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RELAY

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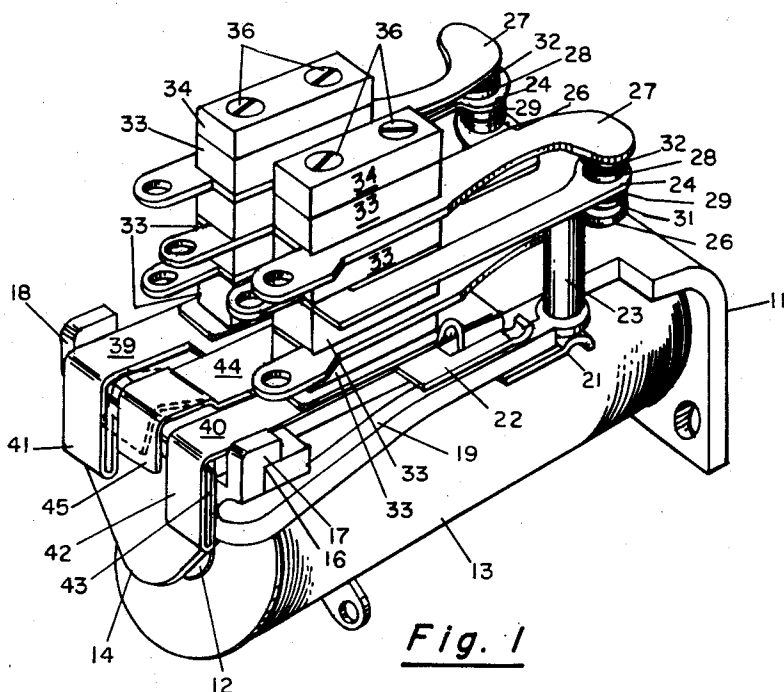


Fig. 1

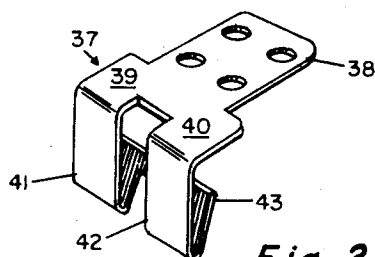


Fig. 2

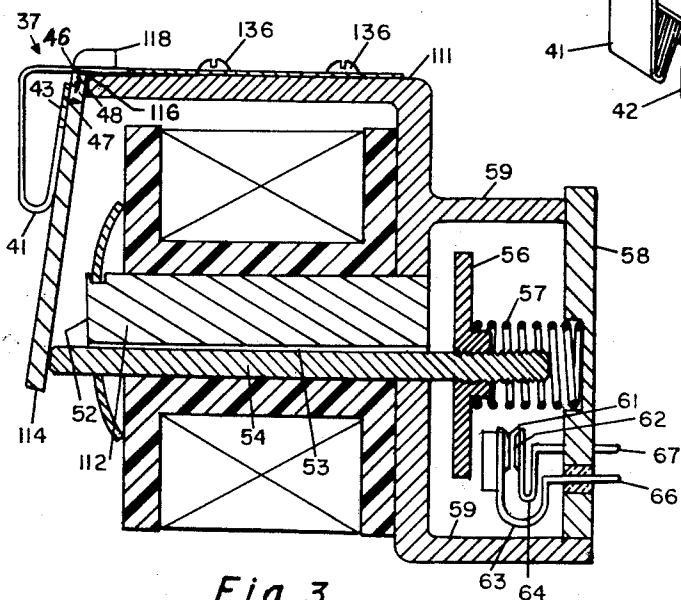


Fig. 3

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RELAY

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This invention relates to electro-magnetic relays and to an improved retaining spring and armature arrangement that allows the armature of the relay to be slipped into position easily and held there with a minimum of adjustment.

The general configuration of the type of relays to be discussed in the following specification includes a magnetizable core, a frame holding the core, a coil surrounding the core, and an armature supported on the frame by a pivot adjacent to one end of the core. When the coil is energized, it creates a magnetic field in the core, and this field attracts the armature, causing the latter to pivot on its support. Means actuated by the armature are arranged to apply pressure to move spring-mounted contacts to engage and disengage the latter with fixed contacts.

More particularly the armature of the present invention is provided at one edge with bent-over extensions which fit around and are pivoted on a rather sharp edge of the relay frame. The armature is held in place against this edge by means of a spring having one portion which is clamped to the frame. The spring extends over the edge on which the armature is pivoted by a distance greater than the length of the bent-over extensions and fits around the extensions so as to press on the edge of the armature adjacent to the extensions. A second portion of the spring extends from the first portion and terminates in a third portion that extends back toward the first portion. This third portion bears against one surface of armature in such a way that the armature is held against the edge of the frame but is not subjected to rotational forces of sufficient magnitude to affect pivoting of the armature. The reason for having the first portion of the spring extend out from the pivot edge by the distance mentioned is to allow the third portion, which bears on the surface of the armature and which, because of its length and the length of the second portion is very flexible, to be flexed sufficiently to allow the bent-over extensions to slip past the pivot edge and hook over the frame without bending the first portion of the spring enough to take a permanent set.

One of the objects of the invention is to provide an improved relay armature and retaining spring arrangement which will allow the armature to be inserted after the coil and core of the relay have already been attached to a frame and which will allow the armature to be pivoted substantially free of undesired rotational forces caused by the spring. Other objects will be indicated in the following specification together with the drawings in which:

Fig. 1 is a perspective view of a relay incorporating the invention;

Fig. 2 shows the armature-locating spring of Figs. 1 and 2; and

Fig. 3 is an enlarged cross-sectional view of another relay using the armature-locating spring arrangement of Fig. 1.

The relay in Fig. 1 is built around an L-shaped frame

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11 of ferromagnetic material such as soft magnetic steel, for example. A magnetizable, or ferromagnetic, core 12 is attached to the frame and a coil 13 is wound upon or placed upon the core 12. An armature 14 of soft steel or the like is hinged upon the rather sharply rounded edge 16 of frame 11 by means of a pair of extensions 17 and 18 which are bent to conform to the rather small radius of edge 16. Preferably edge 16 is smoothed off so as to remove any burrs so that the armature 14 may pivot freely thereon.

Extending from the main part of armature 14 is a pair of arms 19, only one of which is visible. In this embodiment both of these arms are more or less perpendicular to the main part of armature 14 and are therefore approximately parallel to the core 12. The ends of the arms rest on stops 21 that are suspended stirrup-like from frame 11, and a thin, leaf spring 22 presses the arm 19 against the stop. The purpose of spring 22, is to bias the arms downward and the main part of armature 14 away from the core 12 except when the magnetic flux induced in the core by an energizing current in coil 13 pulls the main part of armature 14 against the end of core 12, thus pivoting the armature on its axis at the edge 16 of frame 11. When the armature is thus pivoted, the end of arm 19 rises from stop 21 and pushes on the lower end of an actuating rod 23, which is usually made of insulating material.

Rod 23 is attached to the underside of the middle, resilient blade 24 of a contact pile. Two such piles are shown in the present embodiment and each has three contact blades of which blades 24 are the movable ones and blades 26 and 27 are relatively stationary. There can, of course, be many more blades if the piles are made higher, but the simple structure shown includes the basic elements. Each of the movable blades 24 carries a contact 28 on its upper side and another contact 29 on its lower side, while blades 26 and 27 carry contacts 31 and 32 respectively. In the unenergized condition contacts 29 are pushed down against contacts 31 to form a connection between blades 24 and blades 26. The downward pressure of contacts 29 may be obtained by the set of the blades 24 or by auxiliary springs (not shown). The blades 24—27 are insulated from each other and from the frame 11 by insulating blocks 33. Each pile of blocks and blades is topped by a metallic end block 34 and is affixed to the frame 11 by a pair of screws 36.

The armature 14 is held against edge 16 by a spring 37 which is shown by itself in Fig. 2. In this embodiment the spring consists of a resilient metal strip, one end 38 of which has four holes to permit the screws 36 to pass through. Adjacent to this apertured end the spring is divided into two parts 39 and 40 for reasons later to be considered. Both parts 39 and 40 include bent-down intermediate sections 41 and 42, respectively, which are approximately perpendicular to the end 38. Parts 39 and 40 are joined together again by a section 43 which is bent upward at an acute angle to the intermediate sections 41 and 42.

Returning now to Fig. 1, it can be seen that the spring 37 is clamped in place by the contact piles and directly by pressure of the central body section 44 of stop 21. It can also be seen that a long strap 45 extends from the central section and is bent down over the armature 14 in the space between sections 39 and 40 of spring 37. This is one of the reasons the spring was divided into two sections. The purpose of this strap is to prevent the armature 14 from moving away from frame 11 far enough to allow the bent-over extensions 17 and 18 to slip free of the edge 16. If the extensions were to do so, they might fall below the level of edge 16, thereby making the relay inoperative since armature 14 could no

longer pivot in response to a magnetic field induced in the core 12.

For this reason the strap 45 must project out beyond the surface of armature 14 by an amount less than the length of extensions 17 and 18, measuring this length on the under surface of the extensions, i.e., the surface in contact with frame 11. However, in order to allow the armature 14 to be inserted in place after the contact piles and spring 37 have already been attached to the frame 11, the end of strap 45 should initially be in the position indicated by the dotted lines. After the armature 14 is in place, the strap can be bent into its final position without injuring the spring 37 or any other parts of the relay.

In order to slip the armature 14 into place, the lowermost part of sections 41 and 42 are pulled outward, away from frame 11. The arms 19 may then be slid in between stop 21 and spring 22 and the main section of armature 14 lifted upward. Since the spring 37 fits between the bent-over extensions 17 and 18 and does not conflict with them, it is not necessary to bend the spring 37 upward in regions 39 and 40, as would be required if the sections 41 and 42 and 43 were not so long and resilient. Once the upper edge of armature 14 is tucked under section 43, it is unnecessary to continue to hold the lower ends of sections 41 and 42. The armature can be slid upward, holding it away from frame 11 until the extensions 17 and 18 have cleared the pivot edge 16. In thus holding the armature 14 away from the frame 11, section 43 of the spring will be compressed toward sections 41 and 42 and the latter sections may be deflected slightly outward, but, due to the length of all of these sections, at no place is the stress so great as to cause any part of spring 37 to take a permanent set.

One of the advantages of inserting the armature last is that the end 52 of the core 12 can be ground to the same plane as the end of frame 11 so as to provide optimum conditions in the working armature air gap. Another advantage is that core 12 can be riveted to the other end of frame 11, thereby assuring excellent contact between the core and the frame so as to reduce the reluctance of the magnetic path.

The relay in Fig. 3 has the same armature retaining spring 37 as is shown in Figs. 1 and 2. This spring cooperates with the armature exactly as in Fig. 1, and relations between the spring and armature of Fig. 3 are equally applicable to those of Fig. 1. However, because of the different mode of operation of the contacts, many of the elements of Fig. 3 that perform the same function as corresponding elements of Fig. 1 are not given the same reference characters but are given characters which differ by one hundred.

In the structure of Fig. 3, the end 38 of spring 37 is clamped against the frame 111 by means of screws 136 and the two parts 39 and 40 (only part 39 is shown in Fig. 3) extend over the upper edge 46 of the main part of armature 114. The dimensions of the parts are such that section 43 of the spring is compressed against the surface of armature 114 and is approximately parallel to the intermediate section of the spring. As is indicated by an arrow 47, pressure between armature 114 and spring 37 is concentrated primarily at the end of section 43, which is just about in line with the sharply rounded pivot edge 116. The pressure of section 43 thus forces armature 114 against its pivot, but, since spring force is applied nearly in line with the pivot axis, the spring 37 does not materially affect movement of the armature. In addition, since sections 41 and 43 of spring 37 are rather long, they may be made quite flexible without unduly reducing the force applied against armature 114.

In order to insure that the armature is pressed downward against edge 116, as well as being pressed inward, the upper edge 46 of armature 114 may extend slightly above the upper level of frame 111. The pressure of spring 37 against edge 46 will force the lower surface

of extension 118 to rest on the upper surface of frame 111. This force is indicated by an arrow 48, and the resultant of the latter with the force applied by section 43 of spring 37 is indicated by an arrow 49. Arrow 49, as may be seen, passes very close to the center of curvature of edge 116 and thus has but little torque effect on the movement of armature 114.

As in the case of the relay in Fig. 1, armature 114 may be inserted after spring 37 has been attached to the frame 111 of the relay. All that is required is to insert the upper edge 46 of armature 114 over the lowermost part of section 41 of the spring and then push the armature 114 straight up, compressing section 43 of the spring against section 41 so as to allow the hooks 118 to clear the edge of frame 111. When the armature 114 has been pushed up far enough to allow the hooks 118 to slip over the edge 116, pressure of section 43 of the spring will force the armature into place against edge 116 and will hold it there as described. It will be noted that there is no need to flex the upper sections 39 and 40 of the spring because of the fact that these sections fit in between the hooks 118 and as a matter of fact it is almost impossible to flex sections 39 and 40 of the spring to any great degree without causing those sections to be permanently bent, i.e., to acquire a set which would prevent these sections from pressing downward on edge 46 of the armature 114 as desired. Practically all of the flexing of spring 37 that need be done is done by sections 41 (and 42) and 43 which are relatively long and which can be moved a relatively large distance without being bent enough to take a permanent set.

The relay in Fig. 3 is provided with a novel contact actuating mechanism to allow the contacts to be placed at the end of the coil instead of on top of it. In order to do this a channel 53 is formed in the core 112 and an actuating pin 54 is placed in the channel. One end of pin 54 is threaded and fitted with a contact actuating disk 56, which is usually made of insulating material. A compression spring 57 pushes on the disk 56 to force the other end of pin 54 against the armature 114. Spring 57 in turn is held in place by means of a plate 58 which is attached to the frame 111 by any convenient means. In the embodiment shown the attachment means consists of several posts 59 which extend from the edge of frame 111 and are bent at right angles thereto and staked into plate 58. Only two contacts 61 and 62 are shown, although many more such contacts can be provided, if desired. These contacts are supported by slightly flexible members 63 and 64 respectively which in turn are supported by pins 66 and 67 hermetically sealed by glass-to-metal seals in the plate 58.

When coil 113 is energized, it induces a magnetic field in core 112 that attracts armature 114, causing the latter to pivot on edge 116. The lower end of the armature pushes pin 54, compressing spring 57 and causing disk 56 to press upon the flexible member 63 and so force contact 61 against contact 62. Due to the short lengths of members 63 and 64, their mechanical resonance can easily be made very high compared to that of the blades 24, 26, and 27 in the embodiment in Fig. 1 and so the embodiment in Fig. 3 is especially adapted for use in places where it will be subjected to high-frequency, mechanical vibrations, although, of course, its use is not limited to just such applications.

What is claimed is:

1. A relay comprising a frame; an armature pivotably mounted on one edge of said frame said armature having a main portion and extensions extending at approximately a right angle to the surface of said armature facing said frame and in the direction of said frame to form, with said surface of said armature, a groove, said extensions being hooked over said edge, and a spring to hold said armature in place against said edge with said edge resting in said groove said spring having a first portion at-

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tached to said frame at a point removed from said edge and extending beyond said edge, a second portion on the side of said armature away from the point of attachment of said spring to said frame, and a third portion which extends back in the direction of said first portion and presses resiliently against said armature in a region where the force of said spring on said armature exerts a substantially torque-free force on said armature by pressing said armature substantially directly against said edge of said frame.

2. A relay comprising a frame; an armature pivotably mounted on one edge of said frame said armature having a main portion and extensions extending at approximately a right angle to the surface of said armature facing said frame and in the direction of said frame to form, with said surface of said armature, a groove, said extensions being hooked over said edge; and a spring to hold said armature in place against said edge with said edge resting in said groove, said spring having a first portion attached to said frame at a point removed from said edge and extending beyond said edge and pressing resiliently upon an edge of said armature to hold said extensions against the edge of said frame in one direction, a second portion on the side of said armature away from the point of attachment of said spring to said frame, and a third portion which extends back in the direction of said first portion and presses resiliently against said armature in a region where the resultant force of said first and third portions of said spring on said armature exerts a substantially torque-free force on said armature by pressing said armature substantially directly against said edge of said frame.

3. A relay comprising a frame; an armature pivotably mounted on one edge of said frame said armature having a main portion and a pair of extensions extending from an edge thereof at approximately a right angle to the surface of said armature facing said frame and in the direction of said frame to form, with said surface of said armature, a groove, said extensions being hooked over said edge; and a spring to hold said armature in place with said edge of said frame resting in said groove, said spring having a first portion attached to said frame at a point removed from said edge of said frame and extending therebeyond and pressing resiliently upon an edge of said armature between said extensions to hold said extensions against the edge of said frame in one direction, a second portion on the side of said armature away from the point of attachment of said spring to said frame, and a third portion which extends back in the direction of said first portion and presses resiliently against said armature in a region where the resultant force of said first and third portions of said spring on said armature exerts a substantially torque-free force on said armature by pressing said armature substantially directly against said edge of said frame.

4. A relay comprising a magnetizable frame consisting of a base section having a sharply rounded edge at one end thereof, the other end of said frame being bent at a right angle to said base section to form a second section; a magnetizable core having one end riveted to said second section and extending parallel to said base section, the end of said core terminating in the same plane as said sharply rounded edge; an armature comprising a main section pivoted on said edge and extending over the end of said core, said armature having a pair of extensions extending from one edge of said main section and bent over at approximately a right angle to fit

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around the rounded edge of said frame, said edge of said main section extending slightly above the level of the rounded edge of the base section of said frame, said armature also having a pair of arms extending from opposite sides of said main section and approximately perpendicular thereto; a spring comprising a flat resilient member affixed to the base section of said frame at a point removed from said rounded edge and extending over said edge of the main section of said armature and exerting pressure thereon, said spring having a bent-down section extending approximately parallel to the surface of the main section of said armature, and a return-bent section approximately parallel to said surface of said armature and exerting pressure on said surface, the distance between said rounded edge of said frame and said bent-down section being greater than the length of said extensions, the resultant force developed by the pressure exerted on the surface of said armature and the pressure exerted on the edge thereof being in a direction such as to pass close to said rounded edge of said frame so as to hold said armature in place against said rounded edge while exerting a minimum torque on said armature.

5. A relay comprising a magnetizable frame consisting of a base section having a sharply rounded edge at one end thereof, the other end of said frame being bent at a right angle to said base section to form a second section; a magnetizable core having one end attached to said second section and extending substantially parallel to said base section; a channel extending through said core and through said second section; an armature comprising a main section pivoted on said edge of said frame and extending over the end of said core, said armature having a pair of extensions extending from one edge of said main section and bent over at approximately a right angle to fit around the rounded edge of said frame, said edge of said main section extending slightly above the level of said rounded edge of said frame; a spring affixed to said base section at a point removed from said rounded edge and extending over said edge over the main section of said armature and exerting pressure thereon to force said extensions against said frame in one direction, said spring having a bent-down section located beyond said edge of said frame by a distance at least substantially equal to the length of the under side of the bent-over portions of said extensions and extending approximately parallel to the surface of the main section of said armature, and a return-bent section extending approximately parallel to said surface of said armature and exerting pressure thereon approximately perpendicular to the pressure on said edge of said main section, the resultant force developed on said armature being directed to pass close to said rounded edge so as to hold said armature in place against said rounded edge while exerting a minimum torque on said armature; a rod extending through said channel, one end of said rod being located in the path of movement of said armature; resilient means urging said rod toward said armature; and a pair of contacts including a relatively fixed contact and a relatively flexible contact located to be engaged by said rod.

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