

Sept. 2, 1958

K. W. GRAYBILL ET AL

2,850,595

POLARIZED RELAY

Filed Feb. 18, 1954

2 Sheets-Sheet 1

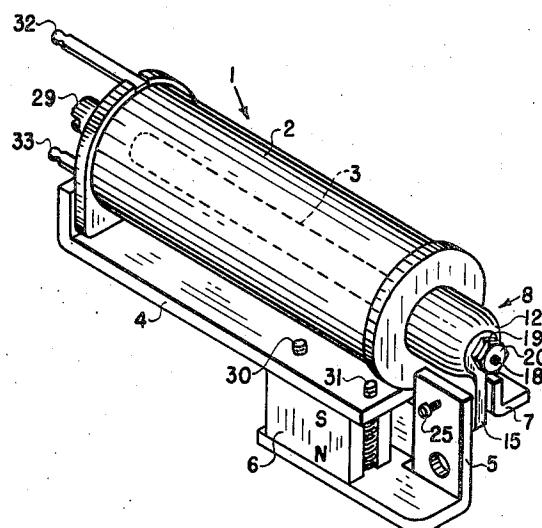


FIG. 1

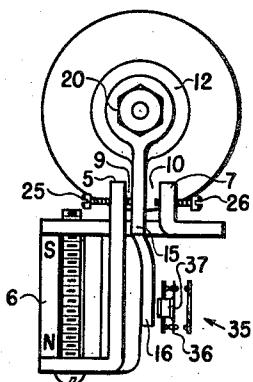


FIG. 2

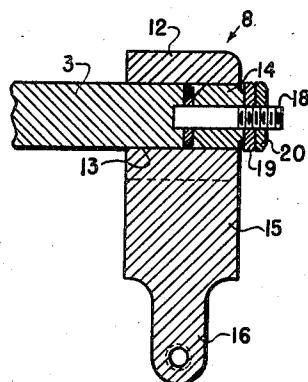


FIG. 3

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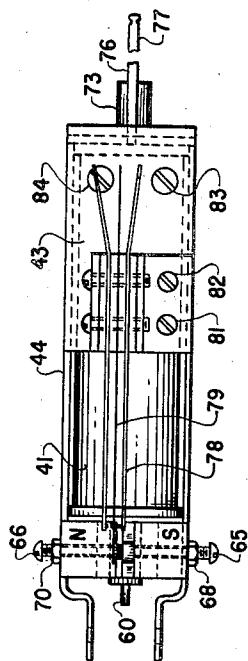
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## POLARIZED RELAY

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2 Sheets-Sheet 2



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FIG

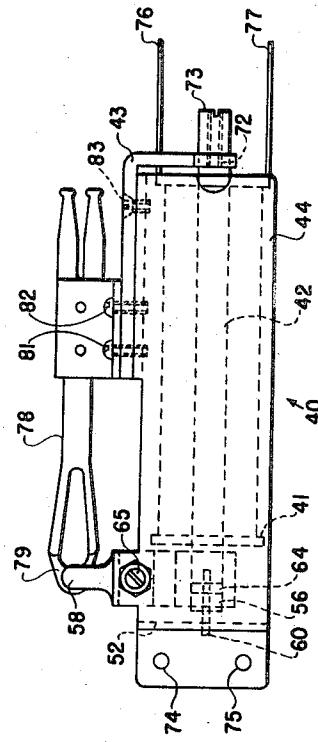


FIG. 4

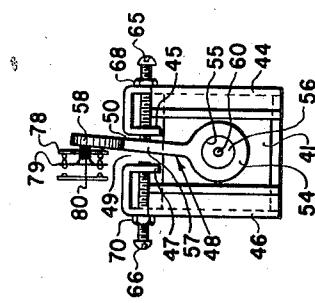


FIG. 6

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## POLARIZED RELAY

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Application February 18, 1954, Serial No. 411,198

6 Claims. (Cl. 200—93)

This invention relates to electromagnetic devices and more particularly to a polarized relay.

An important application of this invention is as an impulsing relay in a telephone circuit where a small induced current of operating polarity can cause false operation of a conventional impulsing relay.

The primary object of this invention is to provide a sensitive, quick-acting polarized relay that will only operate upon being energized by a sufficient electromotive force of one polarity.

Another object of my invention is to provide a relay with an armature that is sleeved over a core for pivotal movement thereon.

A further object of my invention is to provide a relay with air gaps of large area and small lengths so as to provide small reluctances in the magnetic circuits.

This invention will appear more clearly, and further objects and advantages will become apparent from the following detailed description when taken in conjunction with the accompanying drawings which show by way of example two preferred embodiments of the inventive idea.

In the drawings,

Figure 1 is a perspective view of a relay embodying the invention;

Figure 2 is an end view of the relay, taken from the right as seen in Figure 1; and,

Figure 3 is an enlarged, fragmentary, sectional view of the relay showing the armature and related core construction.

Figure 4 is a plan view of another relay embodying the invention;

Figure 5 is a top view of the relay shown in Figure 4; and,

Figure 6 is an end view of the relay shown in Figure 4, the permanent magnet being omitted to more clearly illustrate the disclosure.

Referring now to Figures 1, 2 and 3, numeral 1 designates a relay embodying the invention that comprises an energizing coil 2 having ferro-magnetic circuits consisting of a cylindrical core 3, a heelpiece 4 with a polepiece 7 extending therefrom, a permanent magnet 6, another polepiece 5, and a rotatable armature member, generally designated 8, that operates in a pair of air gaps 9 and 10, located between the armature traction faces and the polepieces 5 and 7, respectively.

Referring now particularly to Figure 3, it will be seen that the armature member 8 comprises a hub 12 having a cylindrical aperture 13 therethrough with a nonmagnetic bushing 14 pressed into the right hand end thereof. A flat traction portion 15, having an armature spring striker portion 16 extending therefrom, is connected to the hub 12.

The armature 8 is movably mounted on an end of core 3, as shown in Figure 3; the hub 12 snugly encompasses the core 3; and a threaded retaining pin 18, which is anchored in the core 3, passes through an aperture in the center of the bushing 14 and carries a nut 19 and a locknut 20 which retain the armature 8 on the core 3

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and permit rotary movement of the armature 8 relative to the core 3. The pin 18 is coaxial with the core 3. The diameter of the core 3 and the diameter of aperture 13 are nearly the same, the minute spacing therebetween 5 is magnetically inconsequential in comparison to either of the air gaps 9 and 10. The traction portion 15 of the armature moves between a pair of nonmagnetic adjusting screws 25, 26 which are coaxially disposed and threaded through the polepieces 5 and 7, respectively. The other 10 end of core 3 is threaded and passes through an aperture (not shown) in the heelpiece 4 and is secured thereto by a nut 29. The coil 2 is secured to the core 3 in a conventional manner. A pair of screws 30, 31 are threaded into the heelpiece 4 and secure the magnet 6 and the polepiece member 5 thereto, as shown in Figure 1. A pair of coil terminals 32, 33 extend from the coil 2. A conventional twin contact break-make spring assembly 35, having an armature spring 36 with a bushing 37 thereon, is secured to heelpiece 4 in a conventional manner. The 20 bushing 37 is spaced slightly from the striker portion 16 of the armature.

While the relay coil 2 is deenergized, the armature 8 is magnetically attracted to the polepiece 5 by the magnetizing force of permanent magnet 6 which causes flux 25 to pass from the north-pole thereof, through the polepiece 5, across air gap 9, through the armature traction portion 15, armature hub 12, core 3, heelpiece 4, and back to the south-pole of magnet 6. Simultaneously with this attraction between armature 8 and polepiece 5, there 30 is a repulsion between the armature 8 and polepiece 7. These forces cause the traction portion 15 of the armature to abut with the polepiece adjusting screw 25.

If the coil 2 is now energized with current of such a polarity as to similarly cause an attraction between the traction portion 15 and polepiece 5, the traction portion 15 will remain in abutment with the adjusting screw 25; under this magnetic condition, both of the polepieces 5 and 7 will be north-poles, and the armature traction portion 15 will be a south-pole; however, due to the additive 40 effect of permanent magnet 6 upon polepiece 5 the polepiece 5 will be a stronger north-pole than the polepiece 7, hence the resulting attraction between polepiece 5 and the traction portion 15 of the armature.

If the polarity of the energizing source connected to coil 2 is now reversed, and the magnetizing force of the coil is of sufficient magnitude, the traction portion 15 of the armature will be attracted by polepiece 7, and the striker portion 16 will act against, and actuate, the armature spring 36; under this magnetic condition, both of the polepieces 5 and 7 will be south-poles, and the armature traction portion 15 will be a north-pole; however, due to the subtractive effect of permanent magnet 6 upon the flux passing to polepiece 5, the polepiece 7 will be a stronger south-pole than the polepiece 5, hence the resulting attraction between polepiece 7 and the traction portion 15 of the armature. Initially, the air gap 10 offers a much larger reluctance to flux than does the air gap 9; therefore, a magnetizing force of sufficient magnitude is needed to cause attraction between traction portion 15 and polepiece 7. Because of this larger initial reluctance, the armature will be held against polepiece 5 even if small induced currents of operating polarity flow in coil 2.

Having reference now to Figures 4, 5 and 6, numeral 40 designates another relay embodying this invention that 65 comprises an energizing coil 41 having ferro-magnetic circuits consisting of a cylindrical core 42 upon which coil 41 is wound, a heelpiece 43, a heelpiece extension 44 having a polepiece 45 extending therefrom, a heelpiece extension 46 on the opposite side of coil 41 having a polepiece 47 extending therefrom, a rotatable armature member, generally designated 48, that operates in a pair of air gaps 49 and 50, located between the armature traction 70

faces and the polepieces 45 and 47, respectively, and a permanent magnet 52 secured between the extremities of the heelpiece extensions 44, 46.

The armature 48 is similar to the previously described armature 8, and comprises a hub 54 having a cylindrical aperture 55 therethrough with a nonmagnetic bushing 56 pressed into one end thereof. A flat traction portion 57, having an armature-spring striker portion 58 extending therefrom, is connected to the hub 54.

The armature 48 is pivotally mounted on an end of core 42, as shown in Figure 6; the hub 54 snugly encompasses the core 42; and a pin 60, which is anchored in the core 42, passes through the aperture 55 and the small hole in the bushing 56. The pin 60 is coaxial with the core 42. A fiber washer 64 is disposed on the pin 60, between the core 42 and the bushing 56. The diameter of the core 42 and the diameter of aperture 55 are nearly the same. The minute spacing therebetween is magnetically inconsequential in comparison to either of the air gaps 49 and 50. The armature traction portion 57 moves between a pair of coaxially disposed nonmagnetic adjusting screws 65, 66. The adjusting screw 65 is threaded through the heelpiece extension 44 and protrudes into air gap 50, through an aperture in the polepiece 45, and is locked to the heelpiece extension 44 by a nut 68; similarly, the adjusting screw 66 is threaded through the heelpiece extension 46 and protrudes into air gap 49, through an aperture in the polepiece 47, and is locked to the heelpiece extension 46 by a nut 70. The other end of core 42 is threaded and passes through an aperture 72 in the heelpiece 34 and is secured thereto by a nut 73. The coil 41 is secured to the core 42 in a conventional manner. A pair of screws and nuts 74, 75 fasten the magnet 52 between the extremities of the heelpiece extensions 44, 46. A pair of coil terminals 76, 77 extend from the coil 41. A conventional twin contact break-make assembly 78, having an armature spring 79 with a bushing 80 thereon is mounted on the heelpiece 43 by the screws 81, 82, which pass through the heelpiece 43 and are threaded into the heelpiece extension 44. The heelpiece 43 is secured to the heelpiece extensions 44, 46 by means of the screws 81, 82, 83, 84 and another screw (not shown) which is disposed beneath the spring assembly insulators. The armature spring 79 is stressed and continuously engages and acts against the armature striker portion 58 to cause the armature 48 to be spring biased.

While the relay coil 41 is deenergized, the spring biased armature is in abutment with the adjusting screw 65. Also, the armature traction portion 57 is magnetically attracted to the polepiece 45 by the magnetizing force of the permanent magnet 52 which causes flux to pass from the north-pole thereof through the heelpiece extension 46, heelpiece 43, core 42, traction portion 57 of the armature, air gap 50, polepiece 45, and back into the south-pole of the magnet 52.

If the coil 41 is now energized with such a polarity as to similarly cause an attraction between the traction portion 57 and the polepiece 45, the traction portion 57 will remain in abutment with the screw 65; under this magnetic condition, additional flux due to the electromagnetic energizing force of coil 41 will pass from the armature traction portion 57 through air gap 50, polepiece 45, heelpiece extension 44, heelpiece 43, core 42, and back into the traction portion 57. The armature traction portion 57 now becomes a stronger north-pole than it was previously; also, the polepiece 45 is now a stronger south-pole.

If the coil 41 is now deenergized and then oppositely reenergized by a magnetizing force of sufficient magnitude, the traction portion 57 of the armature will be attracted by the polepiece 47, and the striker portion 58 will engage and actuate the armature spring 79. Under this magnetic condition, the polepieces 45 and 47 will be north-poles and the armature traction portion will be a south-pole; the polepiece 47, however, will be a stronger north-pole than the polepiece 45 because the flux in pole-

piece 45 due to the permanent magnet 52 opposes and nullifies a portion of the flux due to the coil 41. A sufficient magnetizing force is also needed to overcome the reluctance of air gap 49 and the armature spring bias.

5 It can therefore be seen that the armature 48 will be held against polepiece 45 if an insufficient current of operating polarity flows in coil 41.

In summary, two relays embodying this invention have been described, each being inoperative to current flow of one direction and operative to current flow of sufficient magnitude of the opposite direction.

While the features of this invention have been disclosed with reference to two embodiments, it is, of course, understood that various modifications may be made in 10 the details of construction without departing from the scope of the invention.

What is claimed is:

1. A polarized relay comprising a core, an energizing coil on said core, an armature pivotally mounted on 20 an end of said core, a heelpiece connected at the other end of said core, a permanent magnet having one of its polar ends connected to said heelpiece, a polepiece connected to said heelpiece, another polepiece connected to the other polar end of said magnet and spaced from 25 said first polepiece, said armature being disposed between said polepieces for movement therebetween and magnetically attracted to said other polepiece by flux generated by said magnet, and a set of contact springs, including an armature spring, mounted on said heelpiece and operatively associated with said armature, the energizing of said coil by current of one polarity causing attraction of said armature to said first mentioned polepiece, thereby causing operation of said set of springs.

2. A polarized relay comprising a cylindrical core, 30 an armature sleeved over an end of said core for pivotal movement thereon, a heelpiece connected at the other end of said core, a permanent magnet having one of its polar ends connected to said heelpiece, a polepiece connected to said heelpiece, another polepiece connected to the other polar end of said magnet and spaced from 35 said first polepiece, said armature being disposed between said polepieces for movement therebetween and being magnetically attracted to said other polepiece while the coil is deenergized or energized with current of a non-operating polarity, and a set of contact springs, including an armature spring, mounted on said heelpiece and operatively associated with said armature, said armature being magnetically attracted to said first polepiece when 40 said coil is energized with current of operating polarity to thereby operate said set of springs.

3. In a polarized relay, a cylindrical core, an energizing coil on said core, a heelpiece connected to one end of said core, a polepiece connected to said heelpiece, a permanent magnet having one of its polar ends connected 45 to said heelpiece, another polepiece connected to the other polar end of said magnet and spaced from said first polepiece, an armature comprising a hub portion sleeved over the other end of said core for pivotal movement thereon, a flat traction portion connected to said hub portion, and a striker portion connected to said traction portion, said traction portion being disposed between said polepieces for movement therebetween and being magnetically attracted to said other polepiece by 50 said magnet, and a set of contact springs, including an armature spring, mounted on said heelpiece and operatively associated with said striker portion, said traction portion being attracted to said first polepiece when said coil is energized by current of one polarity.

4. In a polarized relay, a core, a winding on said 55 core adapted to be energized by currents in different directions therethrough, an armature apertured adjacent one end and seated upon and disposed to revolve about an extension of one end of said core, said extension projecting through said aperture, a set of contact springs 60 operatively associated with the opposite end of said arm-

ature, a heelpiece connected to the other end of said core, a pair of branches extending from one end of said heelpiece, a pair of polepieces one in each of said branches and disposed adjacent a point mediate the ends of said armature, a permanent magnet generating a flux tending to attract said armature to one of said polepieces, energization of said winding by current in one direction inducing a flux in said core which supports said flux of said permanent magnet in attracting said armature to said one of said polepieces, and energization of said winding by current in the opposite direction inducing a flux in said core which opposes said flux of said permanent magnet causing the armature to swing over to the other of said polepieces thereby operating said springs.

5. In a polarized relay, a core, a heelpiece connected to said core, a pair of polepieces connected to said heelpiece at one end thereof, an armature pivotally mounted on said core and extending between said polepieces, a permanent magnet mounted in juxtaposition to one of said polepieces, flux induced by said permanent magnet biasing said armature towards said one of said polepieces, a winding on said core, flux induced by current flow through said winding in one direction aiding said biasing flux, flux induced by current flow through said winding in the opposite direction opposing said biasing flux, said last mentioned flux stronger than said biasing flux, whereby said relay is maintained in one position by said biasing flux per se or by said biasing flux and said flux induced by current in one direction and whereby said relay is operated to another position by said flux induced by current flow in the opposite direction.

6. In a polarized relay, a core, a heelpiece connected to said core, a pair of polepieces connected to said heelpiece at one end thereof, an armature pivotally mounted

on the core and extending between said polepieces, a permanent magnet mounted in juxtaposition to one of said polepieces, flux induced by said permanent magnet biasing said armature towards said one of said polepieces 5 by imparting opposing polarity to said armature and said one of said polepieces, the other of said polepieces having the same polarity as said armature to repel said armature, a winding on said core adjacent said armature, flux induced by current flow through said winding in one direction aiding said biasing flux, flux induced by current flow through said winding in the opposite direction opposing said biasing flux, said latter flux of a sufficient magnitude to overcome the attractive force of said biasing flux, said polepieces having one polarity of different 10 flux magnitude during current flow in said winding in said one direction, and said polepieces having another polarity of different flux magnitude during current flow in said winding in said other direction.

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