearing means disposed thereon at portions thereof approximately opposite the polar ends of said magnet; and contact means carried by said assembly.

2. In a polarized relay, a moving system in the form of a compact subassembly including a pair of pole plates; an elongated permanent magnet disposed between said plates; insulating means carried on a side of one of said plates which is remote from the side thereof confronting said magnet; a combination clamping and bearing member of non-magnetic material extended around one of said plates past the polar ends of said magnet at least to the adjacent margins of the other plate and having bearing means disposed thereon in the region thereof confronting said polar ends; said combination clamping and bearing member and said plates having inter-engaging formations and said combination member also having formations locking with said other plate and engaging said magnet to prevent movement of the latter; and at least one spring blade member carried by said subassembly and insulated from the conductive parts thereof by said insulating means; said pole plates being spaced apart by said magnet a distance sufficient to admit pole pieces therebetween on opposite sides of the linear axis of said magnet.

3. In a polarized relay, armature means comprising a permanent magnet carried between a pair of magnetically-attractable armature plates of larger planar area than the magnet so as to leave a cavity on opposite polar sides of the magnet between the plates; an electromagnet having opposite pole pieces each projecting into one of said cavities; non-magnetic, U-shaped strap means embracing and interlocked with said plates and permanent magnet for securing the armature means in assembled relation; bearing means engaging opposite legs of said strap means and pivotally mounting said armature means to rock so as to move said armature plates toward and away from the appertaining pole pieces of the electromagnet; spring means carried by said armature means for biasing the latter relative to one or the other of said pole pieces; and contact means actuated by said armature means.

4. In a polarized relay, an armature subassembly comprising an elongated permanent magnet sandwiched between a pair of armature plates leaving a cavity on opposite sides of the permanent magnet; and a strap of non-magnetic material passing around at least one of said plates and having lug means engaging the other said plate to secure the plates, magnet, and strap in assembled relation.

5. In a polarized relay, an armature subassembly comprising a permanent magnet sandwiched between a pair of ferromagnetic armature plates and of lesser overall dimension than the plates; a retaining strap of springy, non-ferrous material passing around at least one of said plates with opposite end portions extending at least to the other plate and respectively having securing portions interfitting with said other plate to secure the plates, magnet and strap in assembled relation; together with

leaf-spring contact means secured in insulated relation between said strap and the outer face of one of said plates.

6. In a polarized relay, an armature subassembly comprising a pair of superposed, ferro-magnetic, approximately rectangular armature plates and a permanent magnet carried between said plates and of a size to lie within the perimeter of the common plane between the plates; a non-magnetic strap of approximately U-shape passing around one of the plates with its bight portion overlying the latter, said strap having each of its legs past one of the opposite ends of said magnet at least as far as the remaining plate, said legs of the strap having securing portions interfitting with both plates to secure the same together and having portions engaging the respective ends of the magnet to prevent movement of the latter relative to the plates, each said leg having a bearing portion located in the region opposite the appertaining end of the magnet; insulating wafer means carried between said bight and the underlying armature plate and having interfit with portions of said strap; and contact means carried between said wafer means.

7. In a relay, an armature and contact assembly comprising: an assembly of pole plates disposed one above another with a polarizing member sandwiched between a pair of said plates; a non-magnetic strap fitted over said assembly and secured therewith to hold said plates and polarizing member in assembled relation; aligned bearing means provided on opposite sides of said strap for engagement with cooperative bearing means to support the assembly for rocking movement; and contact means carried by said assembly and held between one of said plates and said strap.

8. In a polarized relay, a rockable armature comprising, in assembly, upper and lower juxtaposed pole plates spaced apart in parallelism with a polarizing magnet situated therebetween; a bearing member fitting over at least one of said plates and extending past oppositely-disposed side margins of both said plates so as to cross at two points a rocking axis for the armature extending in the region between the planes of the plates and provide aligned bearing support at each of said oppositely-disposed portions of the bearing member adapted for supporting engagement with complementary bearing means mounting the armature for rocking movement as aforesaid; means interlocking the plates and the bearing member in assembled relation as aforesaid; the spacing between said plates on opposite sides of said axis being substantially greater than zero to freely admit with clearance therebetween cooperative complementary pole elements relative to which the armature can rock in opposite directions.

9. A construction according to claim 8 further characterized in that at least one contact member is mounted for movement with the armature and is secured therewith in a location between one of said plates and said bearing member.

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