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3,076,880

RELAY

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2 Sheets-Sheet 1

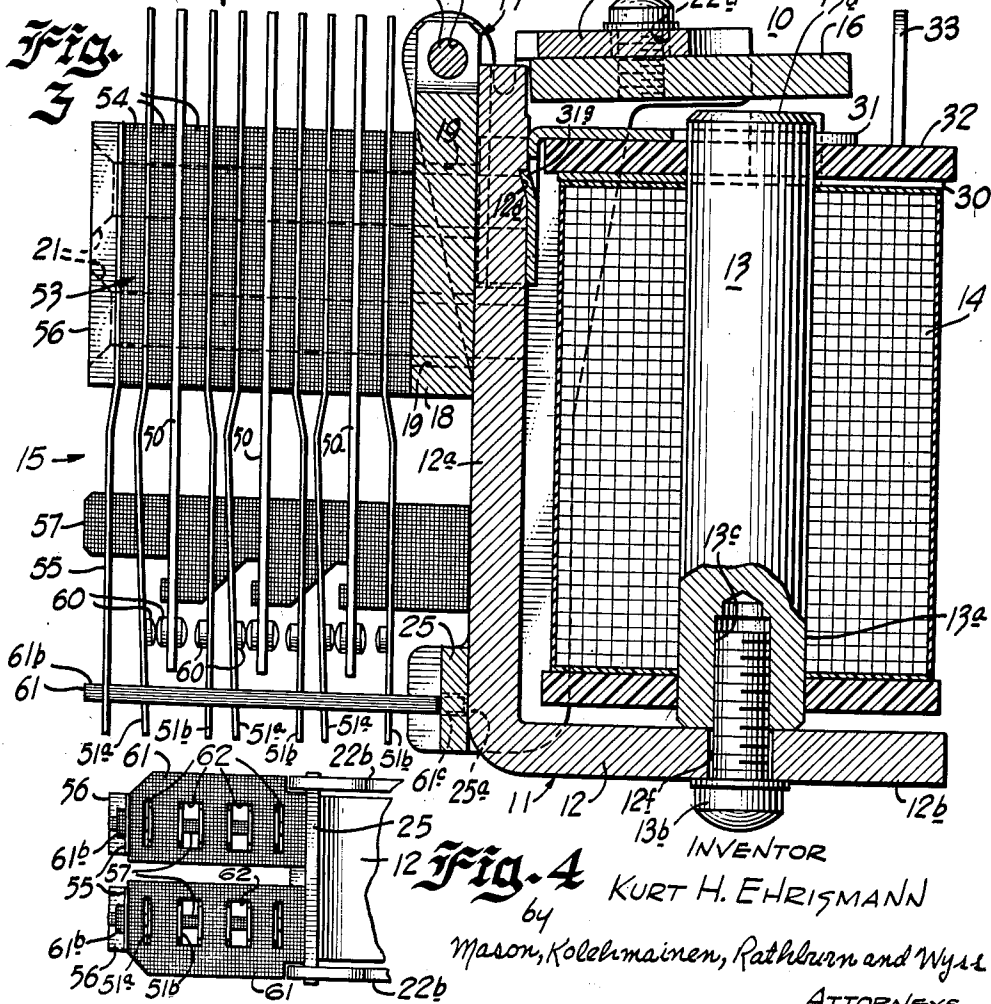
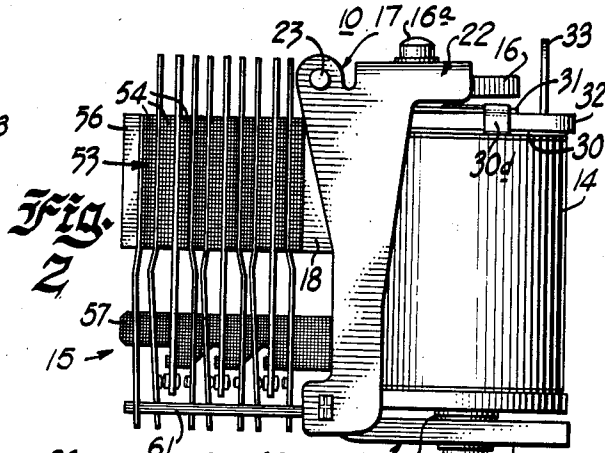
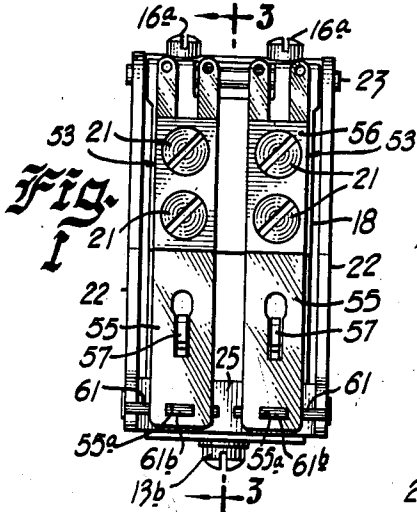


Fig. 4
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ATTORNEYS.

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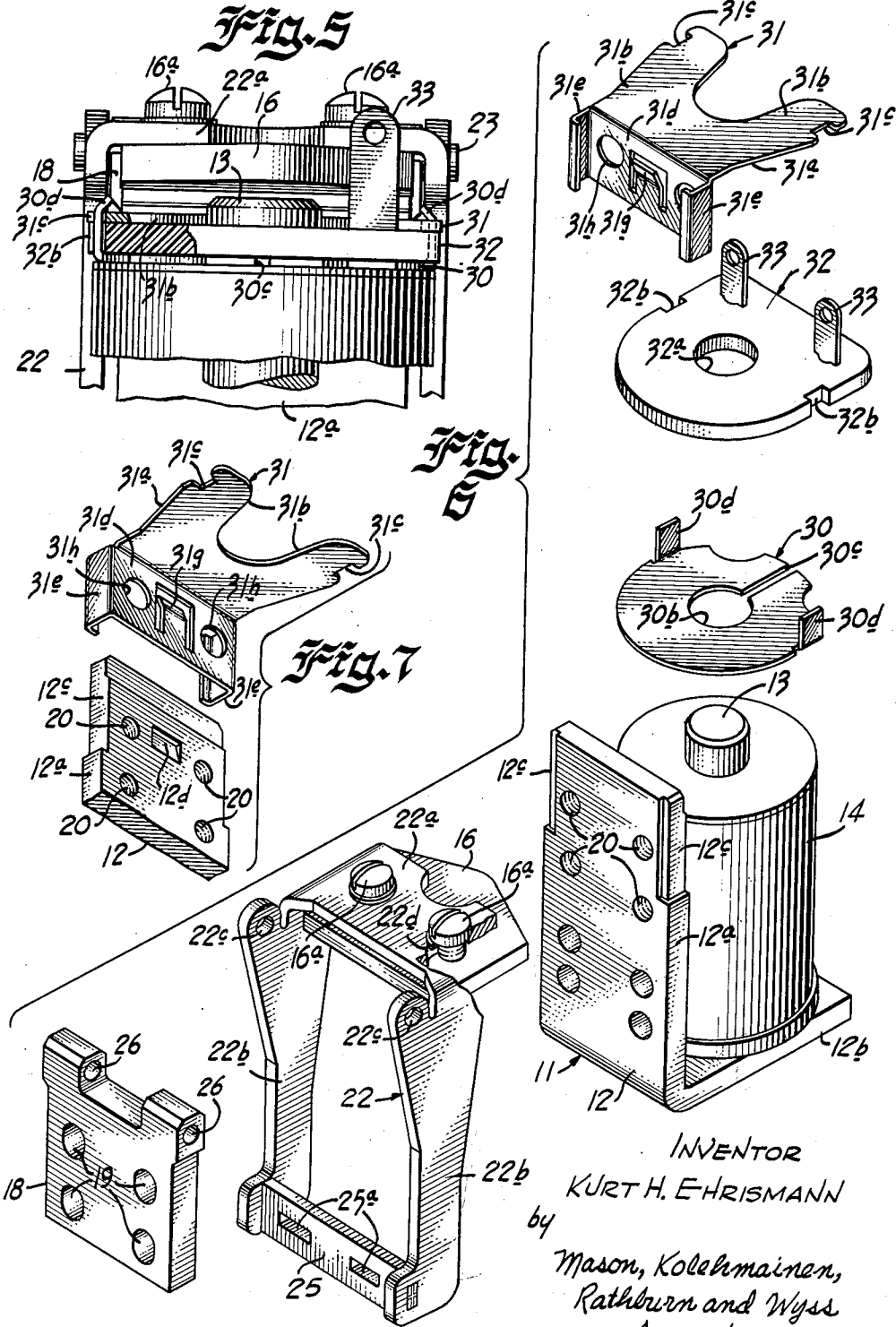
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2 Sheets-Sheet 2



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3,076,880 RELAY

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This invention relates to an electric relay and, more particularly, to an electromagnetic relay operable in response to an electric signal.

In one type of prior electric relay, an electromagnetic coil is positioned on a stationary field pole which is supported at one end on a magnetizable field structure. A magnetizable armature is spaced from the free end of the pole so that an air gap is formed between the pole and the armature. The armature is connected to actuate the electrical contacts.

Such prior relays have generally required that the adjustment of the air gap affect the stroke of the armature and, consequently, the contact spacing of the switch contacts. Moreover, difficulty has been experienced with such prior relays in that they did not possess sufficient mechanical strength when subjected to the effects of shock and vibration. This was particularly true as regards the field pole which supports the electromagnetic coil. As the field pole is cantilevered at one end to the field structure, difficulty has been experienced in maintaining the free end of the pole in desired position and alignment relative to the armature.

It is therefore an object of the present invention to provide an improved electromagnetic relay which overcomes the aforementioned difficulties.

A further object of this invention is to provide an improved electromagnetic relay in which the air gap thereof may be adjusted independently of the contact spacing.

A further object of this invention is to provide an electromagnetic relay with improved means for adjusting the air gap thereof.

A further object of this invention is to provide an electromagnetic relay having improved means for actuating contact means in response to a signal impulse.

A still further object of the present invention is to provide an improved shock and vibration insensitive electromagnetic relay which is of simple and economical construction.

Another object of the present invention is to provide an electromagnetic relay of the type which has a cantilevered field pole supported on a field structure with an improved means of locking the free end of the cantilevered field pole.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly stated, in accordance with the invention, an electromagnetic relay includes a generally U-shaped magnetizable field structure having both a frame member and a pole member on which an electromagnetic coil is mounted. In order to positively support the free end of the pole member, it is secured to the field member by a novel stabilizing washer and bracket assembly. A pivotally movable armature assembly is secured to the frame member in one of a plurality of selectable positions to permit an alignment of the armature and pole member so as to fix the length of the stroke of the armature through a first air gap. Moreover, the armature may be selectively positioned from the frame member to form a second or variable air gap in series with the first air gap and which provides an adjustment of the total air gap to alter the operating characteristics of the relay. A plu-

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ality of switch contacts mounted in a fixed position on the field structure is connected to the armature by a sliding connection so that the alignment of the armature and pole member does not vary the normal relative positions of the contact springs.

The nature of the invention will best be understood when described in connection with the accompanying drawings, in which:

FIG. 1 is an end elevational view of an electromagnetic relay embodying the present invention;

FIG. 2 is a front elevational view of the relay;

FIG. 3 is an enlarged sectional view taken along line 3-3 of FIG. 1;

FIG. 4 is a fragmentary bottom view of a portion of a contact spring operator assembly included in the relay shown in FIGS. 1 and 2;

FIG. 5 is an enlarged fragmentary view in partial section illustrating the relay from the end opposite to that shown in FIG. 1;

FIG. 6 is an exploded isometric view of the relay with the contact spring assembly removed; and

FIG. 7 is an exploded isometric view illustrating a stabilizing bracket and a means for mounting the bracket on a frame structure.

Referring now to the drawings, the improved electromagnetic relay shown generally at 10 includes a field structure 11 formed of a heelpiece or L-shaped frame member 12 having a long leg 12a and a short leg 12b at substantially right angles to each other. The frame structure 11 also includes a stationary field pole or pole member 13 having one end 13a thereof secured to the short leg 12b of the field piece 12 and having a free end 13d extending generally parallel to the long leg 12a of the field piece 12. The field structure 11 is formed of magnetizable material such as soft iron. An electromagnetic coil or inductive means 14 is positioned on the pole member 13. The pole member 13 can conveniently be secured to the heelpiece 12 by a threaded member 13b which passes through an aperture 12f in the short leg 12b and is screwed into a threaded aperture 13c in the pole member 13.

For the purpose of completing the magnetic circuit of the relay and of actuating a switching assembly on the frame structure 12, there is provided a magnetic armature 16 that is secured to a contact spring operator assembly 17 formed of non-magnetic components. The operator assembly 17, which can be supported on the frame structure 12 at different positions, pivotally supports the armature 16 in a position bridging the space between the free end 13d of the pole member 13 and the free end of the long arm 12a of the field piece 12. In the de-energized position of the relay 10, one end of the armature 16 is adjustably positioned adjacent the upper end of the long arm 12a of the field member 12 to form a variable size air gap and the other end of the armature is spaced above the free end 13d of the pole member 13 to define a fixed size air gap. By adjusting the position of the armature 16 relative to the free end of the long leg 12a of the field piece 12 (FIG. 3), the air gap of the magnetic circuit can be adjusted to control the operating characteristics of the relay 10. However, this adjustment does not alter the size of the fixed air gap between the armature and the end 13d of the pole member 13 and therefore does not change the stroke of the armature 16 or operator assembly 17.

The contact spring operator assembly 17 includes a plate or supporting member 18 (FIG. 6) on which a somewhat U-shaped element 22 is pivotally mounted. The plate 18 contains a plurality of elongated apertures or slots 19, and the long leg 12a of the field piece 12 is provided with a plurality of threaded apertures 20 which are aligned with the slots 19. A plurality of screws 21

(FIGS. 1 and 3) which extend through supporting means for the assembly 15 and the slots 19 into the threaded apertures 20 adjustably secure the plate 18 to the field piece 12. The elongated slots 19 permit the plate 18 to be adjustably positioned along the end of the long leg 12a to permit the alignment of the armature 16 with the end 13d of the pole member 13 thereby fixing the size of the air gap between these members and therefore the length of the armature stroke. Moreover, the armature 16 may be accurately squared with the end 13d of the pole member to provide uniform flux distribution.

The armature extension or U-shaped element 22 is pivotally secured to one end of the plate 18 by a pin 23 which passes through a pair of spaced, aligned openings 26 in the upper end of the plate 18 and a pair of aligned openings 22c in two parallel arms 22b of the element 22. The armature extension 22 is preferably made of a light nonmagnetic material to minimize the inertia of the moving system. The two arms 22b of the element 22 are joined by an offset bight portion 22a to which the armature 16 is secured. The free ends of the arms 22b support a bridge element 25 for actuating the contact springs in the assembly 15.

To provide for adjustment of the air gap to control the operating characteristics of the relay, a variable size air gap is provided between the end of the armature 16 and the frame member 12 in series with the air gap formed between the armature 16 and the pole member 13. The armature 16 is secured to the bight portion 22a of the element 22 by a plurality of threaded fasteners or screws 16a which extend through elongated apertures or slots 22d in the element 22 and which are received in threaded apertures in the armature 16. The elongated slots 22d provide for the adjustable positioning of the armature 16 relative to the end of the long leg 12a of the frame member 12 to provide for the adjustment of the air gap therebetween.

For the purpose of securing the free end 13d of the pole member 13 to the heelpiece 12, there is provided a stabilizing washer 30 and a stabilizing bracket 31 which are formed of a nonmagnetic material such as brass. The stabilizing washer 30 comprises a circular main body of flat sheet material which is mounted on the upper end of the coil 14 (FIG. 3) with the free end 13d of the pole member 13 extending upward through a central aperture 30b in the washer 30. A slot 30c extending radially from the aperture 30b to the outer periphery of the washer 30 permits the edge of the opening 30b to resiliently engage the pole member 13. A flat dielectric terminal member 32 is mounted on the upper surface of the washer 30 and includes an opening 32a for receiving the pole member 13. The member 32 supports a pair of electrical terminals 33 which are connected to the coil 14. The terminal member 32 and the washer 30 are held in a fixed assembled relation by a pair of tabs 30d formed integral with the washer 30 which are disposed in a pair of slots or recesses 32b in the edges of the terminal member 32.

The stabilizing bracket 31 (FIG. 6) includes a generally Y-shaped arm 31a mounted on the upper surface of the member 32 and having a pair of arms or extensions 31b forming a V-shaped opening through which the pole member 13 passes. Each extension 31b contains a slot or recess 31c in its outer edge through which the tabs 30d of the stabilizing washer 30 pass. The ends of the tabs 30d are bent over (FIG. 5) against the upper surface of the stabilizing bracket 31 to hold the washer 30, the member 32, and the bracket 31 in an assembled relation. The stabilizing bracket 31 also includes a support portion 31d offset at substantially a right angle to the arm 31a and having a pair of opposite channel portions 31e (FIG. 7). The channel portions 31e are slidably mounted on a pair of recessed edges 12c of the long arm 12a of the frame member 12. A resilient tongue 31g struck out of the portion 31d engages a recess 12d in the long

arm 12a to lock the bracket 31 in a proper position on the field structure 11. In this position, a pair of apertures 31h in the portion 31d are aligned with the two uppermost apertures 20 of the long arm 12a of the frame member 12 to permit the two upper screws 21 to be tightened.

When the relay 10 is assembled, the pole member 13 is secured to the short leg 12b of the frame member 12, and the coil 14 is mounted on this pole member. The washer 30, terminal member 32 and the bracket 31 are secured in an assembled relation by the lugs 30d and the recesses 32b and 31c. The channel portions 31e are placed on the recessed edges 12c, and the stabilizing assembly is then moved downwardly on the field structure 11 so that the free end 13d of the pole member 13 is received within the openings 30b and 32a and so that the tongue 31g slides downwardly along the inner surface of the upper end of the long leg 12a until it snaps into the recess 12d to lock the assembly in a predetermined position on the field structure 11. In this position, the free end 13d of the pole member 13 is positively secured in a fixed position on the frame member 12.

The contact spring assembly 15, which is actuated by the operator assembly 17, comprises two similar "pile-ups," each including a plurality of fixed contact springs 50 and a plurality of pairs of movable contact springs 51a and 51b. One end of each of the switch blades 50, 51a and 51b is secured in one of a pair of dielectric supporting assemblies 53 comprising a plurality of separate insulating plates 54 and an outer plate 56. Each of the two "pile-ups" in the assembly 15 also contains at least one biasing spring 55 which is secured to the insulating supporting assembly 53 and which biases the movable contact springs 51a and 51b to the normal position shown in the drawings. The two supporting assemblies 53, the springs 55, the fixed switch blades 50, and movable switch blades 51a and 51b, are held in position on the frame member 12 by the screws 21 which extend through openings in these elements and the slots 19 in the plate 18 to be threadably received in the apertures 20. The screws 21 are electrically isolated from the blades 50 and 51 by the use of enlarged apertures in the blades 50 and 51. Two dielectric spacing posts 57 which pass through openings in the movable springs 51a and 51b engage the fixed springs 50 to hold the free ends of these springs in a fixed position. The lower ends of the contact springs 50, 51a and 51b carry a plurality of contacts 60.

To provide means for actuating the switching assembly 15, there is provided a pair of dielectric members 61 having a pair of tongues 61c at one end which are positioned within a pair of openings 25a in the bridge element 25 carried on the lower end of the arms 22b. The other ends of the two members 61 are provided with a pair of tongues 61b that are received within a pair of openings 55a (FIG. 1) in the bias springs 55. Each of the members 61 includes a plurality of slots or apertures 62 (FIG. 4) in which the free ends of the movable springs 51 in one of the contact spring stacks are freely slidable. The slots 62 are so arranged that each pair of movable springs 51a and 51b is separated by an insulating portion of the member 61. Thus, when the members 61 are moved to the left (FIGS. 3 and 4), the contacts 60 on the springs 51a are moved away from the contacts 60 on the fixed springs 50 by positive engagement with the member 61, while the resiliency of the displaced springs 51b permits the contacts 60 on the springs 51b to move into engagement with the mating contacts on the fixed springs 50.

Having thus described the construction of the new and improved relay 10, its operation will now be explained. The relay in FIG. 3 is illustrated in the de-energized position. Upon energization of the coil 14 by an electric signal, the armature 16 is drawn toward the pole member 13 and the element 22 is rotated about the pin 23 in

a clockwise direction thereby moving the members 61 to the left against the bias of the springs 55. The members 61 engage the movable blades 51a to move the blades to the left and open the contacts 60 between these blades and the fixed blades 50. Simultaneously, the resiliency of the blades 51b, whose contacts 60 are open with respect to their mating contacts on blades 50, moves the blades 51b to the left until the contacts on the blades 51b engage their mating contacts on the fixed blades 50. Upon de-energization of the coil 14, the bias of the springs 55 will move the member 61 and the bridge member 25 to the right (as viewed in FIG. 3), rotating the armature assembly 22 counterclockwise. The resiliency of the blades 51a biases their contacts 60 into engagement with the mating contacts 60 on the fixed blades 50, and the member 61 moves the blades 51b to the right to disengage their contacts from the mating contacts on the fixed blades 50.

To provide for alignment of the armature 16 with the frame structure 12 and the pole member 13, the screws 21 are loosened and the lower surface of the armature 16 is moved into contact with the flat end 13d of the pole member 13 against the force of the springs 55. The end of the armature 16 adjacent the upper end of the long leg 12a of the frame member 12 is moved against this frame member after loosening the screws 16a thereby insuring that the armature is not only parallel to the flat top 13d of the pole member 13 but also perpendicular to the frame structure 12. The plate 18 can be adjusted relative to the frame member to permit this positioning of the armature 16 because of the elongated slots 19 in the plate 18 through which the screws 21 pass. The contact assembly 15, however, is not moved with the plate 18 since the screws 21 extend through close fitting apertures in the insulated support block assembly 53 to hold the contact assembly 15 in a fixed position. Therefore, movement of the plate 18 longitudinally along the long leg 12a of the heelpiece 12 moves the armature and armature assembly without moving the contact assembly 15. Movement of the armature extension 22 will, of course, move the bridge member 25 and the mating end of the dielectric member 61 because of the engagement of tongue 61c in the slot 25a of bridge member 25. The member 61 will then pivot at the apertures 55a of the springs 55 through which the tongue 61b thereof extends. Because of the sliding fit of the movable switch blades 51 in the slots 62 of the member 61, the member 61 is freely movable in this direction with respect to the blades 51. When the armature 16 has been adjusted to the desired position, the screws 21 are tightened to lock the plate 18 in position.

To provide for adjustment of the size of the effective air gap, the gap formed between the end of the armature 16 and the frame member 12 can then be varied without changing the armature operating stroke by moving the armature 16 to the right as viewed in FIG. 3. The desired spacing between the armature 16 and the upper end of the long leg 12a of the frame member 12 can be accurately adjusted by inserting gauges. As this air gap is in series with the air gap formed between the pole member 13 and the armature 16, the positioning of the armature 16 relative to the frame member 12 permits the total effective length of the air gap to be adjusted throughout the desired range of operating characteristics. When this gap is properly adjusted, the screws 16a are tightened, the gauges are removed, and the armature 16 is released so that it is moved to the position shown in FIG. 3 by the springs 55.

Although the present invention has been described with reference to a single embodiment thereof, it should be understood that numerous other embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A relay comprising a field structure, electromagnetic coil means carried by said field structure, contact means mounted on said field structure, an armature assembly rotatably mounted with respect to said field structure and having an armature in spaced magnetically inductive relation with said field structure forming a preselected air gap and adapted for movement in response to signals received by said coil means, said armature forming an additional adjustable air gap between said armature and said field structure, contact actuating means responsive to movement of said armature, and means for adjustably moving said armature with respect to said field structure to selectively vary said adjustable air gap spacing between said armature and said field structure without affecting the length of the stroke of said armature.

2. A relay comprising a field structure, electromagnetic coil means carried by said field structure, contact means mounted on said field structure and including at least one pair of electrical contacts movable toward and away from each other between an open and a closed position, an armature assembly rotatably mounted with respect to said field structure and having an armature in spaced inductive relation with said field structure forming a preselected air gap and adapted for movement in response to signals received by said coil means, said armature forming an additional adjustable air gap between said armature and said field structure, contact actuating means responsive to movement of said armature for moving said contacts between said open and said closed positions, and means for moving said armature with reference to said field structure to selectively adjust said adjustable air gap between said armature and said field structure without affecting the length of the stroke of said armature.

3. A relay comprising a magnetic field structure defining spaced portions, a coil mounted on said structure, a magnetic armature, supporting means for movably mounting said armature adjacent one of said portions in a position substantially bridging said spaced portions, mounting means for mounting said supporting means in a selected one of a plurality of spaced positions on said one portion to vary the position of said armature relative to the other of said spaced portions, to provide a preselected armature movement, contact means including a plurality of contact springs mounted in a fixed position relative to said field structure, operating means controlled by said armature for moving at least one of said contact springs to actuate said contact means, said operating means including means providing a sliding connection between said armature and said one contact spring to permit said supporting means to be secured in said position without moving said contact springs and adjusting means independent of said mounting means for selectively positioning said armature relative to said one portion to provide a desired air gap spacing therebetween while maintaining the preselected armature movement.

4. A relay comprising a field structure including an L-shaped frame member of magnetizable material and having a long leg and a short leg and further including a stationary pole member of magnetizable material having one end secured to said short leg and having a free end extending in the direction of said long leg, a coil positioned on said pole member, a plate adjustably secured to the end of said long leg for selective positioning along said long leg, an armature extension pivotally mounted on said plate, an armature of magnetizable material carried by said armature extension in spaced magnetically inductive relation to both said pole member and said frame member and forming air gaps with both said pole member when said coil is in a de-energized condition and with said frame member, means adjustably

positioning said armature relative to said frame member, contact means mounted on said field structure, actuating means actuating said contact means in response to movement of said armature, and means biasing said armature away from said pole piece when said coil is de-energized.

5. A relay as defined in claim 4 above wherein said contact means comprise an insulating block support assembly mounted on said frame member, at least one fixed switch-blade mounted in said support assembly, at least one adjacent movable switch blade biased toward said fixed blade, and mating contacts carried by said blades at least one of which is movable between a switch closed and a switch open position, and wherein said actuating means comprises an insulating member having at least one slot through which the free end of said movable switch blade extends and movable with said armature extension in response to the movement of said armature whereby movement of said insulating member moves said contacts with respect to each other.

6. A relay as defined in claim 4 above wherein said armature extension is of light nonmagnetic material.

7. A relay as defined in claim 4 above wherein said contact means comprises a dielectric supporting assembly mounted on said frame member, a plurality of fixed switch blades mounted in said supporting assembly and each containing at least one electrical contact, a plurality of movable switch blades mounted in said supporting assembly and each carrying an electrical contact co-operable with a mating one of said contacts carried by one of said fixed switch blades, each of said movable switch blades having a normal bias tending to move it toward its mating contact carried by said fixed blade, and wherein said actuating means comprises an insulating member movable with said armature extension in response to the movement of said armature and containing a plurality of apertures through which at least one movable switch blade slidably extends whereby movement of said insulating member moves said contacts with respect to each other, and a spring mounted on said insulating block assembly and biasing said insulating member and armature into the deenergized position of said relay.

8. A relay as defined in claim 4 above and additionally including a stabilizer washer having a central aperture through which the pole member extends and having a pair of oppositely located tabs, a terminal board of insulating material containing a plurality of terminal members secured to said coil and through which said pole member passes and located adjacent said stabilizer washer, and a substantially angularly shaped stabilizer bracket having a pair of arms containing grooves for receiving said tabs and containing a channel-shaped section adapted to slidably receive the long leg of said frame member thereby to secure the free end of said pole member.

9. A relay comprising a field structure including an L-shaped frame member of magnetizable material and

having a long leg and a short leg and further including a stationary pole member of magnetizable material having one end secured to said short leg and having a free end extending in the direction of said long leg, a coil positioned on said pole member, an armature extension pivotally mounted adjacent the end of said long leg, an armature of magnetizable material carried by said armature extension in spaced magnetically inductive relation to both said pole member and said frame member and forming air gaps with both said pole member when said coil is in a de-energized condition and with said frame member, means adjustably positioning said armature relative to said frame member, contact means mounted on said field structure, actuating means actuating said contact means in response to movement of said armature, and means biasing said armature away from said pole piece when said coil is de-energized.

10. A relay comprising a magnetic field structure having a pair of generally parallel legs, a winding mounted on one of said legs, and nonmagnetic means for securing said winding on said one leg and for maintaining the free ends of said legs in a predetermined spaced position, said means including a rigid structure slidably mounted on both of said free ends and secured to the other of said legs.

11. A relay comprising a field structure of magnetizable material including an L-shaped frame member having a long leg and a short leg and further including a stationary cylindrical pole member of magnetizable material mounted on the short leg of said frame member and having a free end extending in the direction of said long leg, an electromagnetic coil positioned on said pole member, a stabilizing washer of nonmagnetizable material having a central aperture positioned over the free end of said pole member and having a pair of tabs extending in the direction of said long leg, and a stabilizing bracket of generally angle-shaped nonmagnetizable material having a pair of extensions each containing a groove adapted to receive one of said tabs and further containing a channel-shaped portion adapted to slidably engage the long leg of said field member thereby to secure the free end of said cantilevered pole member to said frame member.

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