March 16, 1948. A. C. DAVIS 2,437,726

POLARIZED RELAY

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Fig. 1.

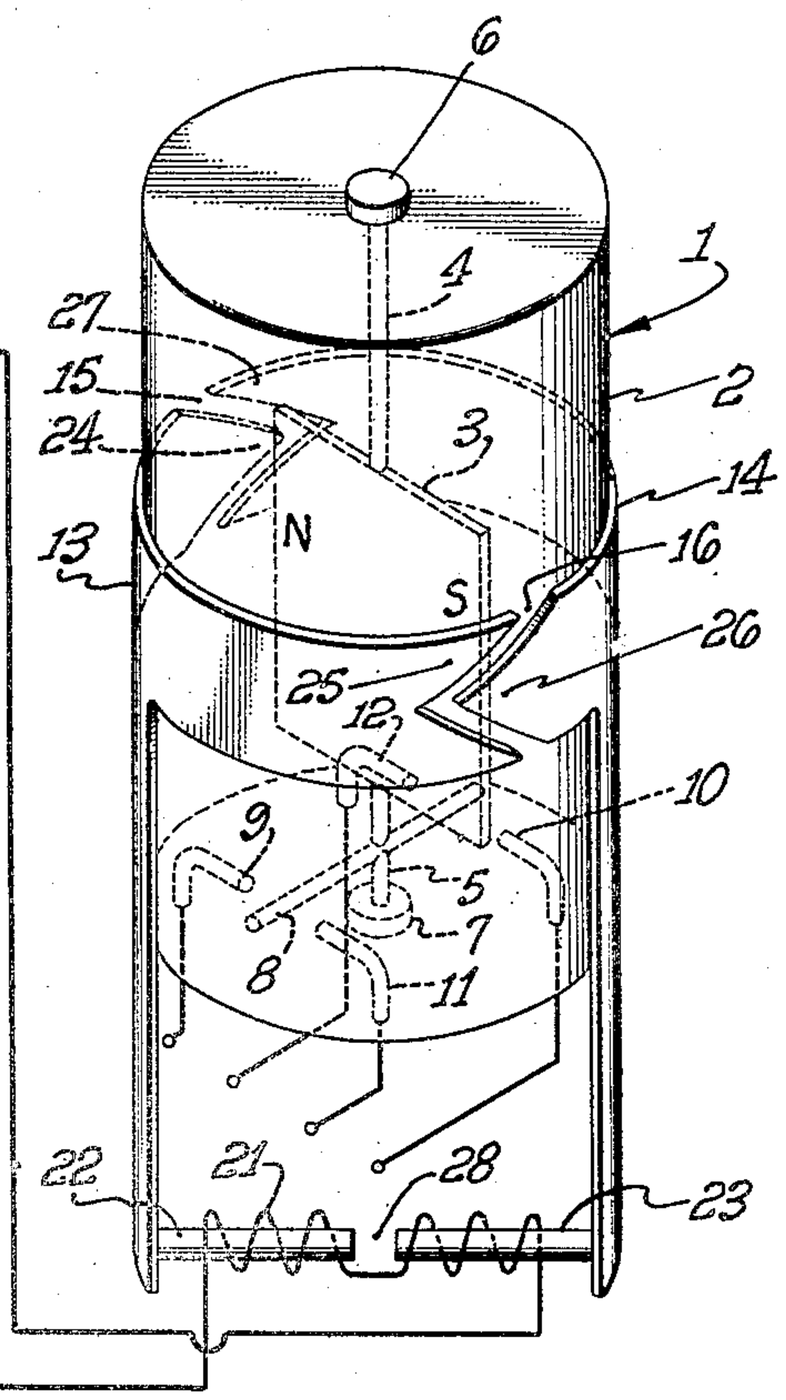


Fig. 2.

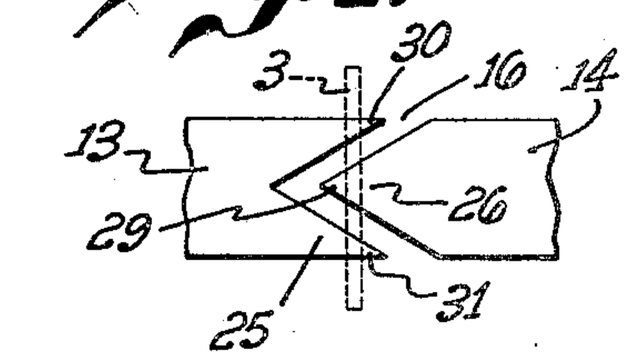


Fig. 3.

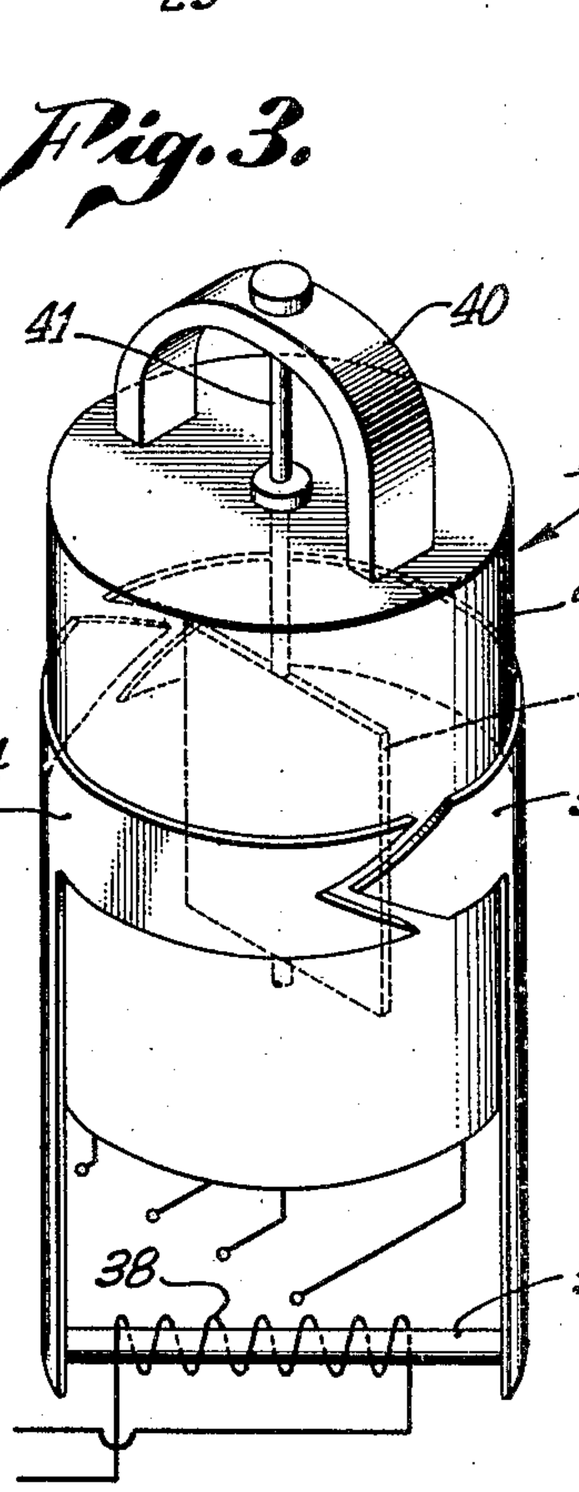


Fig. 4.

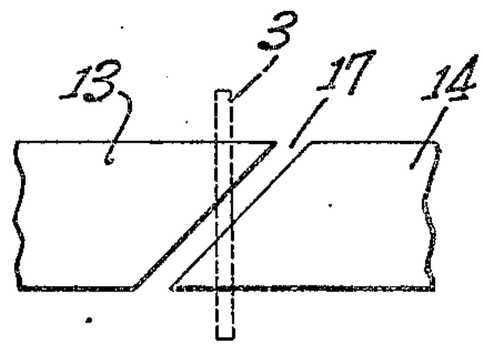
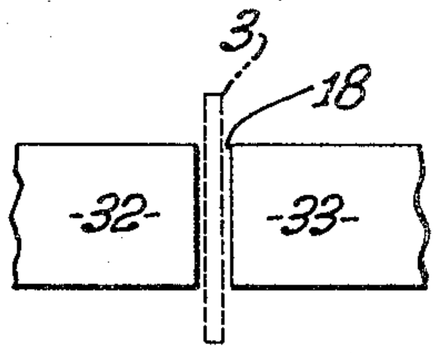


Fig. 5.



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POLARIZED RELAY

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8 Claims. (Cl. 200—93)

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The invention relates to a polarized relay wherein an electric current in an input circuit is employed to reverse the polarity of one or more pole pieces or magnetizable members in order to reverse the direction of movement of a rotatable permanent magnet which controls contacts in an output circuit. Thus, a weak current in the input circuit may control a larger current in the output circuit, to effect the operation of any desired apparatus in the output circuit.

The usual type of polarized relay has no tendency, through the magnetic attraction of the armature by the magnet, when the armature is not magnetized, to assume a neutral position. Hence, it is common to use a spring, which is employed to bias the polarized magnet in its neutral position. This neutral position may, of course, be one where the contacts controlled by the magnet are either open or closed.

An object of the invention is to provide a polarized relay having magnetizable pole pieces so constructed and arranged that the magnet will assume the neutral position without the use of a spring, although a bias device such as a keeper may be employed if desired.

Another object of the invention is to provide a polarized relay having a construction whereby the electrical contacts may be operated quickly by a snap action, and in a modified form by a more gradual opening and closing movement of the contacts.

Another object of the invention is to simplify and improve the construction of a polarized relay and in particular to provide an improved form of polarized relay embodied in a vacuum tube which may have a conventional base with terminals to fit in a socket of the type usually employed for electron discharge devices.

Another object of the invention is to provide a polarized relay having a rotatable magnet which assumes a neutral position providing a path of minimum reluctance with its field pole when the latter is not magnetized.

For further details of the invention, reference may be made to the drawings, wherein

Fig. 1 is a perspective view of one form of polarized relay according to the invention.

Fig. 2 is a view in elevation with parts broken away of the air gap and one end of the pole pieces and magnet of the relay of Fig. 1.

Fig. 3 is a perspective view of a modification.

Figs. 4 and 5 are views like Fig. 2 of further modifications.

Referring in detail to the drawings, the polarized relay 1 comprises an evacuated cylindrical glass tube 2 in which is mounted magnet 3 in the shape of a vane mounted for oscillation on the axis of tube 2 and having at its opposite ends shafts 4 and 5 which are pivotally mounted in the bearings 6 and 7, respectively, at the opposite ends of the tube 2. The shaft 5 carries a movable contact member 8 which is adapted in one position to complete the circuit from fixed contact 9 to the fixed contact 10, and in the alternate position, to complete the circuit from fixed contact 11 to the fixed contact 12.

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The contacts 9 to 12 are mounted in the lower end of the tube 2 and are connected to suitable output circuits to be controlled.

The permanent magnet 3 is slightly shorter crosswise of the tube 2 than the inside diameter of the circular tube 2 and its opposite ends have opposite polarities as indicated at N and S. On the outside of the tube 2 are arranged two similar soft iron magnetizable arcuate pole pieces 13 and 14, which are separated at their ends by air gaps 15 and 16. The air gaps 15 and 16 may be somewhat in the shape of a letter V, lying on its side, as indicated in the drawings, or each of these air gaps may slant at forty-five degrees across the end of the magnet 3 as indicated at 17 in Fig. 4, or each air gap may be parallel to the end of magnet 3 as shown at 18 in Fig. 5.

Referring again to Fig. 1, the relay 1 may be operated by supplying current in one direction or the other from battery or other source 19 and reversing switch 20 through coil 21 arranged on extensions 22 and 23 of the pole pieces 13 and 14 respectively. Current in coil 21 magnetizes pole piece 13 to be of north polarity when 14 is south and vice versa. When 13 is north, both ends of 13 cause clockwise movement of magnet 3, and 14 then being south, both of its ends also cause clockwise movement of magnet 3. Reversal of the polarity of pole pieces 13 and 14 by operating switch 20 causes movement of magnet 3 in the reverse direction. Hence four pole tips, that is both ends of both pole pieces 13 and 14 are effective to move magnet 3 in one direction or the other.

The N and S ends of magnet 3, of course, swing in an arc about the axis of bearings 5, 6, i. e., the axis of tube 2 and the pole pieces 13 and 14 extend in a concentric arc on the outside of the tube 2. The pole pieces 13 and 14 are the same in shape, pole piece 13 terminating at one end in a tapered point tapered at sixty degrees, and at the other end in a fork 25 each branch of which

is tapered at thirty degrees. Likewise one end of pole piece 14 terminates in a sixty degree tapered point 26 and at the other end in a fork 27 having thirty degree legs.

The over-all circumferential length of each pole-piece 13 and 14 is slightly more than one-half the circumference of tube 2, whereby when magnet 3 is in neutral position shown, both ends of each pole-piece 13 and 14 are in front of one end of magnet 3 which provides a path of low reluctance for lines of force from magnet 3 when relay 1 is not in use. Also when current in coil 21 is interrupted, magnet 3 will move to its neutral position shown in Figs. 1 and 2 because it will move until the reluctance is minimum. The reluctance for any position of magnet 3 beyond neutral is higher because in neutral position the only air gaps in the path are the air gaps between the N and S ends of magnet 3 radially to the opposite ends of pole-pieces 13 and 14, whereas if magnet 3 is in a position to the right or left of that shown in Fig. 2, then the magnetic circuit includes the air gaps 15 and 16, resulting in much higher reluctance. To avoid shunting out the gaps 15 and 16, the pole extensions 22 and 23 are separated by an air gap 28.

In the neutral position in Fig. 2, the area of pole 26 directly in front of the end of magnet 3 is the same as the sums of the areas of the branches of fork 25 directly in front of magnet 3 and the same is true at the other end of magnet 3. Also in this position the area of the tip 29 to the left of magnet 3 equals the sum of the areas of tips 30 and 31 to the right of magnet 3 and the same is true of each end of magnet 3 when in neutral position. Somewhat the same condition is true of the forty-five degree air gap 17 in Fig. 4. Hence magnet 3 is magnetically balanced when in neutral position.

In the form shown in Fig. 5, the end of magnet 3 centers in the air gap 18 when magnet 3 is in neutral position, the opposite end of magnet 3 also appearing as shown in Fig. 5. In this case, each pole piece 32 and 33 is slightly less than a half circle. When magnet 3 is in a position to the right or left of that shown in Fig. 5, as in the other figures, the reluctance is high and includes not only the air gaps between the magnet 3 and the pole pieces such as 32, 33, but also the air gaps between the ends of pole pieces 32, 33. Hence magnet 3 as before will automatically move to the neutral position shown in Fig. 5 when pole pieces 32, 33 are not magnetized or are de-magnetized.

As magnet 3 moves from neutral position when the pole pieces are magnetized, this movement will be sudden, like a snap action with the construction in Fig. 5 as the change in reluctance is high for small movements of the magnet, whereas the acceleration of magnet 3 is more gradual with the form in Figs. 1 and 2 and the reluctance changes gradually when magnet 3 is moved by the magnetized pole pieces.

The soft iron extensions 22 and 23 may be arranged at one side of the tube 2 which may have a conventional base with usual contact prongs connected to contacts 9—12. Or the base may house the coil 21 and extensions 22, 23. As shown in Fig. 3, one may dispense with the air gap 28 in Fig. 1 and magnetically connect the armatures 34, 35 together by soft iron core 36 on which the control coil 38 is arranged. In this case the magnet 39 has a reduced tendency to seek its neutral position when pole pieces 34 and 35 are not magnetized, and hence a keeper 40, rotatably mounted on spindle 41, may be employed to adjust magnet 39 to its neutral position, but being overcome by pole pieces 34 and 35 when the latter are magnetized.

Various other modifications may be made in the invention without departing from the spirit of the following claims.

I claim:

1. A polarized relay comprising a circular vacuum tube having an axis, a polarized vane in said tube, contacts in said tube controlled thereby, means supporting said vane for movement about said axis, a pair of arcuate pole pieces arranged end to end around said tube and around said vane concentric with said axis, the adjacent ends of said pole pieces being separated by air gaps at opposite sides of said tube, said pole pieces having extensions beyond said tube, an air gap between said extensions, and coil means on said extensions for oppositely magnetizing said pole pieces.

2. A polarized relay according to claim 1 wherein said air gaps are each substantially in the shape of the letter "V" lying crosswise of said axis, said vane having opposite ends narrower than the length of said air gaps around said axis.

3. A polarized relay according to claim 1, wherein said air gaps are each substantially parallel to said axis.

4. A polarized relay according to claim 1, wherein said pole pieces have extensions separated by an additional air gap to prevent shunting the flux from said vane when said coil means is de-energized.

5. A polarized relay according to claim 1, wherein each of said air gaps slants with respect to said axis, said vane having ends narrower than the length of said gaps around said axis.

6. A polarized relay comprising a vacuum tube having therein a movable polarized armature having opposite ends, means supporting said armature for movement about an axis, contacts in said tube controlled by said armature, said armature having a neutral position and an operative position in opposite directions therefrom, a pair of soft iron arcuate pole pieces arranged end to end around said tube and around said armature, the adjacent ends of said pole pieces being separated by air gaps at opposite sides of said tube, extensions on said pole pieces beyond said tube, and a coil on said extensions for reversing the movement of said armature, said pole pieces and air gaps being constructed and arranged to provide for said armature a different reluctance for different armature positions sufficient to restore said armature to neutral position when said coil is de-energized.

7. A polarized relay comprising a vacuum tube, contacts in said tube, a movable permanent magnet in said tube for operating said contacts, said magnet having a neutral position and an operative position in opposite directions therefrom, means supporting said magnet for movement about an axis, stationary magnetic pole pieces of low residual induction outside of said tube, said pole pieces having overlapping ends separated by an air gap, a coil outside of said tube for energizing said pole pieces to operate certain of said contacts in either of said operative positions, said pole pieces and said movable magnet constituting means for automatically, magnetically restoring said movable magnet to neutral position when said coil is de-energized.

8. A polarized relay according to claim 7 wherein said movable magnet has opposite poles

at opposite ends of a diameter of said axis, and said pole pieces have overlapping ends separated by an air gap at opposite ends of a diameter of said axis, the area of overhang of each of said pole pieces at the same end of said magnet being the same when said magnet is in neutral position.

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