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ELECTROMAGNETIC SWITCH

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The technical drawing consists of two parts: a cross-sectional view on the left and a side view on the right. The cross-section shows two horizontal heating elements, labeled 8 and 9, positioned within a furnace chamber. The chamber is bounded by a thick wall, with a central vertical section showing internal structural details. Various components are labeled with numbers: 1, 2, 3, 4, 5, 6, 7, 8, 9, 13, 17, 18, 19, 20, 23, 24, 25, 26, 27, 30, 31, 36. The side view shows the furnace from the side, with a vertical axis labeled 1 and 2. It illustrates the furnace's profile, including the heating elements and the surrounding structure. The drawing is a detailed technical illustration of a vacuum furnace with two heating elements.

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ELECTROMAGNETIC SWITCH

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This invention relates to contact-making devices and particularly to improvements in relays for use in telephone systems.

An object of the invention is to simplify the construction and increase the utility of relays.

Heretofore relays have been used in telephone systems where they serve as so-called combination line and cut-off relays or two step relays where, when a line was seized by a subscriber, the relay operated a signal at the central office, and when the line was extended at the central office the relay was again operated in a different manner to extinguish this signal and to prepare the connections for further extensions through the central office. In automatic telephone systems such operations of the combined relay served to control the automatic connections in various ways and to hold the line engaged. This combined relay often requires marginal operational characteristics of the windings or requires two separate windings actuated to control line relay contacts on the seizure of the line and to open these contacts and close the cut-off relay contacts. In some instances in automatic systems it may be necessary for the control of the connections to have certain of the first operating contacts maintained after the cut-off relay contacts are made.

The present invention relates to this latter type of combined line and cut-off relays and follows in the general design the construction of an all-purpose relay design disclosed in my copending application Serial No. 693,595 filed on even date herewith.

A feature of my invention is an arrangement in this type of all-purpose relay construction of a line relay winding and a cut-off relay winding operating on a single armature in three different stages to establish a common electrical connection when either winding is energized and a separate connection when one or the other of the windings is energized, that is, means is provided in combination with this armature whereby the armature may be given three movements, one when either winding is first energized and later one each when a corresponding one of the windings is energized, and electrical circuit controlling contact means operative during each of the three movements of the armature.

The invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a top view of a relay embodying the applicant's invention with parts of the top and front covers broken away;

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Fig. 2 is a cross-section taken on line 2—2 of Fig. 1;

Fig. 3 is a rear end view of the relay;

Fig. 4 is a front view of the relay with the part of the front cover broken away;

Fig. 5 is a cross-section taken on line 5—5 of Fig. 2;

Fig. 6 is a partial front view showing the various positions of the armature in relation to the core;

Figs. 7 and 8 show fragmentary views of the armature and the two types of contact spring combinations employed in this type of relay; and

Fig. 9 is a circuit diagram showing a general application of this type of relay in telephone systems.

Referring now to these drawings, the core 1 consists of a rear portion 2 having five forwardly extending prongs or pole piece members 3, 4, 5, 6, and 7. This core consists of laminated sheets to reduce the hysteresis losses. Around the member 4 is wound the line relay winding or coil and around member 6 is wound the cut-off relay winding or coil. These windings are provided with the usual spoolheads to confine the windings within the desired space. The rear end 2 of the core is clamped to an insulation block 10 and held therein is a nut 11 in which the screw 12 is threaded and by means of which the relay may be mounted on a support (not shown). The winding terminals, one of which is designated by the numeral 13, are embedded in this block 10 and extend forwardly through the block under the core structure and to which the terminals of the windings are connected. On top of block 10 is mounted another insulation block 15 in which the bottom contact springs are embedded or molded. Each of these bottom contact springs, of which there are four groups, shown in Fig. 3 at 17, 18, 19 and 20, consists of a pair of springs in the form of two round wires of somewhat different diameter to reduce contact chatter due to vibrations. On top of the block 15 is another block 23 in which the mating top contact springs are molded. These four springs are shown in Figs. 3 and 4, at 24, 25, 26 and 27. Each of these top springs consists of a single wire with a flat piece welded thereto at the front for contact with its mating bottom pair of springs.

Across the front ends of pole pieces 3 to 7 is located an armature 30. To this armature is secured a member 31 of insulating material. This member 31 is provided with various slots or openings through which all of the springs

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project. The contact springs 24 and 25, are however, actually connected to the member as shown particularly in Fig. 8 by having the flat piece 32 looped over a portion 33 of the member 31 while the springs themselves extend under the portion 33 and are welded on either side of this portion to the flat piece 32. The companion or mate springs 17 or 18 extend through slots such as 35 shown in Fig. 8 and are free to move in these slots but are tensioned against the insulated cross rod or pin 36 running across between all the top and bottom springs and which is connected to the cover of the relay as will be explained hereinafter.

The top springs 24 and 25 normally are out of engagement with the mating bottom springs 17 and 18 and are movable downwardly by the member 31. On the other hand the top springs 26 and 27 are, as shown in Fig. 7, merely guided in slots in the member 31 while the mating bottom springs 19 and 20 extend through slots such as 35 in member 31. In this case the springs 26 and 27 normally rest against pin 36 while the lower springs 19 and 20 make contact with the mating upper springs but are movable downwardly by a cross-connecting piece 37 of member 31, as shown in Fig. 7. Thus the springs, controlled as shown in Fig. 8, are normally open and when the armature 30 is attracted toward the pole pieces the upper springs will be moved by portion 33 of the member 31 into contact with the lower springs, while in Fig. 7, the springs are normally closed and when the armature 30 is attracted toward the pole pieces, the lower springs are separated from the upper springs by portion 37 of member 31.

It should be noted, as shown in Figs. 5 and 6, that the middle pole piece 5 of the core 1 is provided with a projection or knife edge 40. When the line relay winding 8 is first energized, the armature will be attracted toward the pole pieces of the core until it engages this projection 40 and will then be further attracted by tilting as shown by the dot-dash line in Fig. 6 in a clockwise direction until the right-hand end of the armature touches a projection 41 on pole piece 3 of the core. When the armature executes this movement the connection between contact springs 25 and 18 and between 24 and 17 is closed. During this movement the connections between contacts 26 and 19 and 27 and 20 remain closed.

If now, in a use of the relay in a circuit such as that shown in Fig. 9, the cut-off winding 9 is energized, the magnetic flux in the pole piece 6 will be sufficient to overcome the attraction of the armature by the magnetic flux in the pole piece 4 set up by the line relay winding 8 and thus cause the armature to tilt on the projection 40 in the opposite or counter-clockwise direction as shown by dotted lines in Fig. 6 until the left-hand end of this armature comes in contact with projection 43 on pole piece 1. When this last-mentioned movement of the armature takes place the connection between contacts 26 and 19 is opened and the connection between contacts 27 and 20 is also opened, while the connection established between contacts 25 and 18 remain closed and the connection between contacts 24 and 17 is opened due to the consequent lifting of the right-hand end of the armature as shown in Fig. 6.

If the relay is employed in a similar circuit but in which winding 9 is energized first, in which case winding 8 would have to be large enough to induce a flux in pole-piece 4 sufficient to over-

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come the attraction of the armature by the magnetic flux in the pole-piece 6 set up by the winding 8, the movements of the armature would be the same except that the tilting movements would be in the reverse order. In this case the parallel movement would close the connection between contact springs 25 and 18 and the first tilting movement would open the connection between springs 26 and 19 and between 27 and 20 while the second tilting movement would close these connections and also close a connection between springs 24 and 17. No matter which winding is energized first the connection between springs 25 and 18 will always be closed and maintained closed as long as the armature is attracted.

In general, however, the line relay winding 8 would be the first to be energized and the cut-off relay winding 9 would be the second to energize. A typical circuit arrangement in which this relay may be employed in telephone systems has been shown diagrammatically in Fig. 9. The line relay winding 8 may be connected in a circuit from battery and ground through the two portions thereof, through the normally closed contacts 26 and 19 and 27 and 20 to a calling line 53 and to a central office 51 when the calling subscriber indicated by a circle 52 initiates a call. The energization of winding 8 would then first close a connection between springs 25 and 18 and then between springs 24 and 17 and thereby establish a connection from ground through springs 25 and 18 to the central office to prepare a signal at the central office and a similar connection from ground through contacts 25 and 18 to the central office. Then when the central office is ready to extend a connection, a circuit is established for energizing winding 9 from a battery at the central office through the winding 9 to ground. The operation of winding 9 then opens the connection between springs 24 and 17, 26 and 19 and 27 and 20 and thereby opens the circuit for winding 8 which then releases. The connection between the contacts 25 and 18 remains closed, for other purposes as may be required. When the subscriber at station 52 releases the connection and the mechanism at the central office operates in the well known manner the circuit for the winding 9 is opened and this relay is restored to normal condition. While the arrangement as shown in Fig. 9 is merely typical of one application of the applicant's relay structure, it is understood that this relay may be employed for various other purposes for operating contacts in three different stages.

What is claimed is:

1. In an electromagnetic relay, a magnetic core structure, two coils mounted on different core members of said structure, a single armature, an operating member attached to said armature, a stop bar, and three sets of contact springs, certain of said springs attached to said member and supporting said armature, said springs being controlled by said member and by said stop bar and so arranged in relation thereto that when one coil is energized to attract the armature and move the member a first and a second set of springs are operated and when the other coil is energized to attract the armature and move the member the second set of contacts and a third set of contacts are operated.

2. In an electromagnetic relay, a core structure, two coils mounted on different core members in said structure, a single armature, an operating member attached to said armature, a stop bar, a first and a second pair of contact

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50 springs associated with said member and said bar so as to suspend the armature above the core structure and normally maintain a connection between the springs of each pair open, a third and a fourth pair of contact springs associated with said member and stop bar so as to normally maintain a connection between the springs in each pair closed, a projection on said core structure so arranged that when one of said coils is energized the armature with its member is first attracted towards said core structure until it engages said projection and causes a connection to be established between the springs of the first pair, and then shifted so that a connection is established between the springs of the second pair and so that if the second coil is then energized the armature with its member is then tilted in the opposite direction to open the connection between the springs of the second pair and to open the connection between the springs of the third and fourth pairs.

3. In an electromagnetic relay, contact springs, a slotted control member for the operation of said springs to establish electrical connections, spring suspension means for said member, an armature connected to said member, a magnetic core structure, two coils mounted on said core structure, projections on said core structure so arranged thereon that on the energization of either of said coils said armature is attracted and moved first with a parallel motion towards the structure and then tilted towards the core structure in one direction or the other depending on which coil is energized, a stop bar associated with said electrical contact springs so arranged in relation to the contact controlling member and to the slots in said member that on the first movement of said member by said armature certain of said contact springs establish an electrical connection and on the subsequent tilting movement of the member by said armature in one direction or the other a different group of contact springs establish electrical connections for each tilting movement.

4. In an electromagnetic relay, a core having five parallelly disposed pole pieces, a coil around the second pole piece, a coil around the fourth pole piece, an armature extending across all five pole pieces near the free ends thereof, a member of insulating material attached to said armature on the top thereof and running the full length of said armature, insulation blocks attached to the base of said core, wire springs embedded in said blocks, some of said springs being attached to said member, others of said springs engaging guide slots in said member, a projection on the middle one of said pole pieces so arranged that when either of said coils is energized said armature will be attracted toward said pole pieces until it strikes said projection and will then pivot on said projection in one

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direction or the other towards certain of said pole pieces depending on the coil energized, a cover for said relay secured in said insulation blocks, and a central rod secured to said casing, said springs serving as electrical contact springs and arranged in relation to said slots in said member and to the central rod so as to close electrical connections between some of them when the armature is first attracted toward the pole pieces regardless of which coil is energized while some other of said springs separate when the armature is moved in one direction on said pivot by the energization of one of said coils and while still some other of said springs close when the armature is moved in the opposite direction, by the energization of the other coil.

5. In an electromagnetic relay, a magnetic core structure, two coils mounted on said structure, a plurality of sets of contact springs, an armature controlling said contact springs and movable to a common first position upon the energization of either of said coils to actuate a first set of said contact springs, movable to a second position upon the energization of one of said coils to actuate a second set of said contact springs, and movable to a third position upon the energization of the other of said coils to actuate a third set of said contact springs.

6. In an electromagnetic relay, a magnetic core structure, two coils mounted on said structure, a plurality of sets of contact springs, a fulcrum, an armature operable upon the energization of either of said coils to move linearly into engagement with said fulcrum and to actuate a first of said sets of contact springs, operable upon the energization of one of said coils to rotate on said fulcrum to actuate a second of said sets of contact springs, and operable upon the energization of the other of said coils to rotate on said fulcrum to actuate a third of said sets of contact springs.

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