Feb. 6, 1940. B. MISHELEVICH 2,189,178

ELECTRICAL RELAY

Filed Feb. 9, 1938 2 Sheets-Sheet 1

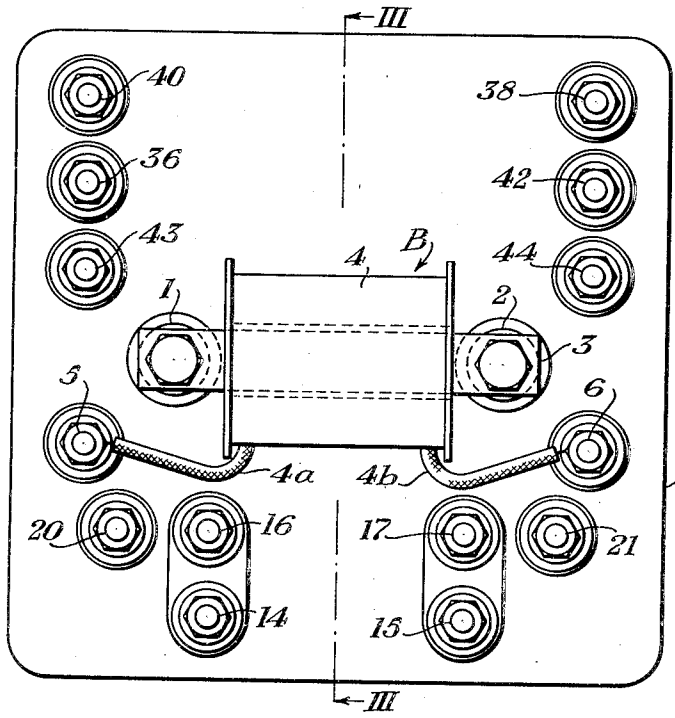


Fig. 1.

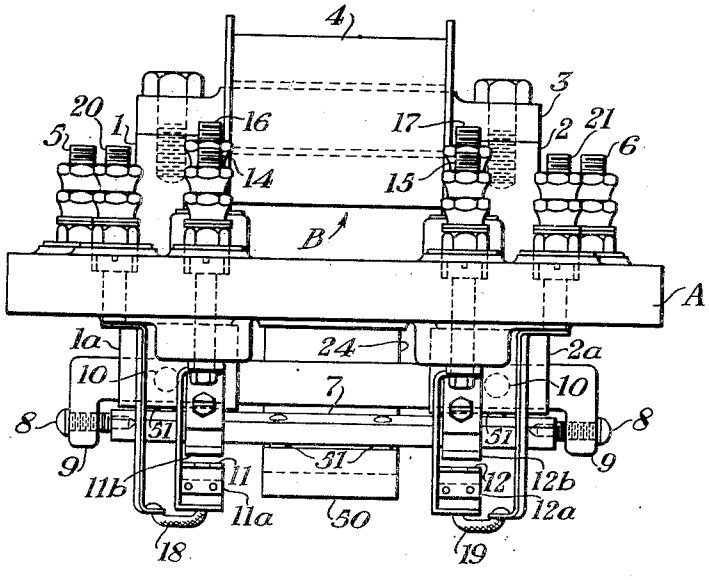


Fig. 2.

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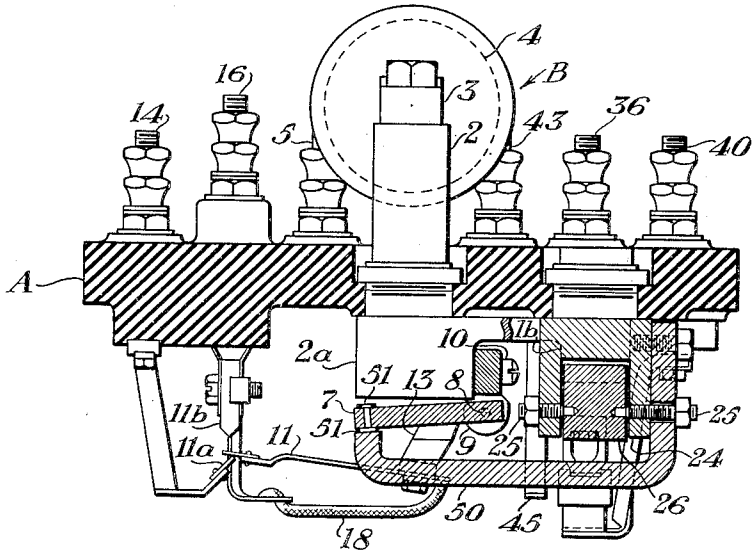


Fig. 3.

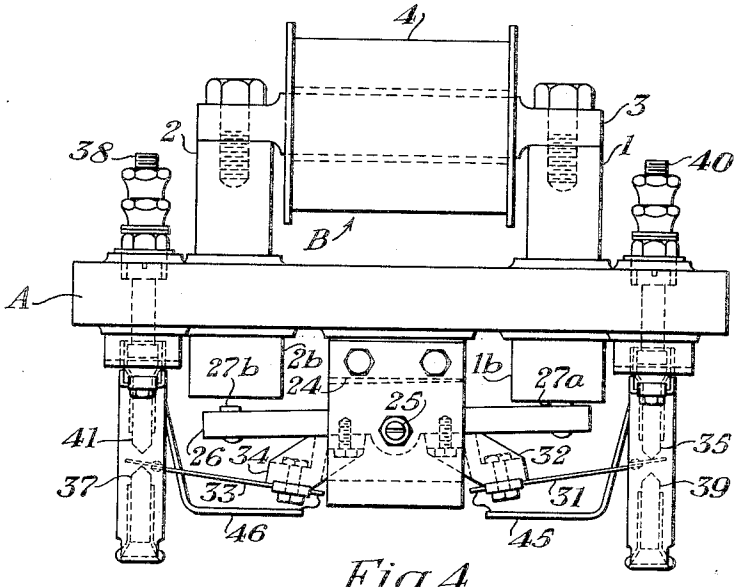


Fig. 4.

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Patented Feb. 6, 1940

2,189,178

UNITED STATES PATENT OFFICE

2,189,178

ELECTRICAL RELAY

Benjamin Mishelevich, Pittsburgh, Pa., assignor to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application February 9, 1938, Serial No. 189,620

5 Claims. (Cl. 175—339)

My invention relates to electrical relays, and particularly to relays of the direct current polarized type.

One object of my invention is to provide a relay of this type in which the permanent magnet which supplies the polarizing flux to the polar armature also serves to exert a hold-down torque on the neutral armature when the relay is deenergized to prevent the back contacts of the relay from bouncing open due to vibration or shock.

Another object of my invention is to provide a relay the design of which is such that it can be efficiently operated by means of an energizing winding consisting of a single coil.

A further object of my invention is to provide a relay which is suitable for use for railway signaling purposes, and which at the same time requires a minimum amount of space.

Other objects and characteristic features of my invention will appear as the description proceeds.

I shall describe two forms of electrical relays embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a top plan view showing one form of a relay embodying my invention. Fig. 2 is a front elevational view of the relay shown in Fig. 1. Fig. 3 is a vertical sectional view taken on the line III—III of Fig. 1. Fig. 4 is a back view of the relay shown in Figs. 1, 2 and 3.

Similar reference characters refer to similar parts in each of the several views.

Referring to the drawings, the relay in the form here shown comprises a top plate A of suitable insulating material such as a phenol condensation product, which top plate serves as a support for all of the operating parts of the relay. Mounted on the top plate A is an electromagnet B comprising a pair of parallel cores 1 and 2 connected together at their upper ends by a backstrap 3, and provided at their lower ends with enlarged pole pieces 1*a* and 2*a* disposed on the underside of the top plate. The electromagnet B also comprises a suitable operating winding 4 which, as here shown, is in the form of a single coil mounted on the backstrap 3. To facilitate making electrical connections with the winding 4, the leads 4*a* and 4*b* thereof are secured to terminal posts 5 and 6 mounted on the top plate A.

A neutral armature 7 is pivotally supported for swinging movement toward and away from the pole pieces 1*a* and 2*a* on two pivot pins 8 threaded through downwardly extending lugs 9 formed on a non-magnetizable bracket which is fastened to the sides of the pole pieces 1*a* and 2*a* by means of screws 10, as best seen in Fig. 2. A plurality of contact fingers, here shown as two in number and designated by the reference characters 11 and 12, are attached to the underside of the armature 7 by means of insulating supports 13. When armature 7 is swung away from the pole pieces 1*a* and 2*a*, as shown in the drawings, the contact fingers 11 and 12 each engage fixed contact members 11*a* and 12*a* to close back contacts 11—11*a* and 12—12*a*. When armature 7 is swung toward the pole pieces 1*a* and 2*a*, however, the contacts 11—11*a* and 12—12*a* become opened, and the contact fingers then engage fixed contact members 11*b* and 12*b*, respectively, to close front contacts 11—11*b* and 12—12*b*. The fixed contact members 11*a*, 12*a*, 11*b* and 12*b* are attached to terminal posts 14, 15, 16 and 17, respectively, mounted on the top plate A. Electrical connections to the contact fingers 11 and 12 are separately made by means of flexible connectors 18 and 19 which are attached at one end to the contact fingers, and at the other end to terminal posts 20 and 21, respectively, mounted on the top plate A.

A bifurcated pole piece 24 is secured to the underside of the top plate A midway between extensions 1*b* and 2*b* which are provided on the pole pieces 1*a* and 2*a*, and pivotally supported intermediate its ends between the bifurcations of the pole piece 24 by means of pivot pins 25 screwed through the bifurcations is a polar armature 26, the ends of which underlie the pole piece extensions 1*b* and 2*b*. The armature 26 is arranged to swing toward one or the other of these pole piece extensions, but is prevented from actually touching them by means of non-magnetic stops 27*a* and 27*b* fastened to the armature. A contact finger 31 is secured to the underside of the armature 26 adjacent one end thereof by means of an insulating support 32, and a similar contact finger 33 is secured to the underside of the armature 26 adjacent the other end thereof by means of an insulating support 34. When the armature 26 is swung toward the pole piece extension 1*b* of pole piece 1*a*, as shown in the drawings, the contact finger 31 engages a fixed contact 35 fastened to a terminal post 36 mounted on the top plate A, to close a normal contact 31—35, and the contact finger 33 engages a fixed contact 37 attached to a terminal post 38, also mounted on the top plate A, to close a normal contact 33—37. When armature 26 is swung toward the pole piece extension 2*b* of pole piece 2*a*, however, the front contact finger 31 then engages a fixed contact 39 to close a reverse con-

tact 31—39, and the contact finger 33 engages a fixed contact 41 to close a reverse contact 33—41. The fixed contact 39 is attached to a terminal post 40 mounted on the top plate A, and the fixed contact finger 41 is attached to a similar terminal post 42 mounted on the top plate A. The contact fingers 31 and 33 are electrically connected with terminal posts 43 and 44 mounted on the top plate A by means of connectors 45 and 46, respectively. While I have shown only two contact fingers attached to the armature 26 for simplicity in illustrating my invention, it is understood that additional contact fingers may be attached to this armature if desired.

The relay further comprises a permanent magnet 50 which is secured at one end to the bifurcated pole piece 24, and the other end of which extends underneath the neutral armature 7 approximately midway between the pole pieces 1a and 2a in such a position that when this armature is swung away from the pole pieces 1a and 2a, it will be swung toward the permanent magnet 50, and vice versa. The neutral armature is prevented from actually touching the pole pieces 1a and 2a, or the permanent magnet, by means of non-magnetic stops 51 secured to the armature.

With the relay constructed in the manner described there are a plurality of paths for the flux due to the permanent magnet. One of these paths passes from the end of the permanent magnet which is secured to the pole piece 24 through the pole piece 24, right-hand half of polar armature 26, as viewed in Fig. 4, the air gap between armature 26 and the pole piece extension 1b, pole piece extension 1b, pole piece 1a, the air gap between pole piece 1a and neutral armature 7, the left-hand half of neutral armature 7 as viewed in Fig. 2, and the air gap between armature 7 and the permanent magnet back to the permanent magnet. Another one of these paths may be traced from the right-hand end of the permanent magnet, as viewed in Fig. 3, through the pole piece 24, right-hand half of polar armature 26, as viewed in Fig. 4, the air gap between armature 26 and the pole piece extension 1b, pole piece extension 1b, pole piece 1a, core 1, backstrap 3, core 2, pole piece 2a, the air gap between the pole piece 2a and armature 7, the right-hand half of armature 7 as viewed in Fig. 2, and the air gap between armature 7 and permanent magnet 50 back to the permanent magnet. A third one of these paths may be traced from the right-hand end of permanent magnet 50, as viewed in Fig. 3, through the pole piece 24, the left-hand end of polar armature 26, as viewed in Fig. 4, the air gap between armature 26 and pole piece extension 2b, pole piece extension 2b, pole piece 2a, the air gap between pole piece 2a and armature 7, the right-hand half of armature 7 as viewed in Fig. 2, and the air gap between armature 7 and the permanent magnet 50 back to the permanent magnet. A fourth path for the permanent magnet flux passes from the right-hand end of permanent magnet 50 as viewed in Fig. 3, pole piece 24, the left-hand half of polar armature 26 as viewed in Fig. 4, the air gap between polar armature 26 and extension 2b of pole piece 2, pole piece extension 2b, pole piece 2a, core 2, backstrap 3, core 1, pole piece 1a, the air gap between pole piece 1a and armature 7, the left-hand half of armature 7 as viewed in Fig. 2, and the air gap between armature 7 and permanent magnet 50 back to permanent magnet 50.

There are also a plurality of paths for the flux which is set up by the current flowing in the winding 4. One of these paths may be traced from the left-hand end of backstrap 3 as viewed in Fig. 2, through core 1, pole piece 1a, the air gap between pole piece 1a and armature 7, armature 7, the air gap between armature 7 and pole piece 2a, and pole piece 2a and core 2 back to backstrap 3. Another path for the electromagnet flux may be traced from the left-hand end of backstrap 3 as viewed in Fig. 2, through core 1, pole piece 1a, pole piece extension 1b, the air gap between pole piece extension 1b and polar armature 26, polar armature 26, the air gap between polar armature 26 and polar extension 2b, polar extension 2b, pole piece 2a, and core 2 back to backstrap 3. A third path for the electromagnet flux may be traced from the left-hand end of backstrap 3 as viewed in Fig. 2, through core 1, pole piece 1a, the air gap between armature 7 and pole piece 1a, armature 7, the air gap between armature 7 and permanent magnet 50, permanent magnet 50, pole piece 24, the left-hand end of polar armature 26 as viewed in Fig. 4, the air gap between armature 26 and pole piece extension 2b, pole piece extension 2b, pole piece 2a and core 2 back to backstrap 3. A fourth path for the electromagnet flux may be traced from the right-hand half of backstrap 3 as viewed in Fig. 2, through core 2, pole piece 2a, the air gap between pole piece 2a and armature 7, the air gap between armature 7 and permanent magnet 50, permanent magnet 50, pole piece 24, the right-hand end of polar armature 26 as viewed in Fig. 4, the air gap between polar armature 26 and pole piece extension 1b, pole piece extension 1b, pole piece 1a, and core 1 back to backstrap 3.

The magnitude and direction of the flux in the various paths traced above will depend, of course, upon the proportioning of the parts, and the parts are so proportioned that the neutral armature 7 will be picked up or released according as the winding 4 is energized with current of either polarity or is deenergized. The parts are further so proportioned that when winding 4 is energized, the polar armature will swing to one extreme position or the other depending upon the polarity of the current supplied to the winding, and that when the winding 4 is deenergized, polar armature 26 will be held, by the flux from the permanent magnet, in whichever extreme position it occupies when the winding becomes deenergized. The parts are still further so proportioned that when winding 4 is deenergized, the neutral armature 7 will be held, by the flux from the permanent magnet, and by the force of gravity, in its deenergized position with sufficient force to prevent the back contacts of the relay from bouncing open due to vibration or shock.

It should be pointed out that while in describing my invention I have described the relay as comprising a permanent magnet 50 and a polar armature 26 of magnetizable material, the relay can be made to work equally well by constructing the armature 26 out of material which can be permanently magnetized and by replacing the permanent magnet 50 with a bar of magnetizable material. In this latter case the permanent magnet would be magnetized to have consequent poles. That is to say, the armature 26 would be so magnetized that it would have two south poles at its center and a north pole at each end or two north poles at its center and a south pole at each end. The operation of the relay

when constructed in this manner will be similar to the operation previously described and this operation need not, therefore, be repeated.

One advantage of a relay embodying my invention is that the permanent magnet serves not only as a means for polarizing the polar armature, but also as a means for providing a hold-down torque on the neutral armature when the relay is deenergized.

Another advantage of a relay embodying my invention is that it readily adapts itself to the use of a single coil for the energizing winding, thereby permitting the relay to be built in a minimum amount of space.

A third advantage of a relay embodying my invention is that the relay can be constructed with a minimum cost.

Although I have herein shown and described only two forms of electrical relays embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A relay comprising an electromagnet provided with two pole pieces, a neutral armature movable toward or away from both said pole pieces according as said electromagnet is energized by current of either polarity or is deenergized, a polar armature movable toward one or the other of said pole pieces, said neutral and polar armatures being independently movable about separate axes, and a permanent magnet for polarizing said polar armature having one pole magnetically connected with said polar armature adjacent the mid-point thereof and the other pole disposed adjacent said neutral armature on the side opposite to said pole pieces, whereby said neutral armature comprises a part of the flux path for the polarizing flux from said permanent magnet.

2. A relay comprising an electromagnet provided with two pole pieces, a neutral armature movable toward or away from both said pole pieces according as said electromagnet is energized by current of either polarity or is deenergized, a polar armature movable toward one or the other of said pole pieces, said polar and neutral armatures being independently movable about separate axes, and a permanent magnet extending between said two armatures for polarizing said polar armature and having one pole disposed adjacent the mid-point of one armature and the other pole disposed adjacent the mid-point of the other armature.

3. A relay comprising an insulating top plate, two parallel cores mounted in said top plate and provided on the underside of said top plate with enlarged pole pieces, a backstrap connecting the upper ends of said cores, a winding for setting up a flux in said cores, a neutral armature mounted for swinging movement toward and away from said pole pieces, a bifurcated pole piece secured to the underside of said top plate, a polar armature pivotally supported between the bifurcations of said bifurcated pole piece for swinging movement toward one or the other of said first mentioned pole pieces, and a permanent magnet secured at one end to said bifurcated pole piece and having its other end disposed adjacent said neutral armature on the side opposite said first mentioned pole pieces.

4. A relay comprising an electromagnet provided with a pair of pole pieces, a first armature pivotally supported for swinging movement toward or away from said pole pieces according as said electromagnet is energized by current of either polarity or is deenergized, and polarized means including a second armature pivotally supported intermediate its ends for swinging movement toward one or the other of said pole pieces and a fixed member having one end disposed adjacent said second armature at its center and the other end disposed adjacent said first armature in such a position that the polarizing flux will pass through said first armature and act as a means to urge said first armature away from said pole pieces when said electromagnet is deenergized.

5. A relay comprising an electromagnet provided with a pair of pole pieces, a neutral armature pivotally supported for swinging movement toward or away from said pole pieces according as said electromagnet is energized by current of either polarity or is deenergized, a polar armature pivotally supported intermediate its ends for swinging movement toward one or the other of said pole pieces, said polar armature being permanently magnetized to have poles of one polarity at its opposite ends and poles of the other polarity at its center, and a magnetizable member having one end disposed adjacent said polarized armature at its center and the other end disposed adjacent said neutral armature at the side opposite to said pole pieces.

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