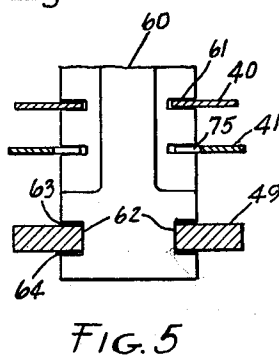
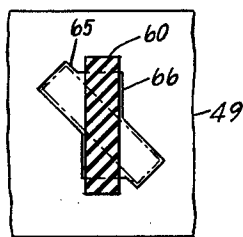
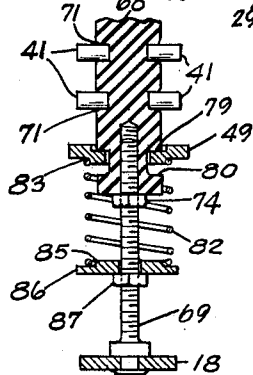
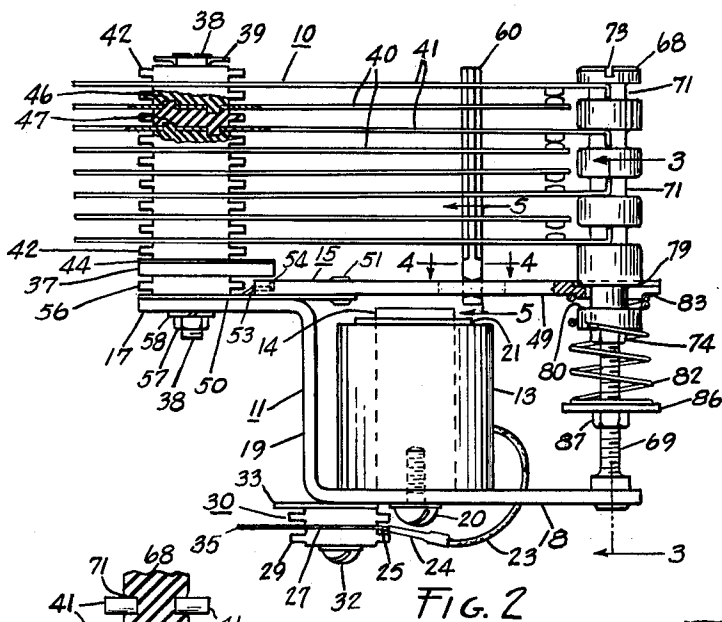
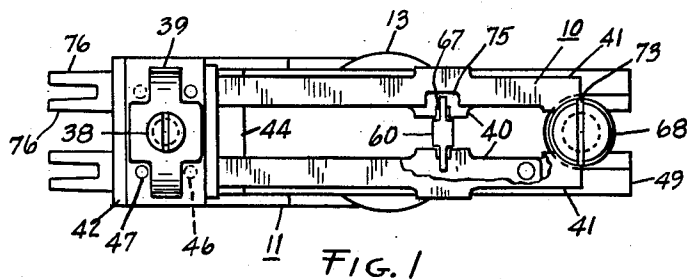


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A. E. PRINCE
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ELECTROMAGNETIC RELAY

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The invention relates to electromagnetic relays and especially to those of the multiple contact type.

The electromagnetic relay, in general, comprises a core, an energizing coil mounted on the core, an armature movable in relation to the core in response to energization and deenergization of the energizing coil and a plurality of movable contact springs co-operating with stationary contact springs for controlling electrical circuits in response to movements of the armature.

In such relays the position of the armature relative to the core is usually adjustable and is preset for specific relay applications. For example, it is usually desirable that a relay operate at a specific value of coil energization. Such operation of the relay may be accomplished by accurately presetting the initial position of the armature in relation to the coil; that is, its unoperated position.

In certain applications of relays it is also desirable to have the relay release at just slightly below its operating value. For example, definitive voltage relays are used in applications where the relay must operate at a predetermined specified value of voltage or current and release at just slightly below that value. An accurate release of the relay is also desirable in applications where the relay is condenser timed to perform a timing function; i.e., a timing interval is measured from when the energizing coil is disconnected from the energizing source to the point where the armature releases (returns to its unoperated position). An accurate release of the armature of a definitive voltage relay or of a relay used to time an interval may be obtained by accurately presetting the final position of the armature in relation to the core (its operated position).

After a relay has been put into operation, wear of the stops used to preset the final and initial positions of the armature and dirt accumulation or wear of the armature and its mounting components, often necessitates readjustment of the armature's initial and final positions.

Also, in order to reduce manufacturing costs, it is desirable that one relay construction be applicable to various circuit control applications, each of which applications may require a different setting of the initial and/or final armature positions.

It is therefore desirable that a relay include means for accurately adjusting both the initial and final positions of its armature.

In conventional relays, if the final and/or initial position of the armature is varied, the armature travel usually changes. Also, the position of the movable contact springs in relation to the stationary contact springs changes as the setting of the armature is varied. Since the distance which a movable contact spring must move before engaging with or separating from its co-operating stationary contact for controlling the electrical circuits is critical, any disturbance of their relationship must be adjusted for. This necessitates taking the relay out of service and by means of a special tool, resetting by hand each movable spring contact. This maintenance method is delicate and laborious and often requires considerable skill to obtain the proper contact relationship.

It is therefore an object of the invention to provide an electromagnetic relay of the multiple contact type which is readily adaptable to various applications and may be easily and accurately adjusted.

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It is another object of the invention to provide a relay in which the initial and final positions of the armature may be adjusted to close tolerances.

It is a further object of the invention to provide a relay of the type described in which the position of the armature may be varied without effecting material changes in the positions and contact pressure of the movable spring contacts with relation to their cooperating stationary spring contacts.

It is still another object of the invention to provide a relay in which the final and initial position of the armature may be varied without changing the armature travel.

Features and advantages of the invention may be seen from the above, from the following description of the preferred embodiment when considered in conjunction with the drawings and from the appended claims.

In the drawings:

FIGURE 1 is a plan view with portions broken away of a pile up type electromagnetic relay embodying the invention;

FIGURE 2 is a side elevational view of the relay of FIGURE 1 with portions broken away;

FIGURE 3 is a cross-sectional view taken along line 3-3 of FIGURE 2;

FIGURE 4 is a cross-sectional view taken along line 4-4 of FIGURE 2, showing movable contact positioner 60 in its locked and unlocked positions in armature 49, the unlocked position being shown by dot-dash lines; and FIGURE 5 is a cross-sectional view taken along the line 5-5 of FIGURE 2.

Referring to the drawings, essentially, the electromagnetic relay comprises a contact pile up assembly, generally indicated 10, a magnetic frame 11, an energizing coil 13 mounted on a core 14 and an armature assembly 15.

Frame 11 consists of two oppositely disposed, offset horizontal flange portions 17, 18 connected by a vertically extending web portion 19. Core 14 is removably mounted on flange portion 18 by means of screw 20 threaded into the bottom portion of the core. Coil 13 is held in position on core 14 by means of retaining ring 21 fitted into a peripheral groove (not shown) formed into the upper portion of the core. The coil may be connected to external energizing circuits by means of wires 23 crimped onto plug on terminals 24 which in turn make a push fit with tapered tabs 25 formed on the right ends of connectors 27. Connectors 27 are mounted between insulating washers 29 of a connecting block, generally designated 30, which block is secured to flange portion 18 by means of screw 32, encased in an insulating sleeve (not shown). Insulating strip 33 positioned between the flange portion and connecting block further insulates connectors 27 from magnetic frame 11. The left ends of connectors 27 are also formed into tapered tabs 35 for connection to external energizing circuits. The other flange portion 17 of frame 11 serves as a support for contact pile up assembly 10 and armature assembly 15.

Contact pile up assembly 10 comprises two spring pile ups, one on each side of the relay, clamped onto base member 37 by means of mounting screw 38 encased in an insulating sleeve (not shown) and locking spring washer 39, screw 38 being threaded through base member 37 to form an interchangeable assembly for mounting on frame 11. Each spring pile up may comprise any desired number and arrangement of co-operating movable and stationary contact springs designated 40 and 41, respectively, two normally open and two normally closed contact pairs being shown in each pile up. The contact springs are separated from each other and from locking washer 39 and base member 37 by interposed insulating washers 42. Interposed between base member 37 and its adjacent insulating washer 42 is an insulating strip 44 for

preventing leakage current flow from the contact springs to base member 37. Each insulating washer 42 has formed thereon projections 46 adapted, when the pile ups are assembled, for passing through apertures formed in the contact springs and for fitting into indentations 47 formed in adjacent insulating washers and base member 37, thereby effectively locking the washers and contact springs in place. Each insulating washer also has an aperture formed therein through which mounting screw 38 passes.

Armature assembly 15 comprises an armature 49 secured by means of rivets 51 to leaf spring hinge 50 of nonmagnetic material. A portion of leaf spring 50 is blanked to form a retaining tongue 53 positioned in a slot 54 to thereby provide the hinge end of armature 49. This retaining tongue 53 serves to secure further the armature to the leaf spring hinge.

Armature assembly 15 is positioned on flange portion 17 of frame 11 for co-operation with core 14, the armature 49 substantially overlapping the flange portion to provide a low reluctance magnetic path between the armature and frame. An insulating spacer 56 of slightly larger thickness than armature 49 is positioned between leaf spring hinge 50 and base member 37 of contact pile up assembly 10. Mounting screw 38 which secures the contact pile ups to base member 37, as has been described, passes through apertures formed in insulating spacer 56, spring hinge 50 and flange 17, and in co-operation with nut 57 and lock washer 58 secures the contact pile up assembly 10 and the armature assembly 15 to frame 11. The portion of base member 37 which extends over the hinge end of armature 49 acts as a stop, limiting the upward movement of the armature to prevent distortion of leaf spring hinge 50.

It may be noted that insulating spacer 56, like insulating washers 42, has projections 46 (not shown) extending from its top and bottom surfaces. The upper projections are fitted into co-operating indents (not shown) formed in the bottom of base member 37, while the lower projections pass through apertures formed in spring hinge 55 and fit into co-operating indents (not shown) formed in the upper surface of flange 17, thereby locking the contact assembly 10 and armature assembly 15 in place.

A movable contact driver 60 of insulating material in the form of a double-edged comb, having spaced contact positioning slots 61 cut along its vertical side edges, is removably secured to armature 49 and is pivotably mounted thereon, as will be next described. Formed in the armature engaging portion of driver 60 at its vertical side edges are two oppositely disposed, horizontally extending slots 62 for mounting the driver to the armature. Shoulders 63, 64, forming the upper and lower inside surfaces, respectively, of each slot 62, are spaced apart approximately the same vertical distance as the thickness of armature 49 and are slightly convex. Formed in armature 49 is a driver receiving opening comprising two slotted apertures 65, 66, one shorter than the other and having their longitudinal center lines intersecting at their mid points at approximately a 45 degree angle. Driver 60 is inserted into the longer slotted aperture 65 (insert position shown by the dot-dash lines of FIGURE 4) and is then rotated clockwise approximately 45 degrees into locked position in slotted aperture 66 (locked position shown in solid outline in FIGURE 4). As driver 60 is thus rotated into its locked position, upper and lower shoulders 63, 64, respectively, of each slot 62 engage the upper and lower surfaces, respectively, of armature 49, thereby effectively and pivotably mounting driver 60 in position. Driver 60 is prevented from rotating out of position by the side edges of cutout portions 67 (FIGURE 1) formed in movable contact springs 40, which springs are inserted into slots 61 of driver 60 and are held in position thereby for actuation by the armature.

A stationary contact positioner 68 of insulating material is threaded onto vertically extending stud or support

member 69 which in turn is securely fastened to flange portion 18 of frame 11. Contact positioner 68 is of substantially circular cross-sectional shape and has a plurality of spaced, peripheral, positioning grooves 71 formed along its upper portion. The contact ends of stationary contact springs 41 are positioned in grooves 71, the end of each contact spring being bent over to obtain a snug fit in its respective positioning groove. Contact positioner 68 and in turn, stationary contact springs 41 may be raised or lowered by rotating the positioner on its threaded stud 69 by means of a screw driver for which slot 73 is formed at the top surface of positioner 68. Once positioned, contact positioner 68 is locked in place by moving locking nut 74 which is also threaded on stud 69 into engagement with the bottom surface of positioner 68.

The contour of the contact springs 40 and 41 may be seen by referring to FIGURE 1. The stationary contact springs 41 have a cut out portion 75 where they pass by driver 60, so that they will not interfere with the movement of the driver. The mounting ends of both the stationary and movable contact springs 40 and 41 overhang flange portion 17 and are bifurcated with each section thus formed providing two tapered tabs 76 for connecting, by means of co-operating plug in terminals (not shown), the contact springs to their respective controlled circuits.

The lower portion of contact positioner 68 is grooved to provide two vertically spaced shoulders 79, 80. The "free" end of armature 49 is bifurcated and positioned in that groove between shoulders 79, 80 which act as stops for the armature to limit its up and down travel.

Armature 49 in its released position is biased against stop 79 by means of a helical compression spring 82, the upper end of which is fitted onto an annular shoulder 83 formed in the lower surface of the bifurcated end of the armature. The other end of spring 82 fits onto an annular shoulder 85 formed on the upper surface of a spring supporting washer 86. The supporting washer is loosely fitted onto stud 69 and adjustably positioned thereon by a self-locking adjusting nut 87. The adjusting nut may be threaded up and down on stud 69 to adjust the bias on the armature against the load applied to it by the contact springs.

In operation, upon coil 13 being energized sufficiently, armature 49 is attracted downward against the pressure of helical spring 82 toward the pole face of core 14 and comes into its final operated position against stop 80. As the armature is thus actuated, movable contact driver 60 actuates movable contact springs 40 to close the normally open contact pairs and to separate the normally closed contact pairs. Upon coil 13 being de-energized, helical spring 82 actuates armature 49 and in turn the movable contact springs 40 back to their original released condition.

It may be noted that the armature travel is constant (that is, the armature travels the same amount upon each operation regardless of its initial position), except when shoulder 80 is positioned below the pole face of core 14. In the latter case, upon the armature being actuated downward, it "bottoms" against that pole face, and is held in that position by residual magnetism after the energizing circuit is disconnected from energizing coil 13. Such an application is desirable when the relay is used as a latching type relay which may be equipped with a hard steel core encircled by two coils, one for operating the armature and one for effecting its release. In such a latching application of the relay the armature remains bottomed against the pole face after the operating coil is disconnected from the energizing source, until the release coil is energized to effect its release.

The aforementioned released position of the armature against stop 79 establishes the "initial" air gap between the armature 49 and the pole face of core 14. This "initial" armature air gap may be accurately adjusted

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to a desired value by "backing off" adjusting nut 74 and then threading stationary contact positioner 68 up or down on stud 69, as has been described.

It is worthy of note that the "initial" armature air gap may be thus accurately adjusted without disturbing the air gap between normally open contacts. As contact positioner 68 and in turn the stationary contact springs 41 positioned in it are moved up or down in setting the "initial" air gap, driver 60 secured to armature 49 follows armature movement and in turn moves the movable contact springs 40. Since both the stationary and movable contacts of each pair are positioned on their respective springs the same distance from a common mounting point, the movable contacts move the same amount as their co-operating stationary contacts and the contact air gap remains unchanged. This feature of the relay construction obviates the laborious and time-consuming necessity of hand bending the contact springs into position to obtain the desired contact air gap whenever the "initial" armature air gap is preset or readjusted.

Likewise, the air gap between co-operating contacts is not disturbed when the "final" armature air gap (the air gap between the armature and the pole face of core 14 with the armature in its operated position against stop 80) must be accurately adjusted in certain applications of the relay. As has been explained, one such application of the relay is as a definitive voltage relay, in which case it is desirable to adjust the "final" armature air gap so that the armature releases when energization of energizing coil 13 falls just slightly below its operate value. Another such application is a condenser timed relay where, after its energizing coil is disconnected from the energizing circuits, the relay remains operated for a time while a condenser discharges through its coil. The point at which the relay releases may be preset by the setting of the "final" air gap; a smaller "final" air gap increasing the holding time of the relay and a larger "final" air gap decreasing it.

The present relay is readily adaptable to various applications, since, as has been previously stated, all of its components are readily removable and capable of being replaced with other similar components. For example the pile up contact assembly 10, coil 13, core 14, movable contact driver 60, stationary contact positioner 68 and helical spring 82 are all readily removable. Furthermore, connection of the relay to its control circuits and energizing circuits may be easily accomplished by means of the tapered tabs and plug on terminals previously described.

As changes can be made in the above described construction and many apparent different embodiments of this invention can be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown on the accompanying drawings be interpreted as illustrative only and not in a limiting sense.

What is claimed is:

1. In an electromagnetic relay employing contacts mounted near the extremity of both movable and stationary contact springs, a mounting frame of magnetic material, an electromagnet mounted on said frame, means mounting said movable contact springs one above the other on said frame with each insulated from the other and from said frame, an armature mounted on said frame in position to be attracted toward said electromagnet when the latter is energized, insulating means coupled to said armature and to each of said movable contact springs fixing each of said movable contact springs in fixed separation from said armature, means engaging each of said stationary contact springs in fixed relationship one to another and to said armature when in its unoperated position, and means for adjusting the position of said last mentioned means for varying the position of said armature in its unoperated state with respect to said

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electromagnet without varying the position of said stationary and movable contact springs with respect to said armature and to each other.

2. In an electromagnetically actuated relay having a plurality of contacts mounted on fixed and movable contact springs and in which the movable contact springs are held in fixed relationship to each other and to the armature by supporting means of insulating material and are moved as said armature is moved by attraction by the electromagnet, the combination with said fixed contact springs and said armature, of insulating means fixedly engaging said fixed springs in non-variable relationship with one another and operating to limit the movement of said armature in its movement toward and away from said electromagnet, said insulating means being adjustable with respect to said electromagnet to vary the position of said armature with respect to said electromagnet while maintaining the spatial relationship of said fixed contact springs one to another, to said armature and to said movable contact springs.

3. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, an electromagnet mounted on said frame, a pile up assembly of co-operating movable and stationary contact springs insulatedly mounted on said frame; an armature mounted on said frame and adapted to co-operate with said electromagnet for actuating said movable contact springs in response to armature movement, first means for respectively positioning said armature and said stationary contact springs relative to the co-operating movable contact springs, and second means for simultaneously adjusting the position of said stationary contact springs and of said armature relative to said electromagnet without affecting the positioning between said armature and said stationary contact springs and said movable contact springs, while maintaining the contact relationship between said contact springs.

4. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, an electromagnet mounted on said frame, a pile-up assembly of co-operating movable and stationary contact springs insulatedly mounted on said frame, an armature mounted on said frame and adapted for co-operation with said electromagnet, a driving member of insulating material mounted on said armature and positioning said movable contact springs relative to said armature for actuating said movable contact springs in response to armature movement, means pre-setting the released position of said armature relative to said stationary contact springs, and means for varying the released position of said armature relative to said electromagnet while maintaining the preset positions of said stationary contact springs relative to said released armature position and in turn to said movable contact springs.

5. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, an electromagnet and a co-operating armature mounted on said frame, a pile up of co-operating movable and stationary contact springs also mounted on said frame, a movable contact driver of insulating material mounted on said armature, said driver positioning said movable contact springs relative to said armature, a stationary contact spring positioner of insulating material adjustably mounted on said frame and positioning said stationary contact springs in space, a shoulder formed on said positioner and serving as an armature stop, and spring means biasing the free end of said armature against said shoulder under conditions where said armature is in released condition, thereby establishing the released position of said armature relative to said stationary contact springs.

6. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, an electromagnet and a co-operating armature mounted on said frame, a pile up of co-operating movable and stationary contact springs also mounted on said frame, a movable contact driver of insulating material mounted on said armature, said driver positioning said movable contact springs relative to said

armature, a stationary contact spring positioner of insulating material mounted on said frame and positioning said stationary contact springs in space, a shoulder formed on said positioner and serving as an armature stop, spring means biasing the free end of said armature against said shoulder under conditions where said armature is in released condition, thereby establishing the released position of said armature relative to said stationary contact springs, and means for adjusting the separation of said positioner from said frame, whereby adjustment of said positioner relative to said frame maintains the established spacial relationship between said stationary contact springs and said armature when in its released position and in turn said movable contact springs, while changing the spatial relationship of said released armature relative to said electromagnet.

7. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, an electromagnet and a co-operating armature mounted on said frame, a pile up of co-operating movable and stationary contact springs also mounted on said frame, a movable contact driver of insulating material mounted on said armature and engaging each of said movable springs in fixed separation from said armature, a stationary contact spring positioner of insulating material adjustably mounted on said frame and engaging each of said stationary contact springs in fixed relation to one another, a first shoulder formed on said positioner in fixed relation to the points of engagement of said positioner and each stationary spring, means biasing said armature against said first shoulder under conditions where said armature is in released condition for establishing the released position of said armature relative to said stationary contact springs and to said electromagnet, and a second shoulder formed on said positioner in fixed relationship to said first shoulder in position for limiting the operated position of said armature relative to said electromagnet, whereby adjustably positioning of said positioner relative to said frame varies the released and operated positions of said armature with respect to said electromagnet while maintaining the established spatial relationship between said stationary contact springs and said movable contact springs with the armature in released position.

8. In a multi-contact electromagnetic relay in which there are provided a mounting frame of magnetic material; an electromagnet mounted on said frame; a pile up assembly of movable and stationary contact springs insulatedly mounted on said frame in cantilever fashion, said contact springs having co-operating movable and stationary contacts at their free ends; an armature having a leaf spring hinge secured to its mounting end, which hinge in turn is secured to said frame and pivotably supports said armature in cantilever fashion below said contact springs in position for co-operating with said electromagnet; a longitudinal driving member of insulating material having longitudinally spaced slots formed therein into which said movable contact springs are positioned; means removably securing said driving member to said armature whereby said movable contact springs are positioned in fixed relation to said armature; a positioning member of insulating material mounted on said frame, said positioning member engaging each of said stationary contact springs at their free ends and positioning said stationary contacts in spaced predetermined relationship to one another; the combination with the foregoing of armature stops formed integral with said positioning member, said stops being in fixed relationship one to the other and limiting the operated and unoperated positions of said armature relative to said electromagnet, and of means for accurately varying the position of said positioning member relative to said frame to change the limits of the operated and unoperated positions of said armature relative to said electromagnet, whereby said limits may be changed while maintaining constant the spatial relationship between said movable and stationary contacts preset

for the limits of the operated and unoperated positions of said armature.

9. A relay as set forth in claim 8, wherein said means for accurately varying the position of said positioning member include a vertically extending threaded stud mounted on said frame, said positioning member being provided with a threaded aperture co-operating with said stud for attaching said positioning member to said frame and for accurate adjustment of the position of said positioning member relative to said frame.

10. A relay as set forth in claim 8, wherein said armature has two intersecting, horizontally slotted apertures formed intermediate its ends, one aperture being longer than the other; said driving member being formed at the vertical side edges of its lower portion with two oppositely disposed, horizontally extending slots, said slots having substantially the same thickness as said armature and having oppositely disposed convex surfaces, said slotted lower portion co-operating with said armature when said lower portion is inserted into said longer aperture in said armature and the driving member then is rotated into alignment with said shorter aperture in said armature to pivotably engage said driver to said armature and to removably secure said driver to said armature.

11. In a multi-contact electromagnetic relay, a mounting frame of magnetic material, a core having a peripheral groove formed on one end, a fastener removably mounting said core vertically on said frame, an energizing coil loosely fitted onto said core, a removable retaining ring positioned in said peripheral groove for holding said coil on said core, an armature having a spring hinge secured to one end of said armature, the opposite free end of said armature being bifurcated, said hinge being in turn secured to said frame for mounting said armature as a cantilever extending horizontally over said core for pivotal up and down movement, a plurality of fixed and movable contact springs insulatedly mounted on one end on said frame and insulated from one another, said contact springs extending horizontally in cantilever fashion above said armature and having co-operating contacts formed on their free ends, a longitudinal driver of insulating material including mounting means co-operating with said armature for removably mounting the driver to said armature intermediate said ends of said armature, said driver also having a plurality of spaced slots formed along its longitudinal dimension, said movable contact springs being inserted into predetermined ones of said slots and being notched to prevent rotation of said driver, a threaded stud secured to said frame, a longitudinal insulating member having its base threaded onto said stud, said insulating member having longitudinally spaced contact positioning grooves formed along its upper portion, the free ends of said stationary contact springs being positioned in predetermined ones of said positioning grooves, a self-locking nut threaded onto said stud below said insulating member and locking said insulating member in position, said insulating member also having a groove formed at its lower end, the latter groove providing upper and lower shoulder stops to limit armature movement, said armature having its bifurcated free end positioned in said latter groove between said upper and lower shoulder stops, a helical compression spring mounted on said stud and engaging the bottom surface of said bifurcated free end of said armature, and means for adjusting the compression of said spring for biasing said armature in its unoperated position against said upper shoulder stop.

12. In an electromagnetic relay having a frame supporting an electromagnet, a pile up assembly with co-operable movable and stationary contact springs mounted on said frame and above said electromagnet, an armature mounted on said frame for movement within an air gap defined between said armature and said electromagnet and adapted to actuate said movable contact springs in response to armature movement; the improvement comprising first means forming a positioner of electrically in-

insulated material, said stationary contact springs and said armature being coupled to said positioner and extending from the latter in perpendicular direction to the same, and second means engaged by said first means for supporting the latter on said frame and for facilitating displacement of said first means relative thereto for adjusting said air gap, while the contact relationship between said movable and stationary contact springs is maintained.

13. In a relay according to claim 12, said positioner being provided with spaced apart stop means for confining the armature movement.

14. An electromagnetic relay having a frame supporting an electromagnet, a pile up assembly with co-operable movable and stationary contact springs located above said electromagnet, an armature mounted on said frame for movement within an air gap defined between said armature and said electromagnet; comprising means coupling said armature with said movable contact springs for actu-

ating the latter in response to armature movement, a positioner of electrically insulating material, said stationary contact springs and said armature being coupled to said positioner, respectively, and adjustment means on said frame and coupled with said positioner for facilitating displacement of the positioner for varying said air gap without affecting the contact relationship between said movable and stationary contact springs in regard to said armature.

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