Sept. 2, 1958 K. W. GRAYBILL ET AL 2,850,595

POLARIZED RELAY

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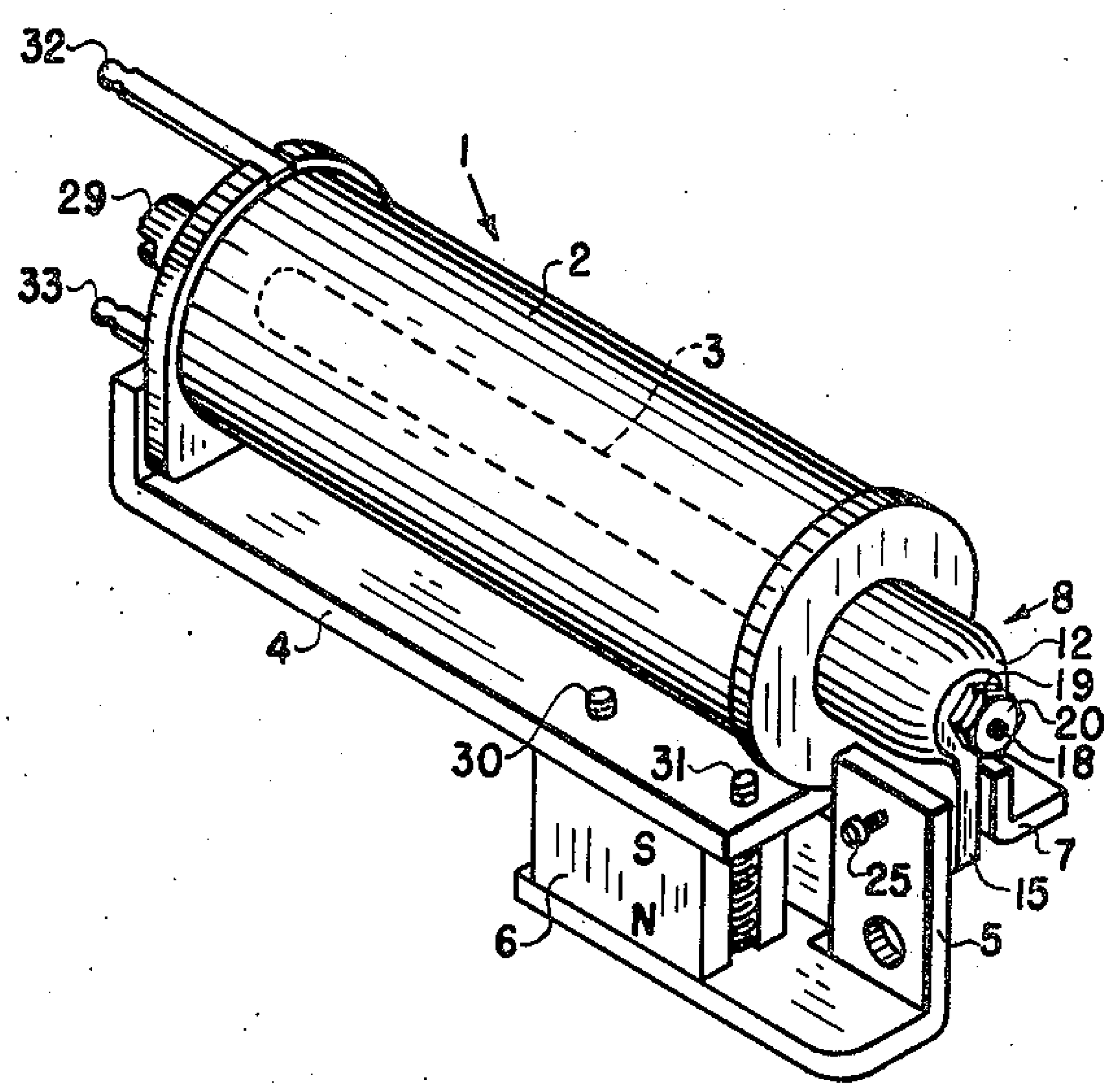

FIG. 1

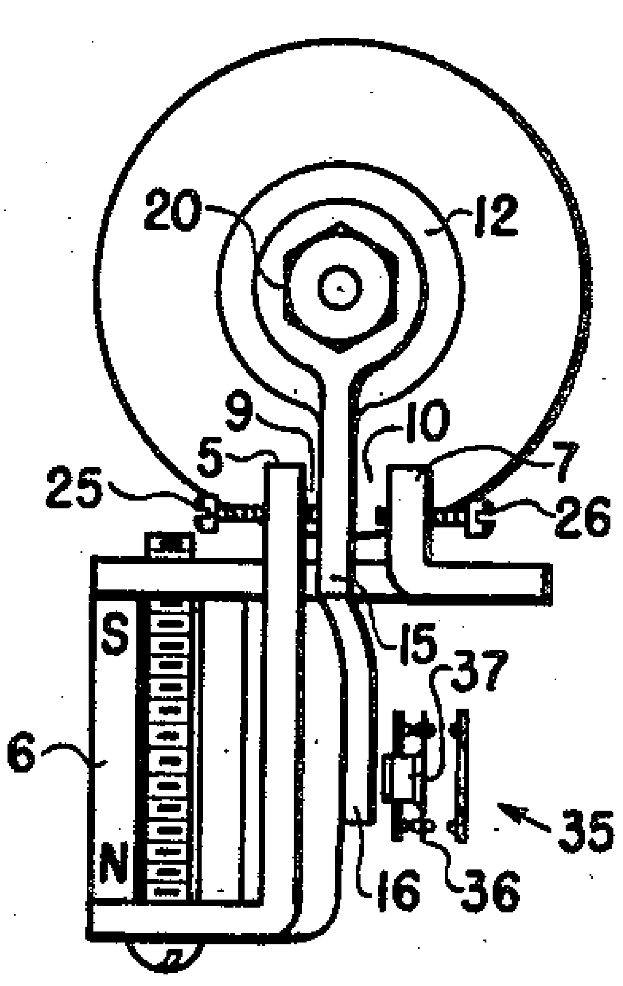

FIG. 2

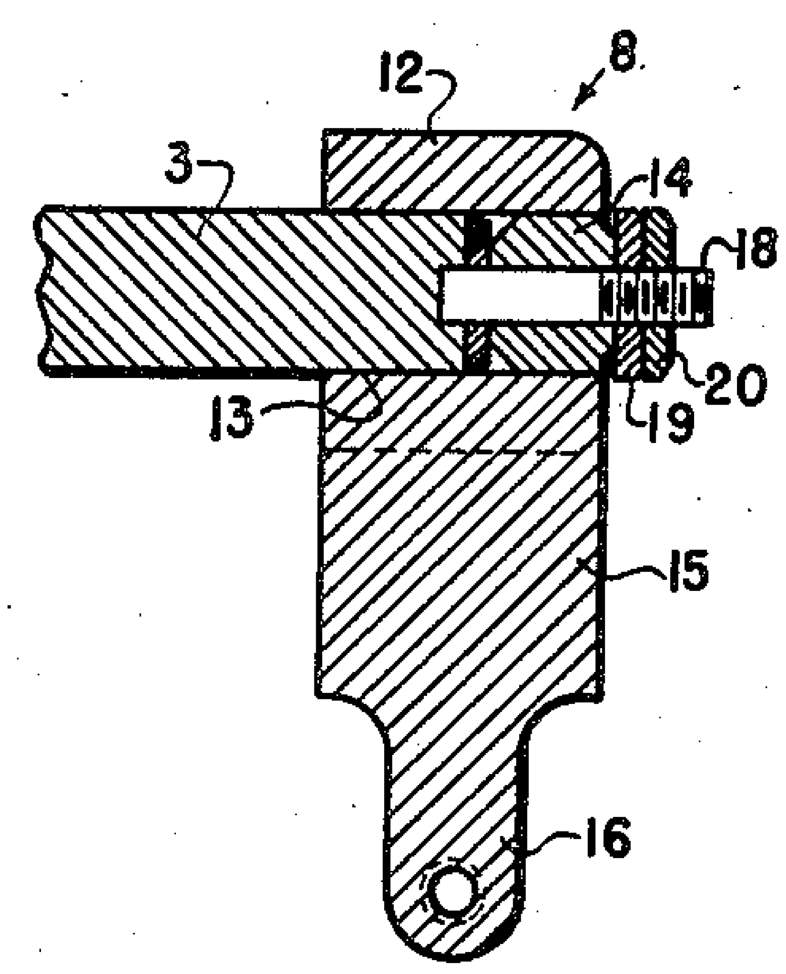

FIG. 3

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POLARIZED RELAY

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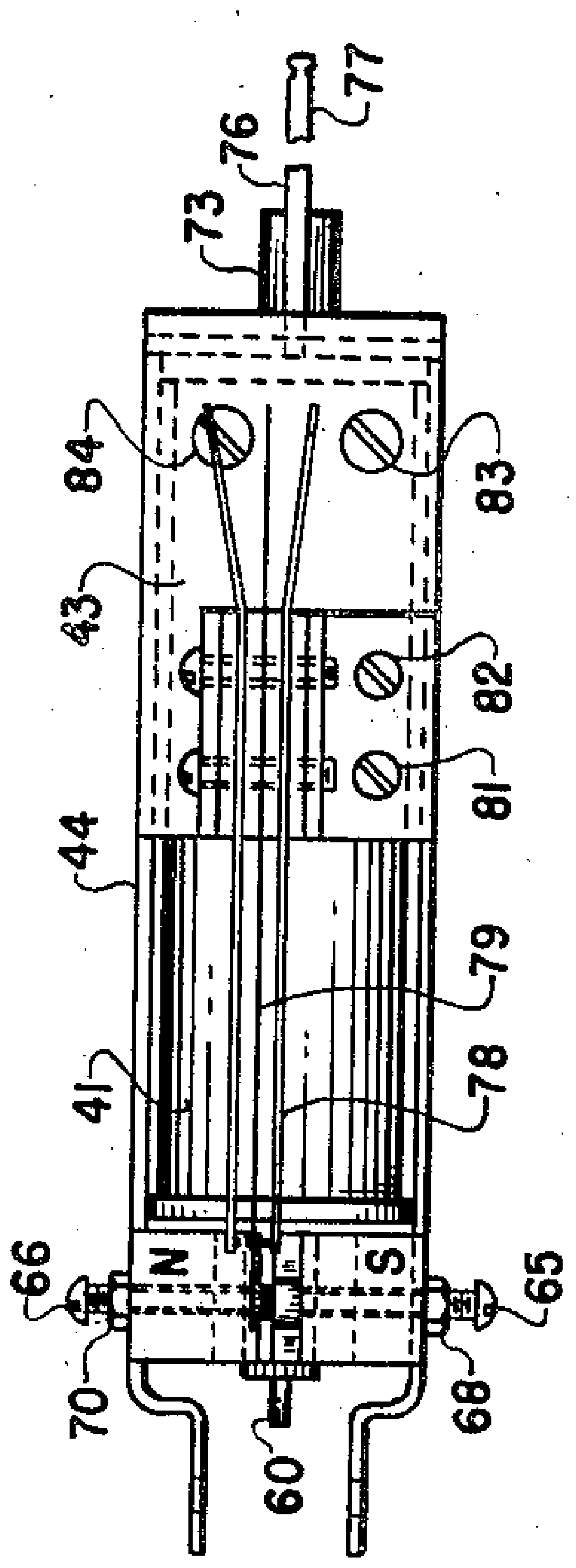

FIG. 5

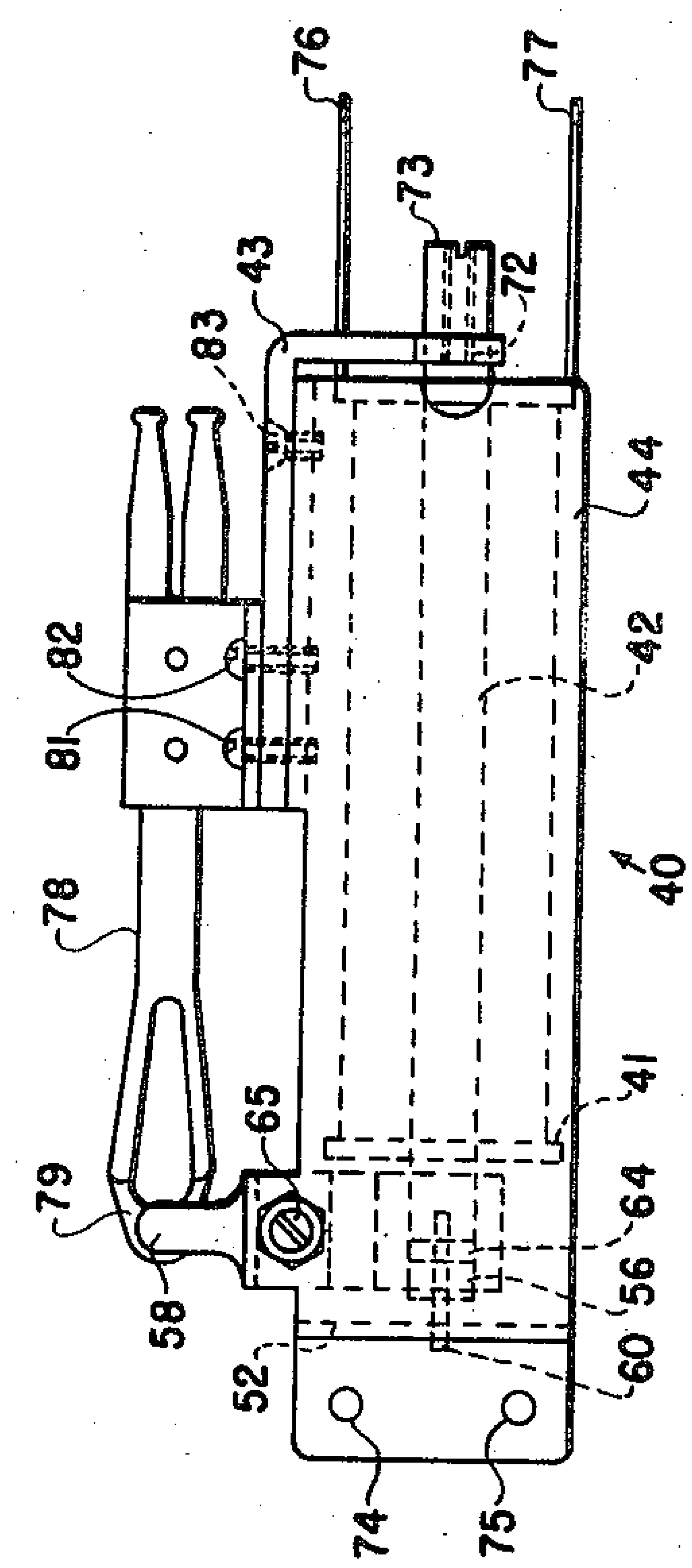

FIG. 4

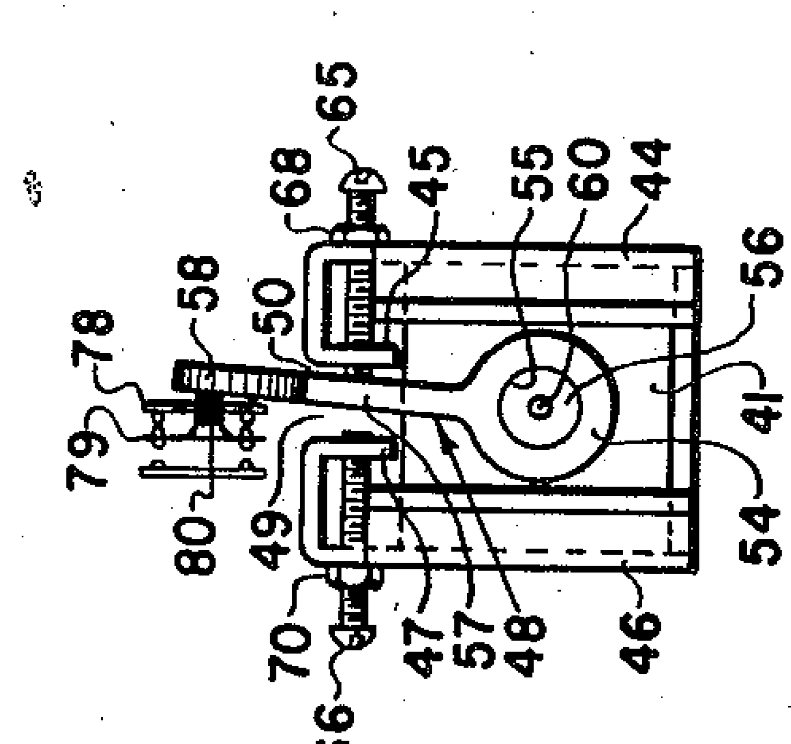

FIG. 6

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United States Patent Office

2,850,595

Patented Sept. 2, 1958

2,850,595

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**

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 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 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 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 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 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 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 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 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 polepiece **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. 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 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 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 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, 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 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 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 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 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 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 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 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 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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