April 5, 1960 A. E. SPRANDO 2,931,872

POLARIZED RELAY

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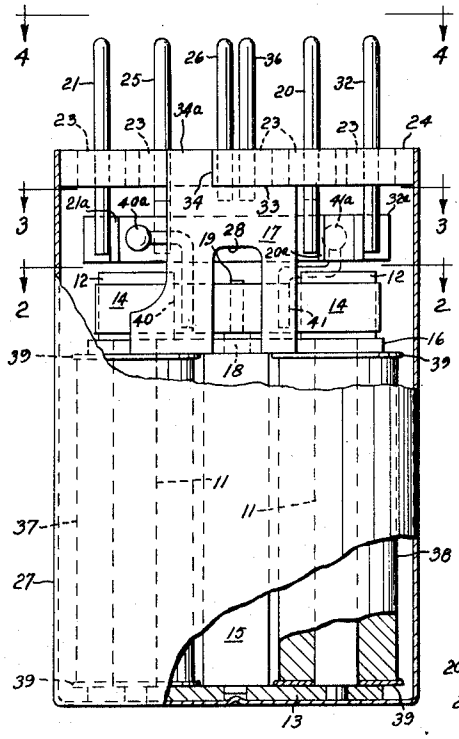


FIG. 1.

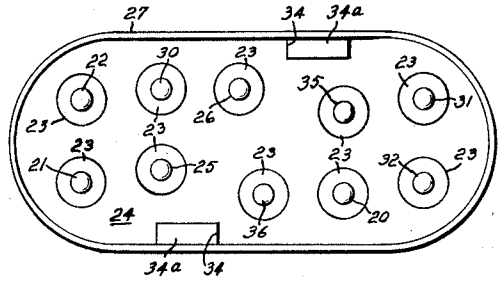


FIG. 4.

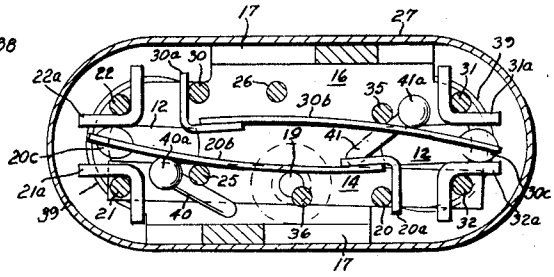


FIG. 3.

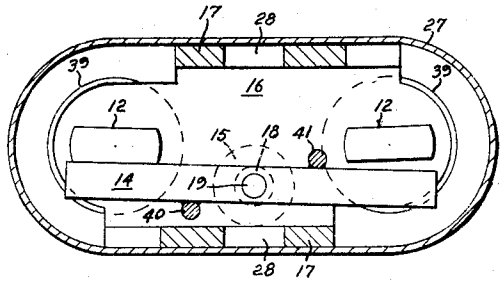


FIG. 2.

INVENTOR
Anthony E. Sprando

BY Mayer Richardson

AGENT

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POLARIZED RELAY

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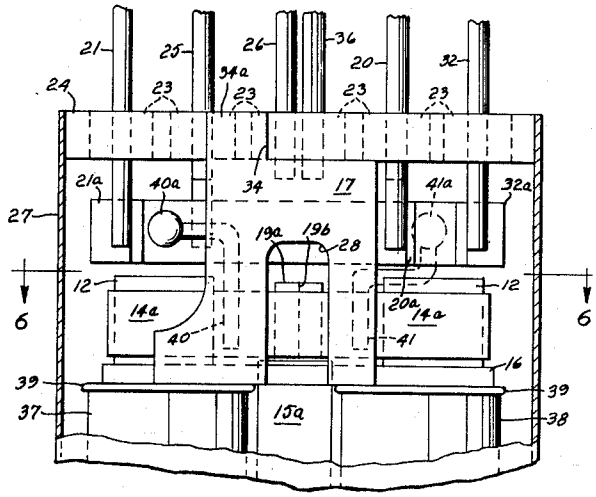


FIG. 5.

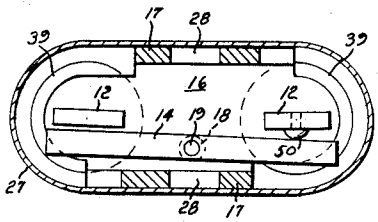


FIG. 8.

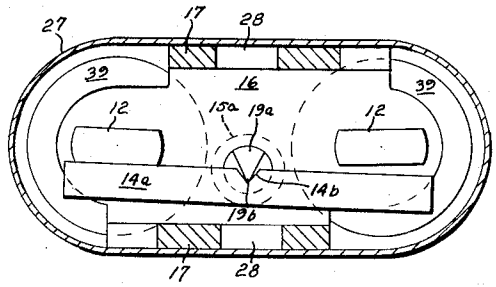


FIG. 6.

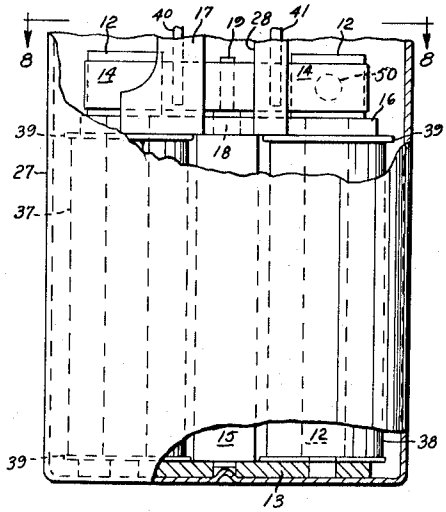


FIG. 7.

INVENTOR
Anthony E Sprando

BY

AGENT

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2,931,872

POLARIZED RELAY

Anthony E. Sprando, Portland, Oreg., assignor to Iron Fireman Manufacturing Company, a corporation of Oregon

Application September 22, 1958, Serial No. 762,648

6 Claims. (Cl. 200—93)

This invention relates generally to electric circuit relays of the polarized type and specifically provides a polarized relay structure of simple form, economical to produce, and particularly adapted for use as a so-called latching or impulse operated relay. However with only slight modification the invention provides the well known biased armature relay function.

It is a particular object of this invention to provide a polarized electric circuit relay which is simple in design, economical to build, reliable in operation and of small size.

It is a second object to provide such a relay having a minimum number of parts and a minimum number of precise operations in the production and assembly of the parts yet having the maximum precision and reliability of operation.

It is a third object to provide such a relay one form of which can be impulse operated to either of two functional positions and will be magnetically latched in the one of the two positions to which it is operated.

It is a fourth object to provide such a relay a second form of which is magnetically biased to one operating position and electro-magnetically operated to another operating position.

It is a fifth object to provide a novel and useful construction for a relay in which the above objects are attained.

How these and other objects are attained is explained in the following description referring to the attached drawings in which:

Fig. 1 shows a fragmental side elevation in partial section of a first form of the relay of this invention.

Fig. 2 shows a plan view in partial section along the line 2—2 of Fig. 1.

Fig. 3 shows a plan view in partial section along the line 3—3 of Fig. 1.

Fig. 4 shows a plan view as seen from the line 4—4 of Fig. 1.

Fig. 5 shows a fragmental side elevation of a second form of the relay of this invention.

Fig. 6 shows a plan view in partial section along the line 6—6 of Fig. 5.

Fig. 7 shows a fragmental side elevation in partial section of a third form of the relay of this invention.

Fig. 8 shows a plan view in partial section along the line 8—8 of Fig. 8.

Like reference numerals refer to like parts in the several figures of the drawings.

Referring now to the drawings the first form of my invention shown in Figs. 1 to 4 is seen to include a switch operator having a non-permanent magnetic circuit comprising a pair of substantially identical parallel electric steel pole pieces **11** with flattened upper pole face ends **12**. The lower end pole pieces **11** are permanently secured into electric steel yoke **13** as shown in Fig. 1. The non-permanent magnetic circuit is completed by armature **14**. Permanent magnet **15** between pole pieces **11** and parallel thereto is secured at its lower end into yoke **13** as shown. A non-magnetic frame channel **16—17** having a horizontal base **16** and vertical legs **17** is seen to have the upper ends of pole pieces **11** secured therethrough and to secure therethrough the reduced upper

end **18** of magnet **15**. Permanent magnet **15** above its section **18** is again reduced to form a journal **19** for armature **14** drilled as shown to be freely rotatably carried on magnet **15** and magnetically secured thereon.

Electrically conducting relay terminals **20, 21, 22, 25, 26, 30, 31, 32, 35** and **36** are hermetically sealed and electrically insulated by insulating supports **23** set into base header **24** as shown.

Welded to the inner ends of terminals **20** and **30** are blade supports **20***a* and **30***a*. Welded to the inner ends of terminals **21, 22, 31, 32** are switch contacts **21***a*, **22***a*, **31***a* and **32***a*.

Resilient, electrically conducting switch blade **20***b* carrying movable contact **20***c* at its free end is secured at its other end to support **20***a* to bias contact **20***c* towards stationary contact **21***a*.

Similarly blade **30***b* carries movable contact **30***c* at its free end and is secured at its other end to support **30***a* to bias contact **30***c* towards stationary contact **31***a*.

As shown in Figs. 1 and 4 base header **24** is notched at **34** on opposite edges to receive tangs **34***a* and to set on the steps **33** formed near the upper ends of legs **17** extending upwardly from the base **16** of the frame channel **16—17**.

The open end of enclosing can **27** is hermetically sealed to the periphery of base header **24**.

Respective operating coils **37, 38** of insulated wire with insulating boards **39** at either ends are positioned around pole pieces **11** as shown. It should be noticed that legs **17** of base channel **16—17** are each formed with an opening **28** therethrough, as shown in Figs. 1 and 2, through which terminal leads, not shown, from coil **37** can be lead and secured to the inner ends of relay terminals **25, 26** and through which terminal leads, not shown, from coil **38** can be lead and secured to the inner ends of relay terminals **35, 36**.

Since switch blades **20***b* and **30***b* are biased towards contact respectively with stationary contacts **21***a* and **31***a* the armature is provided with arms **40** and **41** welded thereto and tipped with insulating glass ends **40***a* and **41***a* respectively to contact blades **20***b* and **30***b* and move contacts **20***c* and **30***c* from contacts **21***a* and **31***a* and into contact with stationary contacts **22***a* and **32***a* whenever armature **14** is rotated clockwise as seen in Figs. 2 and 3.

It should be noted that permanent magnet **15** is always of one polarity and when neither of coils **37** nor **38** are energized the magnetic field of magnet **15** will in major part include the half armature and magnetic pole piece which are in contact and only in minor part the half armature and magnetic pole piece which are separated as shown in Figs. 2 and 3 where the armature **14** is seen to be latched clockwise on to the left hand pole piece **12** causing arms **40, 41** with glass ends **40***a* and **41***a* to hold switch blades **20***b* and **30***b* against their inherent biases into contact of moving contacts **20***c* and **30***c* with stationary contacts **22***a* and **32***a*.

As noted above the leads of coil **37** are independently brought out to terminal pins **25, 26** and the leads of coil **38** are independently brought out to terminal pins **35, 36** so that coils **37** and **38** may be selectively energized with direct current polarized to give their respective pole pieces a polarity opposite to that of the permanent magnet. Then to release switch blades **20***b* and **30***b* from the restraint of arms **40** and **41** of armature **14** and allow moving contacts **20***c* and **30***c* to move from stationary contacts **22***a* and **32***a* to stationary contacts **21***a* and **31***a* respectively, it is only necessary momentarily to energize coil **38** at which time its magnetomotive force will be added to that of the permanent magnet **15** and the instantaneously increased magnetic flux of the circuit including permanent magnet **15**, the right hand end of yoke **13**, pole piece **12** and the right hand end of arma-

ture 14 will cause armature 14 to move counter clockwise to contact the pole piece of coil 38 where the armature will be magnetically latched by the force of the permanent magnet 15 even after the energization of coil 38 is interrupted.

It is seen that the structure of Figs. 1 to 4 provides an electric relay having a pair of S.P.D.T. electric switches instantaneously operable from one of their two throw positions to the other by the selective momentary energization of one or the other of a pair of electromagnet coils. The switches are seen to be held in their positions to which they were last operated until the alternate solenoid is momentarily energized.

Without duplicating the complete description as above given of the latching relay of Figs. 1 to 4, attention is called to the use in Figs. 7 and 8 of substantially the same construction but with minor changes causing the relay to operate in the more usual way of having the armature biased to one position and operated to its other position by the energization of a magnetic circuit and held in its said other position until the magnetic circuit is deenergized.

The relay of Figs. 7 and 8 is the same as the structure of Figs. 1 to 4 with Figs. 7 and 8 corresponding to Figs. 1 and 2 except that as particularly shown in Fig. 8 the air gap between armature 14 and the right hand pole piece 12 is always maintained at greater length by copper plug 50 than the greatest opening of the air gap between armature 14 and the left hand pole piece 12. Thus without energization of the magnetic circuit by coils 37, 38, armature 14 will always be biased by permanent magnet 15 into contact with the left hand pole piece 12. Also in the relay of Figs. 7 and 8 it should be noted, although not shown, that the two operating coils 37, 38, are connected in series with coil 37 giving its pole piece 12 the polarity of permanent magnet 15 and with coil 38 giving its pole piece 12 a polarity opposite to that of magnet 15. Thus when the positions of switch blades 20*b* and 30*b* are to be changed coils 37, 38 are energized in series by direct current thereby causing the magnetic flux to concentrate in the circuit of yoke 13, magnet 15, the pole piece including the plug 50 and the side of the armature near plug 50. Although the air gap is bigger at the plug 50 end of armature 14, the increase flux causes the armature to move into contact with plug 50 and to remain there so long as coils 37, 38 are energized. When coils 37, 38 are deenergized the permanent magnet and the shorter air gap on the side opposite the plug 50 side will cause the armature to rotate clockwise into contact with the left hand pole piece 12 and stay there until the coils 37, 38 are again energized.

The devices of Figs. 1 to 4 and 7 to 8 respectively show two functional arrangements of the relay of my invention while Figs. 5 and 6 show a novel armature mounting structure which is preferred in some uses of my device. Figs. 5 and 6 are equivalent to Figs. 1 and 2 and are used to disclose the change in armature mounting structure only. Thus in place of the journal end 19 of magnet 15 as shown in Figs. 1 to 4, in Figs. 5 and 6 and the end 19*a* of a magnet 15*a* is formed with a knife edge 19*b* parallel to the axis of magnet 15*a* and armature 14*a* is formed with a V-notch 14*b* mating with knife edge 19*b*. Armature 14*b* will of course be held by magnet 15*a* freely pivoted thereon.

Having thus recited some of the objects of my invention, illustrated and described alternate functional uses and structures for and with which my invention may be practiced and explained the operation and use thereof, I claim:

1. A polarized relay comprising an electric switch element alternately movable between two operative positions and a magnetic operator selectively operable to position said element, said operator comprising a first single element magnetic pole piece, a second single element magnetic pole piece, a permanent magnet pole piece, a magnetic yoke, a magnetic armature, a first single electric coil surrounding said first pole piece, a second single electric coil surrounding said second pole piece, a first direct current means for energizing said first coil and a second direct current means for energizing said second coil, one end of each of said pole pieces being secured to said yoke to extend from the same side thereof with said permanent magnet between and equally spaced from said first and second pole pieces, means cooperatively formed on the other end of said permanent magnet and on said armature to support said armature for balanced rotation on said permanent magnet about an axis parallel to the axes of said first and second pole pieces and equally spaced therefrom.

2. The polarized relay of claim 1 in which said first direct current means is polarized to give the adjacent ends of said first pole piece and said permanent magnet opposite polarities and said second direct current means is polarized to give the adjacent ends of said second pole piece and said permanent magnet opposite polarities, whereby on alternate momentary applications of said two direct current means to said two coils said armature will move into contact with the respective pole piece of the coil to which said direct current means is applied and remain in contact therewith until the other of said two direct current means is applied to the other of said coils.

3. The polarized relay of claim 1 in which said two direct current means are connected to said two coils for simultaneous energization thereof and polarized to cause one of said pole pieces to be polarized with the same polarity as said permanent magnet and the other of said pole pieces to be polarized with the opposite polarity of said permanent magnet when both said coils are energized and in which said relay includes means for maintaining a minimum air gap length between said armature and said pole piece of opposite polarity to said permanent magnet greater than the maximum length of the air gap between said armature and the other of said pole pieces whereby when said direct current means are disconnected from said coils the bias of said magnet on said armature will rotate said armature to shorten said air gap having a maximum length shorter than the minimum length of the then air gap of said armature.

4. The polarized relay of claim 1 in which said means cooperatively formed on said other end of said permanent magnet and said armature includes a journal formed on one and a cooperating bearing formed on the other of said permanent magnet and said armature.

5. The polarized relay of claim 1 in which said means cooperatively formed on said other end of said permanent magnet and said armature includes a knife edge formed on one and a cooperating bearing formed on the other of said permanent magnet and said armature, said armature being rotatably held on said magnet solely by the magnetic attraction of said knife edge and said cooperating bearing.

6. The polarized relay of claim 1 in which said means cooperatively formed on said other end of said permanent magnet and said armature includes a knife edge formed on one and a cooperating groove formed on the other of said permanent magnet and said armature, said armature being rotatably held on said magnet solely by the magnetic attraction of said knife edge and said cooperating groove.

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