Dec. 31, 1940. E. KLEIN 2,227,351

POLARIZED DYNAMIC RELAY

Filed July 21, 1939

Fig. 1.

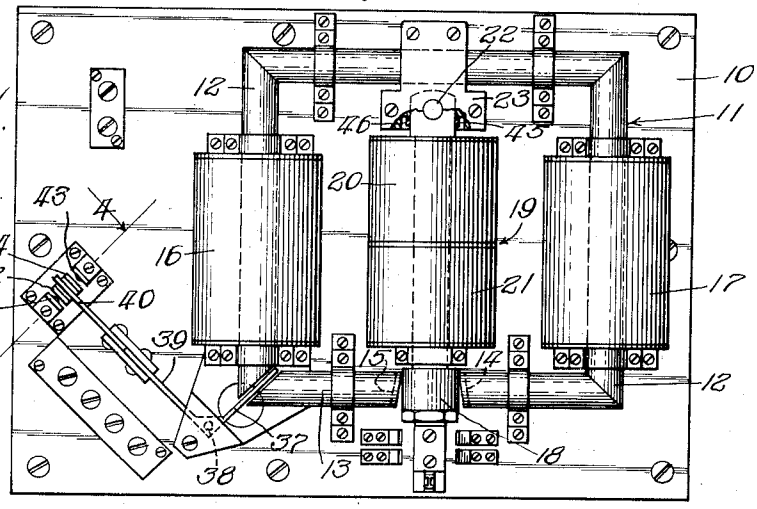

Fig. 2.

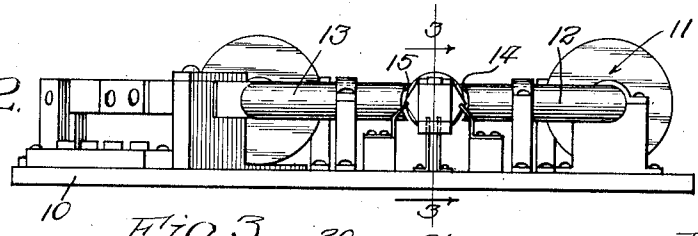

Fig. 3.

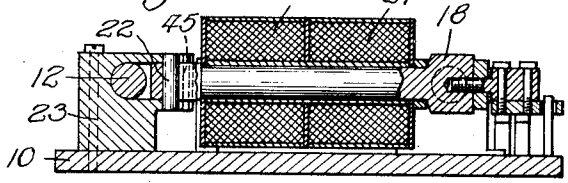

Fig. 4.

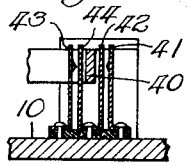

Fig. 5.

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POLARIZED DYNAMIC RELAY

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6 Claims. (Cl. 175—335)

This invention relates to a polarized relay, a relay of the dynamic type adapted to open and close either of two separate circuits or sets of circuits in different combinations in response to a relatively small current transmitted from a remote point of control.

One feature of this invention is that it provides a relay having an entirely dynamic action; another feature of this invention is that the apparatus is compact and capable of control by a quite small current, yet in turn able to make and break circuits having particularly high currents flowing therein; a still further feature of this invention is that it is adapted to provide a relatively large movement of the main switch means, yet considerable contact pressure; yet another feature of this invention is that only two operating connections need be made to the relay apparatus, reversal of the direction of current flow to these contacts effecting the desired action of the relay apparatus; other features and advantages of this invention will be apparent from the following specification and the drawing, in which:

Figure 1 is a top plan view of an embodiment of my invention; Figure 2 is an end elevation of the relay shown in Figure 1; Figure 3 is a detailed sectional view along the line 3—3 of Figure 2; Figure 4 is a detailed sectional view along the line 4—4 of Figure 1; and Figure 5 is a schematic wiring diagram.

While polarized relays adapted to selectively open and close either of a pair of circuits have been known and used, they have heretofore had a number of objections which a relay constructed in accordance with my invention obviates. In general, my relay comprises a polar element, and an armature element movably mounted and operatively associated therewith; coil means on each of the elements for setting up magnetic flux therethrough to attract the armature toward or repel it from a face of a pole of the polar element; and auxiliary switch means responsive to the direction of flux in one of the elements for changing the connections of the coil means on the other element, so that when current supplied to the apparatus flows in one direction the armature will be attracted to a certain pole face and when the direction of current flow to the apparatus is reversed the armature will move away from the face. Switch means for controlling the circuits to be opened and closed is, of course, actuated by the movable armature.

In the particular embodiment of my invention disclosed herewith a base plate 10 has fixedly mounted thereon a polar element 11 consisting of the principal part 12 and the small part 13. This element is formed of magnetic material having high permeability and low retentivity of induced magnetism, preferably being of round cross section. It is of the type providing a substantially closed magnetic circuit, although there are two air gaps therein. The larger gap is between the pole face 14 of the part 12 and the pole face 15 of the part 13; and the other gap is the relatively small one in the lower lefthand corner (speaking with respect to Figure 1) of the pole element, between the other ends of the parts 12 and 13 thereof. The parts of the polar element are mounted in the desired fixed relationship by brackets, preferably of non-magnetic material.

Coils 16 and 17 are mounted on the two side legs of the polar element. These coils each comprise a large number of turns of wire and they are connected together, as may be best seen in Figure 5, in such a way that they aid each other in creating a strong magnetic flux in the polar element upon the flow of a relatively small direct current through them. The direction of the flux in the polar element is, of course, a function of the direction of flow of the direct current supplied to the coils 16 and 17.

An armature element 18 is movably mounted between the pole faces 14 and 15 and adapted to move toward one pole face or the other in accordance with the relation between the direction of flux in the armature and that in the polar element. Magnetic flux is adapted to be created in the armature element by coil means mounted thereon and here referred to in general as 19, although actually this coil means comprises two coils 20 and 21, or two sections of a single medially tapped coil. The movable mounting of the armature is provided by making it swingable at one end about a vertical pin 22 carried in the bracket 23. Light leaf springs 45 and 46, or other convenient means, may be employed to normally bias the armature to central or neutral position. The pivot is at a considerable distance from the pole faces with which the armature is adapted to cooperate. The coil means 19 is, of course, movable with the armature.

The outer end of the armature, beyond the polar element, carries the main switch means for opening and closing either of a pair of circuits or combination of circuits. As here shown, this main switch means comprises a pair of con-

tact bars insulated from each other, and preferably also from the armature, adapted to cooperate with contact points. The contact bar 24, for example, is adapted to close a circuit through the wires 25 and 26 upon its engagement with the contact points 27 and 28. Similarly, the other contact bar 29 is adapted to close a circuit through the wires 30 and 31 when it engages the contact points 32 and 33.

It will be readily apparent that when the direction of the flux through the polar element 11 and that through the armature element 18 bears a certain relationship the armature element will be caused to swing or move to the right, toward the pole face 14, this movement, in the particular construction shown, being a function of attraction by one pole and repulsion by the other; and that this will cause engagement of the contact bar 24 with the points 27 and 28 to close the circuit through the wires 25 and 26. Since the contact bars of the switch means are farther from the pivot pin 22 than the pole pieces, the movement of the contact bars will be greater than that of the part of the armature adjacent the pole faces. This enables a relatively large movement of the main switch means without such a large movement of the armature adjacent the pole faces as to destroy the strength of the action; and the dynamic construction, with a large number of turns of the coils, enables a very firm contact pressure to be secured. If the direction of the flux through one of the elements be reversed without reversing that through the other the armature will at once swing to the left, operating from the points 27 and 28 and causing engagement of the contact bar 29 with the points 32 and 33.

Direct current is supplied to the apparatus to effect operation thereof through a two-wire circuit connected to the binding posts 34 and 35; and the circuit includes, at some remote point where it is desired to effect control, a polarity changing or reversing switch 36. This switch may be operated manually, or in any other desired way. In the position of the reversing switch illustrated in Figure 5 the positive supply connection would be made to the binding post 35, and the negative to the binding post 34; but when the switch is thrown the polarity of the binding posts is reversed. It is this reversal of the direction or polarity of the direct current supplied as an actuating medium which effects selection of the circuit which is to be closed by the main switch means heretofore described.

If the various coil means were all permanently connected to the binding posts of the apparatus, reversal of the actuating current would reverse the flux direction in both the armature and polar elements, so that there would be no effective change. In order to secure the desired movement of the armature it is necessary to reverse the flux in one of the elements without reversing it in the other, and I will now describe the means which I provide for doing this without supplementary connections or currents.

In the small secondary gap in the polar element is located one end of the permanently magnetized member 37, this member being pivotally mounted on the pin 38. Since this member is a small permanent magnet, carriage of magnetic flux in one direction in the polar element 11 will cause the end of the member 37 to move toward the end of the part 13; and carriage of flux in the opposite direction in the polar element will cause movement of the member 37 toward the face of the part 12.

The member 37 is the actuating portion of the auxiliary switch means. The member is here shown as having rigidly connected to it for movement with it a bar 39, terminating in an end 40 preferably of insulating material. Two pairs of arms are provided in operative relation with the end of the portion 40, so that movement of the end portion causes one pair or the other to come into electrical contact. As may be best seen from Figures 4 and 5, movement of the portion 40 in one direction causes the contact parts 41 and 42 to come into electrical engagement; and movement of the portion 40 in the other direction permits these parts to reopen and causes engagement of the similar parts 43 and 44.

As has been previously mentioned, the coil means 19 of the armature comprises the two electrically independent and preferably reversely wound coils 20 and 21. As may be best seen in Figure 5, closing of the contacts 41 and 42 connects the coil 20 to the binding posts of the apparatus, and thus to the source of direct current; and closing of the contacts 43 and 44 renders the coil 20 ineffective and connects the coil 21 to be energized by the direct current.

To summarize the operation of the device, it may be assumed that when the reversing switch 36 is in the position shown in Figure 5 the pole coils 16 and 17 are energized in such a direction that the pole face 14 is a north magnetic pole; that the member 37 is pulled toward the cooperating end of the part 13, so that the contacts 43 and 44 are closed and the coil 21 is energized; and that the coil 21 is wound and connected in such a direction that the end of the armature 18 adjacent the pole faces is a south pole. It is apparent that this will cause movement of the armature to the right, and closure of the contacts 27 and 28 by the bar 24. When the reversing switch 36 is thrown to the other position the pole face 14 immediately becomes a south pole, since the direction of current flow in the coils 16 and 17 is directly dependent upon the position of the switch 36. This change in polarity, however, causes the member 37 of the auxiliary switch to swing toward the cooperating end of the polar part 12, so that coil 21 is rendered ineffective and contacts 41 and 42 are closed to render coil 20 effective to create a magnetic flux in the armature 18. Since this coil is reversely wound its connection neutralizes the reversal of the direct current, insofar as the armature 18 is concerned, and the end of the armature adjacent the pole faces is still the south pole of the armature. It is apparent that the armature will then immediately swing to the left, breaking the circuit through the wires 25 and 26 and closing that through the wires 30 and 31.

While I have described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. Relay apparatus of the character described, including: a polar element; a movably mounted cooperating armature element; a coil on each of the elements; a source of direct current for energizing the coils to create magnetic flux in the elements; and switch means responsive to the direction of flux through one of the elements for maintaining the direction of flux through the other constant upon reversal of the direction of current

flow from the source, whereby the direction of said current flow selects the position of the armature.

2. Apparatus of the character claimed in claim 1, wherein the direction of flux in the polar element is determined by the direction of current flow from the source and the switch means is operatively associated with the polar element.

3. Relay apparatus of the character described, including: a polar element of the type having opposed pole faces and providing a substantially closed magnetic circuit; an armature element lying between said faces and movable therebetween; coil means on each of the elements; a source of direct current for energizing the coil means to create magnetic flux in the elements; and switch means responsive to the direction of current flow in one of the coil means for changing the connections of the other coil means, whereby the direction of flow of said direct current determines the pole face toward which the armature element moves.

4. Relay apparatus of the character described, including: a polar element; a movably mounted cooperating armature element; coil means adapted to create magnetic flux in the elements when direct current is supplied to the apparatus; and switch means responsive to the direction of current flow in one of the coil means for changing the connections of the other coil means, whereby the direction of the direct current supplied to the relay apparatus determines the position of the armature.

5. Relay apparatus of the character described, including: a polar element of the type having opposed pole faces and providing a substantially closed magnetic circuit; an armature element lying between said faces and movable therebetween; coil means on each of the elements; a source of direct current for energizing the coil means to create magnetic flux in the elements; and switch means including a permanent magnet mounted in a gap in the polar element, the switch means being responsive to the direction of current flow in the coil means on the polar element for changing the connections of the coil means on the armature element, whereby the direction of flow of said direct current determines the pole face toward which the armature element moves.

6. Relay apparatus of the character described, including: a polar element; a movably mounted cooperating armature element; a coil on each of the elements; a source of direct current, one of the coils being connected directly thereto; switch means automatically reversible upon reversal of said current; and a connection between the current source and the other coil including the switch means, whereby reversal of the current reverses the flux direction in one element without reversing that in the other.

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