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D. M. COSTIGAN

3,135,846

LATCHING RELAY

Filed Nov. 24, 1961

FIG. 1

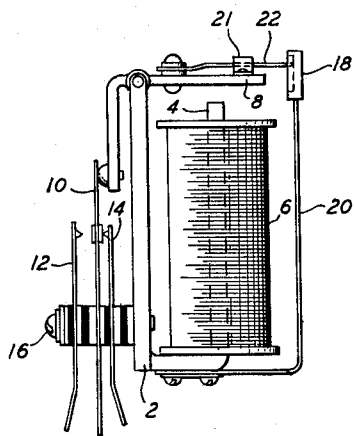


FIG. 1A

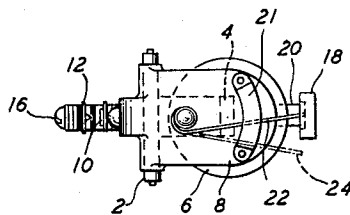


FIG. 1B

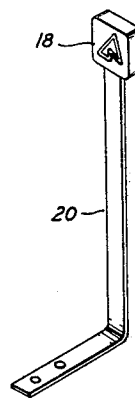


FIG. 1C

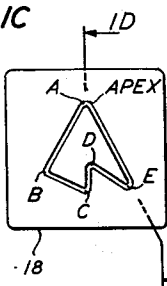


FIG. 1D

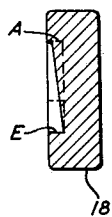


FIG. 2A

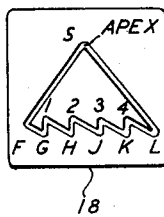


FIG. 2B

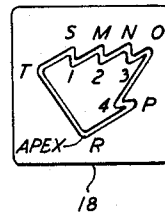


FIG. 3

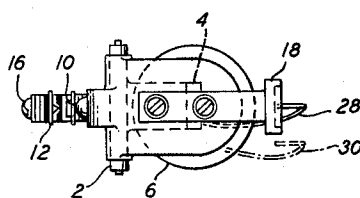
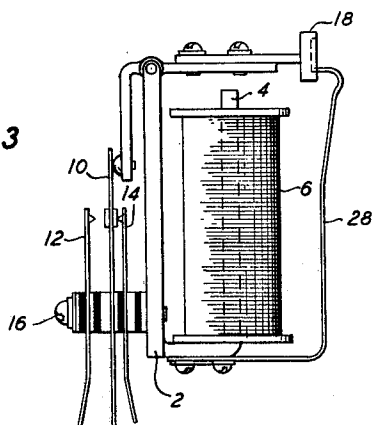


FIG. 3A

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1

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LATCHING RELAY

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5 Claims. (Cl. 200—87)

This invention relates to switching devices and more particularly to electromagnetic relays.

An object of the invention is to provide a relay in which the displacement of the armature with respect to the core, each time an electrical impulse is applied to the coil winding, may be programmed for a specified number of impulses in accordance with a predetermined pattern.

This objective is achieved by modifying the conventional electromagnetic relay to include two basic components. These components are a grooved guide member which, in one embodiment of the invention, is attached or affixed to the support member or frame of the relay, and a spring member having one end affixed to the armature of the relay and the free end disposed in the groove of the guide member. The groove provides a closed loop path over which the free end of the spring member is guided in steps determined by the contour of the groove and the electrical impulses applied to the relay coil winding. The displacement of the free end of the spring member in the groove determines the displacement of the armature with respect to the core.

Each time an electrical impulse is applied to the coil winding the core attracts the armature and the spring member affixed thereto. The direction and degree of displacement of the armature are dictated by the direction and distance traveled by the spring member as determined by the contour of the groove. In accordance with the invention, it is possible to predetermine the interval during which the switching contacts controlled by the armature are to be held in the make or break position, and to change the interval pattern by modifying the contour of the groove of the guide member.

The nature of the invention and its distinguishing features and advantages will be more clearly understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a view in side elevation of one embodiment of the invention;

FIG. 1A is a plan view of the embodiment shown in FIG. 1;

FIG. 1B is a view in perspective of the guide member and support therefor shown in FIG. 1;

FIG. 1C is a view in front elevation of the groove in the guide member shown in FIG. 1;

FIG. 1D is a sectional view taken on the line 1D—1D of FIG. 1C;

FIGS. 2A and 2B are examples of other guide groove contour patterns;

FIG. 3 is a view in side elevation of another embodiment of the invention; and

FIG. 3A is a plan view of the embodiment shown in FIG. 3.

As disclosed in FIGS. 1, 1A and 1B, one embodiment of the invention comprises a frame 2, a core 4 affixed to the frame and disposed within coil 6, an armature 8, a spring member 10 adapted to be actuated by the armature, contact support members 12 and 14, bolt or rivet means 16 for affixing the spring and contact support members to the frame, guide groove block 18 made of a wear resistant material such as nylon, a flat spring support member 20 having one end affixed to the frame and the other end affixed to the guide groove block, and a follower spring member 22 having one end affixed to the armature and the free end disposed in the groove of the guide block 18.

2

The guide block and follower spring members may be affixed to their respective supporting members by any suitable means. Motion restricting member 21, which may be of any suitable material, is affixed to the armature in such manner as to restrict the free vertical motion of follower spring member 22. As indicated in FIG. 1A, the follower spring member 22 is tensioned in such manner as to assume the position shown by dotted line 24 if allowed to be free of the restraining force applied by the groove in block 18.

With the follower spring member 22 and the guide groove block 18 disposed as indicated in FIG. 1, the tip of the spring member 22 rests at point A, FIGS. 1C and 1D, when the coil is not energized and armature 8 is in its normal or unoperated position. An impulse of current applied to the winding of coil 6 will pull down armature 8 causing the tip of spring member 22 to follow the guide groove in block 18 from the rest or start position A to position B, FIG. 1C. The tension on spring member 22 will cause its tip to move to position C as the armature 8 reaches a position which causes the contact on spring member 10 to break away from the contact on support member 14 and make with the contact on support member 12. Upon removal of current from the winding of coil 6, armature 8 will rise and the tip of spring member 22 will move to position D where it will be held due to the pressure exerted on armature 8 by spring member 10. The armature is not allowed to rise enough to affect the make position of the contacts on spring member 10 and support member 12. Thus, with current removed, after application of the first impulse, the relay will remain in the operated condition. Upon application of a second impulse of current to the winding of coil 6 the armature will again move downward and the tip of spring member 22 will move to position E. Upon removal of current from the winding of coil 6, the tip of spring member 22 will return to position A, allowing the relay to return to its normal condition.

As shown in FIG. 1D, the return leg of the guide groove becomes increasingly shallow toward the top. This provides assurance that the tip of spring member 22 will snap back into start position A when it reaches the apex of the groove. This action requires that the flat spring support member 20 be sufficiently flexible to permit the guide block 18 to move backward as the depth of the return leg of the guide groove decreases.

FIG. 2A shows a guide groove pattern which will cause the relay to operate when the first impulse of current is applied to the winding of its coil, and to release after four additional impulses of current are applied to the coil. The application of the first impulse will pull down the armature and cause the tip of the follower spring member to move from the start position S to positions F and G. At the termination of the impulse the armature will rise slightly and the spring tip will move to position 1. The armature will not have arisen enough to affect the condition of the relay contacts. On application of the second impulse the spring type will move to position H, and at the termination of the second impulse the spring tip will move to position 2. It will readily be understood that two additional impulses will have to be applied to the relay coil before the spring tip returns to start position S and the relay returns to its normal condition.

FIG. 2B shows a guide groove pattern which will permit the relay to operate after four impulses of current have been applied to the winding of its coil, and to release after the fifth impulse of current is applied to the coil. The application of the first impulse will pull down the armature and cause the follower spring tip to move from start position S to position 1. The degree of displacement of the armature is controlled by the displacement of

the spring tip and will not be sufficient to alter the make and break condition of the relay contacts. At the termination of the first impulse the spring tip will move to position M and the armature will rise toward its normal unoperated position. It will be readily understood that the application of the second and third impulses will produce results similar to those produced by the first impulse. The application of the fourth impulse will pull down the armature and cause the spring tip to move from position O to position 4. At the termination of the fourth impulse the spring tip will move to position P. The armature will have moved sufficiently to cause the contact on spring member 10 to break away from the contact on support member 14 and make with the contact on support member 12. The application of the fifth impulse will pull the armature down sufficiently to permit the spring tip to move from position P to position R and, at the termination of the fifth impulse, the armature and spring tip will return to their normal and start positions, respectively. As noted heretofore, it is preferred that the return leg LS of the groove shown in FIG. 2A and the return leg PR of the groove shown in FIG. 2B become increasingly shallow toward the apex.

The embodiment shown in FIGS. 3 and 3A requires that the guide groove block 18 be fixedly mounted on the armature in the inverted position and that the follower spring member 28 be affixed to the frame. As indicated in FIG. 3A, the follower spring member 28 is tensioned in such manner as to assume the position shown by dotted line 30 if allowed to be free of the restraining force applied by the groove in block 18.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A relay comprising:

a support;

contacts on the support;

a lever pivoted to the support and having a contact operating part and an armature part;

a core surrounded by a coil;

and means interconnecting said support and said lever for controlling the displacement of the lever each time the coil is energized, said means comprising two elements, one a grooved element wherein the groove is a closed loop of variable depth which traces longitudinal and transverse deviations on said grooved element, and the other a spring element having a movable end guidably embraced by said groove on said grooved element whereby said movable end is guided which over an undulating path in steps determined by the contour of the groove and the number of coil energizations.

2. A relay comprising:

a frame;

motor means responsive to electrical impulses including a core, a coil secured to the frame, and an armature pivoted to the frame, said armature biased to a rest position and having a contact operating member;

contacts associated with the contact operating member of the armature;

and controlling means for positioning the armature, said controlling means responsive to electrical impulses applied to said motor means and comprising a guide and a follower, one mounted on the armature and the other on a spring secured to the frame, said spring oriented to bias the guide and the follower toward each other, said guide embracing the follower in a continuous groove of varying depth which cyclically controls the follower as it moves in response to impulses applied to said motor means.

3. A relay in accordance with claim 2 wherein at least one abrupt depth change in said continuous groove defines a shoulder to prevent retrogression during the control cycle.

4. A relay in accordance with claim 2 in which the continuous groove is a tortuous path with a plurality of latching positions, and in which the follower is biased to move without retrogression step-by-step from one latching position to the next as it traverses said plurality of latching positions under the cyclical control of said continuous groove in response to electrical impulses applied to said motor means.

5. A relay comprising:

a frame;

selecting means for choosing a relay switching condition;

motor means mounted on said frame and responsive to electrical impulses, said motor means having an armature, said armature pivoted to the frame, biased to a rest position and having a contact control member responsive to the selecting means, said selecting means responsive to a follower and comprising said follower and a guide, one mounted on the armature and the other on a spring secured to the frame, said spring oriented to bias the follower and the guide toward each other, said follower responsive, within the scope of a control cycle, to electrical impulses applied to said motor means, said follower embraced in a continuous groove contoured in the guide wherein said control cycle is defined by the continuous groove, said continuous groove being of variable depth with at least one abrupt depth change defining a shoulder to prevent retrogression during the control cycle;

and at least one contact set mounted on said frame and comprising means responsive to said contact control member for alternating an electrical input between two electrical outputs.

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