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2,275,145

POLARIZED RELAY

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2 Sheets-Sheet 2

FIG. 5

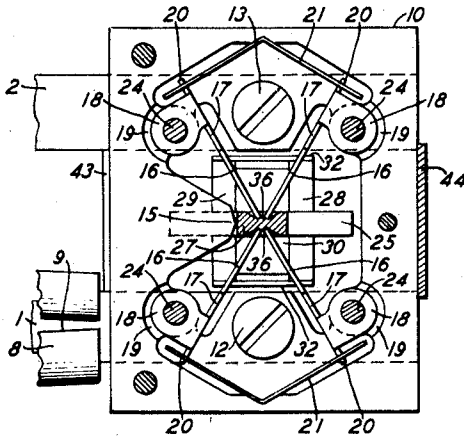


FIG. 7

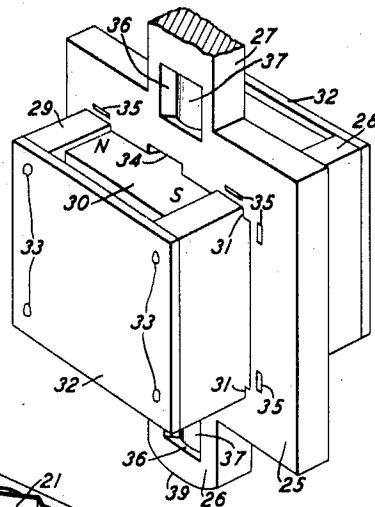
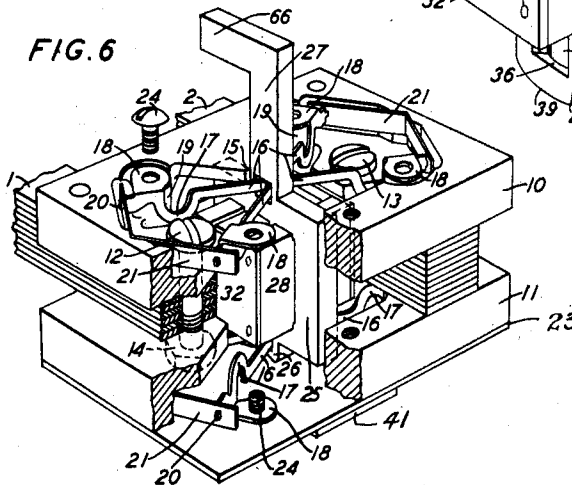


FIG. 6



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POLARIZED RELAY

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7 Claims. (Cl. 200—93)

This invention relates to relays and more particularly to relays of the polarized type.

It is often desirable in signaling systems to selectively close two work circuits by the operation of a polarized relay in response to the energization of its winding by current of either positive or negative potential. If a polarized relay of the type which has a single armature biased to a neutral position is used for this type of service, there is always the possibility that if the armature is not accurately biased in its neutral position, it may fail to operate on current of one polarity or may operate falsely due to vibration when its winding is not energized or is energized by current of a non-operating value.

It is therefore an object of the present invention to provide a relay structure of the polarized type which has three very definite positions of which two are circuit closing and the third a neutral or open circuit position.

It is a further object of the invention to provide a polarized relay structure which is reliable in operation, is sensitive, and which requires a minimum of maintenance.

In accordance with this invention these objects are attained by the provision of a relay of the motor type in which the stator comprises two groups of L-shaped laminations which are assembled with their short arms abutting and clamped between an L-shaped mounting bracket and a T-shaped spring pile-up supporting bracket to form a U-shaped core structure on one arm of which the stator coil is mounted. The forward end of the long arm of each lamination is provided with a hole and the ends of the two groups of laminations which serve as stator poles are held in the desired spaced relationship by two box-like spacers, one placed with its bottom abutting the upper faces of the two groups of laminations and the other one placed with its bottom abutting the under faces of the two groups of laminations. The spacers are clamped to the ends of the groups of laminations by bolts extending therethrough and through the holes in the laminations.

Each spacer has the central portion of its bottom cut away and has assembled therein four spring fingers extending radially towards the center of the spacer, the fingers being retained therein by a cover plate and screws which extend therethrough, through the base portion of the fingers and into tapped holes in the spacers. The spring fingers of each spacer serve as a support for a grooved rotor yoke spindle the ends of the fingers engaging in the grooves of the spindle

to form a substantially frictionless bearing support for the rotor. This feature of my invention has been presented in the application Serial No. 402,785, filed July 17, 1941, as a continuation-in-part of the present application.

The rotor is a composite structure and comprises a yoke having upwardly and downwardly extending spindle portions which are grooved to receive the ends of the spring fingers and having a permanent bar magnet and flanking permalloy shoes secured within the yoke. The rotor is so supported between the stator pole arms by the spring fingers engaging in the grooves of its spindle portions that the polar axis of its permanent magnet is normally parallel to the pole arms. The upper spindle portion is provided with an inwardly extending arm which is engaged by studs mounted on the inner ones of two pairs of contact springs which are insulatedly secured to the stem of the pile up supporting bracket previously mentioned, whereby the rotor is normally held in its neutral position in which position the springs of each pair are out of engagement. If the rotor swings its arm in either direction, the arm presses upon one of the studs to engage the contacts of the corresponding pair of springs.

A channel-shaped shield is secured to the relay for enclosing it on the bottom and sides and a can cover is provided to be slipped over the shield to completely enclose the relay to protect it from dust. A pair of contact springs is included in one of the spring pile-ups, one of which has a cam portion whereby when the can cover is slipped into place over the shield the contacts of these springs are brought into engagement. These contacts may be included in the work circuits of the relay so that when the can cover is removed for the adjustment of the relay these contacts will open the work circuits to prevent the false operation of apparatus included therein.

A polar relay of this type offers the advantage of a large operating force and the ability to handle spring pile-ups having a rather large number of contact springs. The rotor element satisfies one important condition for high efficiency in a polar structure, that is, that the motion of the rotor has little effect on the reluctance associated with either the permanent magnet or the operating coil but has a large effect on the mutual reluctance common to the two. It also offers an improvement in efficiency obtained by the use of a laminated stator core structure. The arrangement is also such that

magnetic fields tend to be localized so that interaction between adjacent relays mounted on a relay rack is very low.

A relay of this type may also be used as a dual relay by the provision of two oppositely poled windings or by the provision of means for reversing the terminal connections of the one winding whereby it can perform two distinct services at two different times and thus replace two independent relays.

For a clearer understanding of the invention reference may be had to the following detailed description taken in connection with the accompanying drawings in which:

Fig. 1 is a top plan view of a relay in accordance with the present invention with the enclosing shield and can cover shown in cross-section;

Fig. 2 is a side elevational view taken along section line 2—2 of Fig. 1;

Fig. 3 is a cross-sectional view taken along section line 3—3 of Fig. 2;

Fig. 4 is a fragmentary view showing the can cover operated contact springs in their open position after the cover has been partially removed;

Fig. 5 is an enlarged view of one of the stator spacers, particularly disclosing the springs by which the rotor yoke is supported for swinging movement;

Fig. 6 is an enlarged perspective view, partly in cross-section, of the rotor, rotor-supporting yoke and yoke supporting spring assemblies; and

Fig. 7 is an enlarged perspective view of the rotor and a portion of the rotor yoke.

Referring to the drawings and particularly to Figs. 1 and 2, the relay comprises essentially two main assemblies, a stator assembly and a rotor assembly. The stator assembly comprises two groups of L-shaped laminations which are assembled with their short arms abutted and with their long arms extending parallel to each other to form two laminated stator core arms 1 and 2. The abutted arms of the laminations are clamped between the horizontal arm of an L-shaped bracket 3 and the head of a T-shaped spring pile-up supporting bracket 4 by screws 5 which extend through holes in the bracket 3, through holes in the laminations and into tapped holes in the base of bracket 4. The vertical arm of bracket 3 is provided with tapped holes to receive screws 6 by means of which the relay may be secured to the mounting plate of a relay rack.

A coil 7 is mounted on a copper sleeve 8 after which the sleeve is slipped over the laminated core arm 1 before the rotor assembly is secured to the ends of arms 1 and 2. For holding the sleeve 8 in its assembled position on the arm 1 the end of the sleeve is slotted at 9 and the two sections thus formed are bent toward each other into firm engagement with the core arm 1. While a single winding coil has been disclosed, the coil could be provided with two oppositely wound windings whereby the relay could function as a dual relay or the coil could be separated into two portions each mounted on one of the core arms.

The forward ends of the core arms 1 and 2 are interconnected by two box-shaped spacers 10 and 11 formed as die castings from non-magnetic material. The spacers are positioned one with its bottom engaged against the upper surfaces of the core arms 1 and 2 and the other with its bottom engaged against the under surfaces of the core arms 1 and 2 and are secured to the core arms by bolts 12 and 13 which extend through holes in such spacers and in the ends of the core arms

and into threaded nuts 14. The bottom of each spacer, as best disclosed in Fig. 5, is provided with a central opening therein through which a spindle of a rotor supporting yoke may extend, the edge of the opening toward the rear end of the relay having a tongue 15 provided with a fulcrum edge against which an edge of a spindle of the rotor rests when the rotor is assembled in the spacers.

Positioned within each spacer are four spring fingers 16 which extend radially toward the center of the spacer. Each spring finger is mounted edgewise in the spacer, is provided with an offset portion 17 to increase its lateral and edgewise flexibility and is provided near its outer end with an ear 18 bent at right angles to the plane of the finger which rests on a recessed shoulder 19 formed in the inside corner of the spacer. Each shoulder 19 is recessed below the outer surface of the spacer substantially the thickness of the ear 18 of the finger supported thereon. The outer end of each finger is provided with a lug 20 which is engaged in a hole in the end of a spring 21. As best disclosed in Fig. 5 two springs 21 are provided, each bent into a wide V shape with its central portion engaged in a V-shaped notch in a side wall of the spacer and its ends engaged with the lugs 20 on the ends of two of the spring fingers 16. The springs 21 serve to force the inner ends of the spring fingers inwardly toward the center of the spacer.

For holding the spring fingers 16 and the springs 21 in their assembled positions disclosed in Figs. 5 and 6, cover plates 22 and 23 are provided for the spacers 10 and 11, respectively, which are secured thereto by screws 24 which extend through holes in the cover plates, through holes in the ears 18 of the spring fingers 16 and into tapped holes in the shoulders 19 of the spacers.

Supported within the openings through the bottoms of the spacers 10 and 11 on the inner ends of the spring fingers 16, is a rotor best disclosed in Figs. 6 and 7. This rotor comprises a square yoke frame 25 of non-magnetic material having axially aligned spindle extensions 26 and 27. Supported within the yoke are two permalloy pole-pieces 28 and 29 and an interposed permanent bar magnet 30. For centering the pole-pieces 28 and 29 with respect to the yoke 25, notches 31 are provided in the center of the upper and lower edges of each pole-piece in which the upper and lower horizontal bars of the yoke 25 are engaged. Two thin nickel-silver plates 32 are also spot-welded at the points 33 to the ends of the pole-pieces 28 and 29.

In assembling the rotor the pole-piece 28 is slipped endwise through the yoke 25 at the point where the notches 34 in its upper and lower bars provide sufficient clearance until the notches 31 in its upper and lower edges register with the upper and lower bars of the yoke and then the pole-piece is moved laterally toward the right as viewed in Fig. 7 until its outer face engages the inner edge of the right vertical bar of the yoke 25. The pole-piece 29 is similarly assembled into the yoke but with its outer face in engagement with the inner edge of the left vertical bar of the yoke. The permanent magnet 30 is then inserted between the pole-pieces 28 and 29 with one of its polar ends in engagement with the inner face of pole-piece 28 and its other polar end in engagement with the inner face of the pole-piece 29. The plates 32 are then spot-welded to the ends of the pole-pieces and the

whole rotor assembly is made rigid with the yoke 25 by staking or upsetting the yoke at the points 35 thereon. The plates 32 serve to prevent the ends of the pole-pieces from sticking to the stator arms 1 and 2 from which they are separated by air-gaps as more clearly disclosed in Fig. 5.

Each spindle extension 26 and 27 of the yoke is provided with grooves 36 oppositely disposed in the faces thereof, the bottoms of which grooves have cylindrical surfaces 37. When the rotor is assembled within the spacers 10 and 11 the inner ends of the spring fingers 16 supported by the upper spacer 10 are seated against the cylindrical bottom surfaces 37 of the grooves 36 in the upper spindle extension 27 of the yoke and the inner ends of the spring fingers supported by the lower spacer 11 are seated against the cylindrical bottom surfaces 37 of the grooves 36 in the lower spindle extension 26. The cover plates 22 and 23 are then slid into place over the outer faces of the spacers 10 and 11, each cover being provided with a slot 38 for permitting the spindle extensions to extend there-through and then secured to the spacers in the manner previously described by the screws 24. The sides of the slots 38 are so shaped adjacent to the spindle extensions as to permit the extensions to rotate to a limited extent around their axes but to be restrained against lateral movement. The spindle extensions are also embraced between the ends of the tongues 15 of the spacers 10 and 11 and the ends of the slots 38 to restrain the movement of the yoke extensions in their own planes.

The end of the lower spindle extension 26 is rounded as indicated at 39 and rests within a cup 40 formed in a brass supporting member 41 secured to the lower spacer 11 by screws 42 which extend through holes in such member, in the bottom plate 23 and into threaded holes in the spacer 11. One end of the member 41 is bent upwardly at right angles to form a shield 43 which fills the entire space between the inner faces of the core arms 1 and 2 and is engaged tightly against the rear edges of the spacers 10 and 11. An additional L-shaped shield 44 of brass is provided for closing the opening formed between the forward ends of the core arms 1 and 2 and the forward edges of the spacers 10 and 11. One arm of this shield is slotted as indicated at 45 in Fig. 1 and is secured by screw 46 which extends through the slot, through a hole in the upper plate 22 and into a tapped hole in the upper spacer 10.

Riveted to the upper spacer 10 and extending upwardly therefrom near its rear edge are two studs 47 to the upper ends of which a plate 48 of insulating material, such as phenol fiber, is secured by screws 49. The plate 48 is provided with notches 50 in its forward edge to receive the tangs of the fixed contact springs of the relay as later described and has riveted thereto two backstop members 51.

Secured on either face of the stem 52 of the T-shaped bracket 4 are two spring pile-ups. One of these spring pile-ups comprises an inner movable or armature spring 53, an outer or fixed mate spring 54 and a pair of coil terminal lugs 55 and 56, and the other pile-up comprises an inner movable or armature spring 57, an outer or fixed mate spring 58, a fixed can cover operable spring 59 and a movable mate spring 60 associated therewith. The springs of these pile-ups are clamped to the stem 52 of the bracket 4

by screws 61 which extend through aligned holes in the clamping plate 62, spacers 63, stem 52, springs 53 to 60, inclusive, interposed strips of insulation which insulate the springs from each other, from the stem 52 and from the clamping plates, thence into threaded holes in the clamping plate 64. The shanks of the screws 61 are surrounded in the usual manner by sleeves of insulating material whereby they are insulated from the springs through which they pass. As disclosed in Fig. 2 the coil terminal lugs 55 and 56 are provided with lateral extensions to which the ends of the winding of coil 7 are connected.

Ring-staked to each of the inner armature springs 53 and 57 near the contact end thereof is an insulating stud 65, the inner ends of which studs engage with the faces of arm 66 extending rearwardly from the upper end of the yoke spindle extension 27. The springs 53 and 57 are so tensioned as to normally hold the rotor in a neutral position with respect to the stator core arms 1 and 2 in which position the polar axis of the permanent magnet 30 of the rotor is parallel to the pole faces of the core arms. In this position the springs 53 and 57 engage against the backstops 51 and their contacts are out of engagement with the contacts of their mate springs 54 and 58. The mate or fixed springs 54 and 58 are provided with downwardly extending tangs near their contact ends which are normally engaged in the notches 50 in the plate 48, such springs being normally tensioned to engage their tangs with the sides of the notches toward the armature springs whereby with the normal positions of the springs 53 and 57 determined by the backstops 51, the contact gaps between the pairs of springs 53, 54 and 57, 58 are determined.

The fixed can cover spring 59 is also provided near its contact end with a tang which is engaged in a notch 50 in plate 51 and the movable spring 60 which mates with it has an operating stud 67 of insulating material ring-staked thereto. The outer end of this stud is engaged with a cam spring 68 which is secured by rivets 80 at its rear end to a side wall of the channel-shaped shield 69 and is provided on its forward end with a cam portion 70 which is operable through a slot 71 in the side wall of the shield.

The shield 69 is preferably of magnetic iron and is provided with an embossed portion 72 in its side wall to which the rear end of the spring 60 is riveted as previously described and with a transversely extending embossed portion 74 in its base near the rear end thereof through a hole in which a screw 73 extends into a tapped hole in the horizontal arm of the mounting bracket 3. When the screw 73 is tightened the inner surface of the embossed portion 74 is drawn against the outer faces of the heads of screws 5 whereby the rear end of the shield is firmly secured to the bracket 3. Near its forward end two embossed portions 75 are struck up from the base of the shield 69 upon which the rear portion of the lower cover plate 23 rests and through holes in which screws 76 extend into threaded holes in the lower spacer 11 for securing the forward end of the shield to the spacer 11. The forward edge of the shield extends beyond the forward edge of the spacers 10 and 11.

Slidable over the shield 69 is a can or dust cover 77 having its forward end closed by an end closure 78 welded to its four side walls and having a cover pull 79 riveted to such end closure. The embossed portions 72, 74 and 75 in the walls of

the shield 69 are of sufficient depth to permit the cover 77 to slide rearwardly on the shield freely over the heads of rivets 60 and the heads of screws 73 and 76. When the cover 77 has been completely pushed on over the shield 69 its rear edge engages a closure plate 81 of insulating material which is clamped between the vertical member of the mounting bracket 3 and the mounting plate of the relay rack when the screws 6 are tightened to clamp the relay to the mounting plate. The closure plate 81 is provided with suitable openings 82 and 83 therein through which the soldering terminal ends of the relay springs and the coil terminal lugs extend. When the cover 77 has been pushed on over the shield 69 into the position shown in Fig. 1, the upper wall thereof depresses the cam portion 70 of the spring 69 whereby through the stud 67 the spring 60 is forced into contact engagement with its mate spring 59. These springs may be connected in series with the work circuits closed through the engagement of springs 53, 54 or 57, 58 whereby such work circuits are effective when the can cover is positioned on the shield 59 as disclosed in Fig. 1 but are ineffective when the can cover is removed for the inspection of the relay or the adjustment thereof. Fig. 4 shows the position assumed by the springs 59 and 60 when the can cover has been nearly or entirely withdrawn from the shield 59.

When the relay coil 7 is energized by current a magnetic flux is caused to flow through the stator core arms 1 and 2 and across the air-gaps between the inner pole faces of such arms and the pole-pieces 23 and 29 of the rotor which will cause the rotor to turn in an attempt to align the field of its permanent magnet 30 with that set up by the flux flowing across the air-gaps. The direction of the turning movement of the rotor will be dependent upon the direction of the flux flowing across the air-gaps and consequently dependent upon the direction in which the energizing current is directed through the stator coil 7. Therefore, in response to current of one polarity the rotor will turn in a direction to engage the contacts of springs 53 and 54 and in response to current of the opposite polarity the rotor will turn in a direction to engage the contacts of springs 57 and 58.

Since the rotational force exerted by the rotor is comparatively large due to the magnetic efficiency of the relay the rotor is enabled to handle large spring loads with a relatively low value of operating current. The contact closure in either operated position of the rotor is very positive and the normal or open circuit condition is not readily subject to vibratory disturbance when the coil is unenergized or is energized by a non-operating value of current. The relay is thus particularly adaptable to circuits of a character in which it is essential that circuit closures shall be possible only when the relay is operated in the prescribed manner to secure such closures.

What is claimed is:

1. In a relay, a stator comprising a U-shaped stator core, a coil surrounding one arm thereof, spacing members secured to the ends of the arms of said core, and a rotor rotatably supported by said spacing members between the inner pole faces of said core arms, said rotor comprising a yoke of non-magnetic material, two pole-pieces positioned within said yoke and a permanent bar magnet positioned within said yoke and interposed between said pole-pieces, said rotor being normally so positioned that its

pole-pieces extend transversely between said core arms and that the polar axis of said permanent magnet lies parallel to said core arms.

2. In a relay, a stator comprising a U-shaped stator core, a coil surrounding one arm thereof, spacing members secured to the ends of the arms of said core and a rotor positioned between the inner pole faces of said core arms, said rotor comprising a yoke of non-magnetic material having shaft extensions rotatably supported by said spacers, two pole-pieces positioned within said yoke, a permanent bar magnet positioned within said yoke and interposed between said pole-pieces, and plates of non-magnetic material secured to the ends of said pole-pieces, said rotor being normally so positioned that its pole-pieces extend transversely between said core arms with their ends separated from the pole faces of said core arms by air-gaps and that the polar axis of said permanent magnet lies parallel to said core arms.

3. A rotor for a motor type relay comprising a rectangular yoke frame of non-magnetic material, the inner edges of the horizontal bars of which are provided with centrally positioned notches, two pole-pieces having notches centrally located in their upper and lower edges and insertable endwise through said frame at the point thereof widened by said first notches and slidable into engagement with the side bars of said frame with the horizontal bars of said frame embraced in their notches, a permanent bar magnet interposed between said pole-pieces and plates of non-magnetic material welded to the ends of said pole-pieces.

4. In a relay, a stator comprising two groups of L-shaped laminations having their short arms abutted and their long arms extending parallel to each other, a mounting bracket and a T-shaped spring pile-up supporting bracket between which said short arms are clamped, spacers of non-magnetic material between which the ends of the long arms of said groups of laminations are clamped, an operating coil surrounding one of said groups of laminations, a rotor rotatably supported by said spacers between the ends of said groups of laminations, and spring pile-ups mounted on either face of the stem of said supporting bracket and controllable by said rotor.

5. In a relay, a stator comprising a U-shaped stator core, a coil surrounding one arm thereof, spacers secured to the end of the arms of said core, a rotor rotatably supported by said spacers between the inner pole faces of said arms, said rotor having a supporting yoke provided with a rearwardly extending arm, two pairs of contact springs insulatedly secured to the rear end of said stator with their free ends positioned on either side of said yoke arm, an operating stud of insulating material secured to the inner spring of each pair, said studs having their inner ends engaged against the faces of said yoke arm, and backstops insulatedly secured to the upper one of said spacers against which the inner ones of said springs are normally biased.

6. In a relay, a stator comprising a U-shaped stator core, a coil surrounding one arm thereof, spacers secured to the ends of the arms of said core, a rotor rotatably supported by said spacers between the inner pole faces of said arms, said rotor having a supporting yoke provided with a rearwardly extending arm, two pairs of contact springs insulatedly secured to the rear end of said stator core with their free ends positioned

on either side of said yoke arm, an operating stud of insulating material secured to the inner spring of each pair, said studs having their inner ends engaged against the faces of said yoke arm, a plate of insulating material secured to the upper one of said spacers having notches in one edge thereof, tangs on the outer ones of said springs engaged in said notches, and back-stops secured to said plate against which the inner ones of said springs are normally biased.

7. In a relay, a stator comprising a U-shaped stator core, a coil surrounding one arm thereof, a rotor rotatably supported between the inner pole faces of the arms of said core, said rotor having a supporting yoke provided with a rear-

wardly extending arm, two pairs of contact springs insulatedly secured to the rear end of said stator core with their free ends positioned on either side of said yoke arm and operable thereby, a channel-shaped shield secured to said stator, a cam spring secured to a side wall of said shield with its cam end extending through a slot in said side wall, a third pair of contact springs insulatedly secured to the rear end of said stator core, a cam cover slidable over said shield to depress said cam spring, and means operable by the depression of said cam spring to cause the engagement of said third pair of contact springs.

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