Nov. 10, 1964 Z. R. SMITH 3,156,797

PLUG-IN ELECTROMAGNETIC RELAY

Filed Dec. 7, 1961 2 Sheets-Sheet 1

FIG. 1

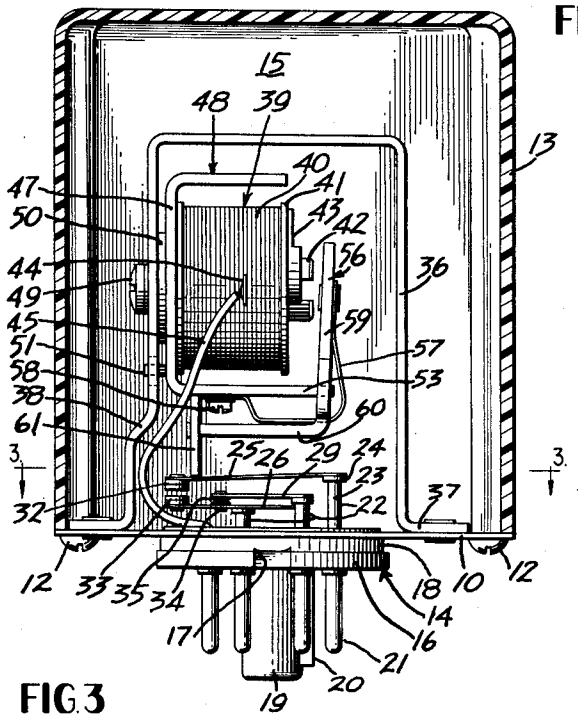



FIG. 2

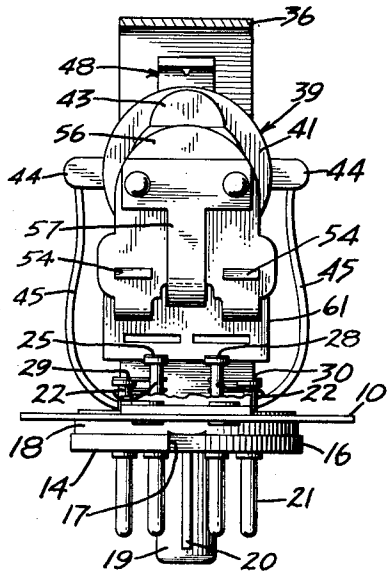



FIG. 3

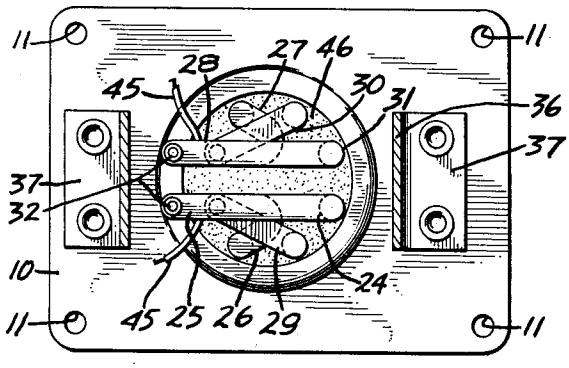
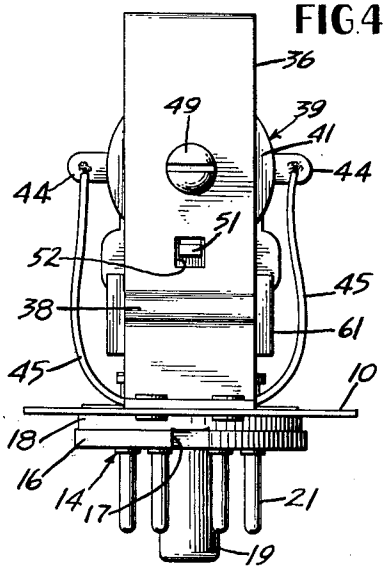



FIG. 4



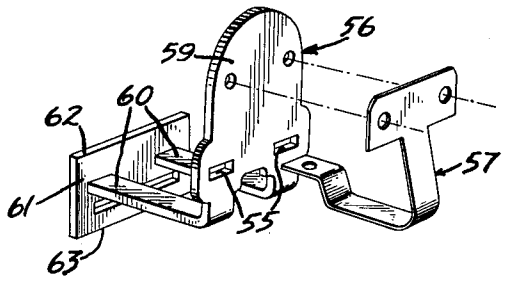




FIG. 5

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PLUG-IN ELECTROMAGNETIC RELAY

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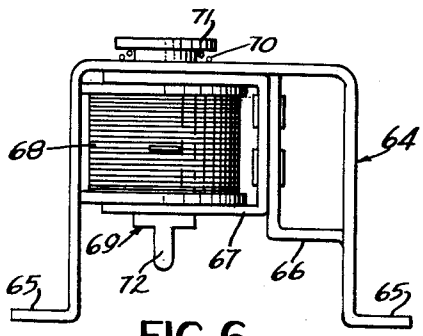



FIG. 6

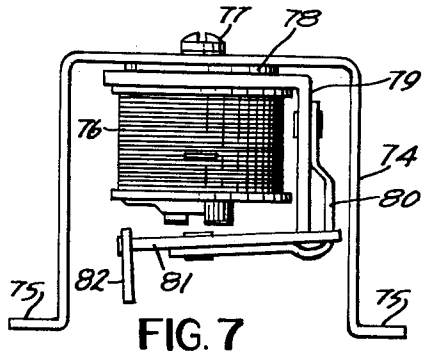



FIG. 7

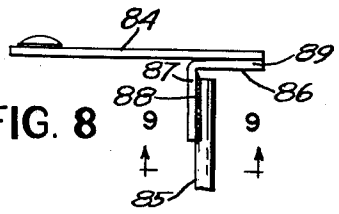



FIG. 8

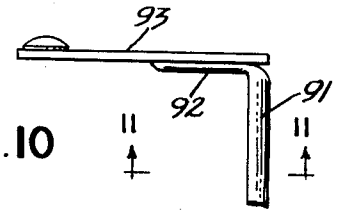



FIG. 10

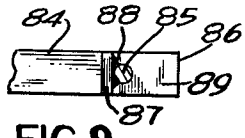



FIG. 9

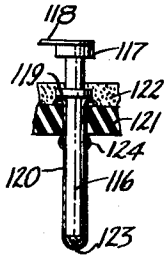



FIG. 18

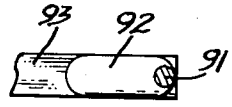



FIG. 11

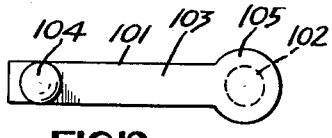



FIG. 12

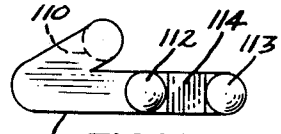



FIG. 16

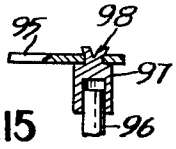



FIG. 15

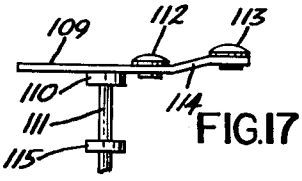



FIG. 17

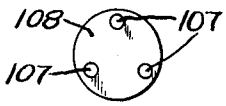



FIG. 13

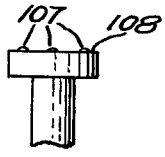



FIG. 14

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United States Patent Office 3,156,797 Patented Nov. 10, 1964



3,156,797

# PLUG-IN ELECTROMAGNETIC RELAY

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Filed Dec. 7, 1961, Ser. No. 157,628
9 Claims. (Cl. 200—87)

This invention relates to electromagnetic relays and, more particularly, to relays of the type adapted to be plugged into a socket connected to the necessary circuitry for operation of the relay.

One of the objects of the invention is to provide an improved electromagnetic relay.

Another object is to provide an improved plug-in type relay.

A further object is to provide a relay of the type having a plurality of base pins with improved means for mounting contact structures on the base pins.

Still another object is to provide improved means for mounting a contact structure on a base pin in such manner that the resultant connection or joint is strong and does not subject the contact structure to unnecessary or unwanted movement caused by shock, vibration or jarring.

Another object is to provide an improved relay wherein the electromagnet is mounted above the contacts so that the relay is relatively compact in a transverse direction.

In order that the manner in which these and other objects are attained in accordance with the invention can be understood in detail, reference is had to the accompanying drawings, which form a part of this specification, and wherein:

FIG. 1 is a side elevational view, with one wall of the case removed, of one embodiment of the invention;

FIG. 2 is an end elevational view, with portions removed, looking at the right end of the relay of FIG. 1;

FIG. 3 is a top plan view, partly in section, looking in the direction of lines 3—3 of FIG. 1;

FIG. 4 is an end elevational view looking at the left end of the relay of FIG. 1, with the case removed;

FIG. 5 is an exploded perspective view showing the relationship between the armature, the spring and the pusher of the relay of FIG. 1;

FIGS. 6 and 7 are side elevational views illustrating two different ways to construct and mount an electromagnet and armature;

FIGS. 8 and 9 and 10 and 11 are side elevational and bottom plan views, respectively, illustrating two different ways to attach the contact arms to the posts, FIGS. 9 and 11 looking in the direction of lines 9—9 and 11—11 in FIGS. 8 and 10, respectively.

FIG. 12 is a top plan view illustrating a modification of the movable contact arm;

FIGS. 13 and 14 are a top plan view and a side elevational view illustrating a modification of a post;

FIG. 15 is a side elevational view, partly in section, illustrating another way to mount a contact arm of a post;

FIGS. 16 and 17 are top plan and side elevational views illustrating a modification of one of the fixed contact arms; and

FIG. 18 is a vertical sectional view illustrating how the posts are connected to the base pins; FIGS. 8–18 being on enlarged scales relative to that of FIGS. 1–7, for clarity of illustration.

Referring now to the drawings, the embodiment of the invention in FIGS. 1–5 includes a rectangular base plate 10 of sheet metal. Base plate 10 is provided at each corner with an aperture 11 through which a screw 12 extends for attaching a plastic case 13 to the base plate to enclose the contacts and movable portions of the relay. Although the case is only shown in FIG. 1, and in this



view the case is in section, it is to be understood that the case includees four side walls and an end wall which cooperate with the base plate 10 to define a fully enclosed chamber 15.

A plug assembly 14 includes an octal base 16 provided with a plurality of peripheral recesses 17. Base plate 10 includes an annular ridge 18 which extends around the upper portion of base 16 and is upset into recesses 17 to mount base plate 10 on base 16 in such a manner that the axis of base 16 extends perpendicular to base plate 10. Base 16 includes an axially extending aligning plug 19 and an aligning key 20 on plug 19. Secured to base 16 in the usual manner are eight hollow base pins 21 which project downwardly from the base.

In order to facilitate describing the structure, the base pins are referred to hereafter in accordance with the code commonly used in the tube industry. That is, when viewed from the bottom, the base pin immediately to the left of key 20 is the #1 pin, the pin immediately adjacent to the #1 pin in a clockwise direction is the #2 pin, and so on, so that the pin immediately counterclockwise of the #1 pin is the #8 pin.

It is thus seen that plate 10 and base 16 form a base assembly which can be considered as including aligning plug 19 and pins 21, the aligning plug and pins projecting away from one side of the base assembly.

A plurality of posts 22 are each mounted in a different one of the #1, #2, #3, #6, #7 and #8 pins. Again, in order to facilitate describing the structure, each post will be described with reference to the pin to which it is attached. Thus, the post attached to the #1 pin is the #1 post, the post attached to the #2 pin is the #2 post, etc. The pins and posts are of an electrically conductive material and constitute terminals through which current can readily flow.

A plurality of movable contact arms 23, 26, 27 and 28 are mounted on the heads of the #1, #3, #6 and #8 posts, respectively, and a pair of fixed contact arms 29 and 30 are mounted on the heads of the #2 and #7 posts, respectively and, in the arrangement illustrated, provide a two pole, double throw, make-before-break arrangement. Each contact arm is of a conductive spring material, such as a silver nickel alloy. Each of the contact arms is flat, when unstressed, and has a width corresponding to the diameter of the head 24 of the post to which the contact arm is connected. Each contact arm terminates in a semi-circular edge, as indicated at 31 in FIG. 3, of a radius equal to the radius of the head so that the end of the contact arm lies flush with the head. Since the contact arms are flat, and the surfaces of the heads to which they are attached are flat and extend transversely to the axes of the posts, the contact arms also extend transversely to the axes of the posts. Each contact arm is welded to the head of the post associated therewith to fixedly secure the contact arm thereto.

With reference to FIG. 1, each of movable contact arms 25 and 28 has a contact 32 riveted to its free end, i.e., the end away from the post to which the contact arm is connected, which cooperates with contacts 33 mounted on the free ends of movable contact arms 26 and 27, respectively. Each of movable contact arms 26 and 27 has a second contact 34 mounted at a medially located point. Each contact 34 is cooperable with a contact 35 mounted on the free ends of each of the fixed contact arms 29 and 30.

As best seen in FIG. 3, each of movable contact arms 25 and 28 is straight. Contact arms 25 and 28 are parallel and lie on opposite sides of a diametrical plane of the socket which plane lies along the longitudinal center line of the base plate 10. Each of movable contact arms 26 and 27 is J-shaped and arranged so that the curved end portion is the end which is connected to the post and the

leg or shank is the end which carries the contacts 33 and 34 and is parallel to but beneath arms 25 and 28, respectively. Each of fixed contact arms 29 and 30 is straight and extends inwardly from its supporting post.

Note also that the contacts on arms 25, 26 and 29 lie in a common vertical plane and that the contacts on arms 27, 28 and 30 lie in another vertical plane parallel to the first. Movable contact arms 25 and 28 are the longest and have the greatest degree of flexibility. The J-shape of each of arms 26 and 27 provides the necessary flexibility within the short space available, whereas arms 29 and 30 are the shortest and are relatively inflexible, since they do not have to be moved during operation of the relay.

As best seen in FIG. 1, the #1 and #8 posts are relatively long so that contact arms 25 and 28 are spaced from base plate 10 a distance greater than any of the other contact arms. The #2 and #7 posts are shorter than the #1 and #8 posts so that contact arms 29 and 30 are closer to the base than contact arms 25 and 27. The #3 and #6 posts are the shortest so that movable contact arms 25 and 27 are closer to the base than any of the other contact arms. In their normal positions, contacts 32 and 33 are disengaged and contacts 34 and 35 are engaged. When the contact arms are actuated, in a manner more fully described hereafter, contacts 32 first engage contacts 33 and thereafter contacts 34 and 35 become disengaged. Subsequent movement or return to their normal position causes contacts 34 and 35 to become engaged before contacts 32 and 33 disengage.

An inverted U-shaped bracket 36, constituting a motor support, is provided at its free ends with feet 37 which are riveted to base 10 so that the bracket is supported upon the base plate 10 and extends upwardly therefrom. The feet are located on the longitudinal center line of the base plate. Bracket 36 is bent at 38 to provide clearance between the bracket and the current carrying contacts adjacent thereto.

An electromagnet 39 is provided for actuating the contacts and comprises a coil 40 wound on a bobbin 41 through which a core 42 extends. The exposed end of the core is split and is connected to a shading coil 43 so that the electromagnet can be actuated by an alternating current. However, it is to be understood that the electromagnet can be designed for actuation by a direct current. The ends of coil 40 are connected to a pair of terminals 44 which project outwardly from the coil and are connected to lead wires 45 having their other ends soldered to the #4 and #5 pins.

Octal base 16 is of conventional construction and includes a recess which is filled with potting material indicated by the stippled area in FIG. 3, such material being indicated generally by reference numeral 46. The potting material surrounds the post at those portions where the posts emerge from the base pins and serves to additionally strengthen and support such posts upon the base 16.

Core 42 is connected to the base 47 of a frame 48 of magnetic material. A screw 49 extends through an aperture in one leg of bracket 36 and secures the electromagnet and frame upon the bracket in such manner that the electromagnet is parallel to and above base plate 10. A washer 50 is disposed between frame 48 and bracket 36. Frame 48 also includes a lug 51 which projects through a slot 52 in the bracket to orient the frame relative thereto. Slot 52 and the aperture through which screw 49 extends can be slightly elongated so that the frame and electromagnet can be adjusted, within limits, in a direction generally perpendicular to base plate 10.

Frame 48 includes a leg 53 which lie beneath and extends parallel to the electromagnet, the leg terminating in a straight edge having a pair of ears 54 projecting therefrom through apertures 55 in an armature 56. A restoring spring 57 is riveted at one end to armature 56 and is connected at its other end by a screw 58 to leg 53 of frame 48 so that the armature is supported for pivotal movement on the frame.

As best seen in FIG. 5, armature 56 includes a flat body portion 59 and a pair of parallel arms 60 the ends of which are staked to a pusher 61 of suitable rigid, insulation material. Pusher 61 is flat and rectangular and lies in a plane which extends transversely of electromagnet 39 and base plate 10. Pusher 61 includes an upper edge 62 which, when the relay is de-energized, abuts leg 53, and a lower edge 63 which engages the upper surfaces of movable contact arms 25 and 28 adjacent to their free ends and extends transversely thereof.

The combination of electromagnet 39, frame or field member 48, armature 56, and restoring spring 57 constitutes the motor structure of the relay, the motor structure being secured to bracket 36 by the screw 49.

When the relay is de-energized, restoring spring 57 acting directly on armature 56 and movable contact arms 25 and 28 acting through pusher 61 bias armature 56 in a clockwise direction; however, movement of the armature in the clockwise direction is limited because edge 62 of the pusher 61 abuts leg 53 of frame 48. As previously indicated, when the relay is de-energized, contacts 32 and 33 are open and contacts 34 and 35 are closed so that current can flow between the #2 and #3 pins and between the #6 and #7 pins. When the relay is energized as by connecting the #4 and #5 pins to a source of alternating current, magnetic forces are established which attract armature 56 to the electromagnet and cause the armature to pivot in a counterclockwise direction from its normal position to its actuated postion. Such movement is against the biasing force of restoring spring 57 and causes pusher 61 to move the free ends of movable contact arms 25 and 28 downwardly and thereby move contacts 32 into engagement with contacts 33. The amount of movement is sufficiently great to cause the movable contact arms to move downwardly even after contacts 32 engage contacts 33 so that contact arms 26 and 27 are also moved downwardly and thereby cause contacts 34 and 35 to become disengaged. It will be apparent that such movement stresses the movable contact arms so that the spring forces thereby created acting through pusher 61 increase the bias upon armature 56 in the clockwise direction, that is, the direction in which the armature must travel to return to its normal position. Thus, when the relay is subsequently de-energized, the spring forces acting upon the armature return it to its normal position. Such returning movement causes contacts 34 to engage contacts 35 and thereafter causes contacts 32 to become disengaged from contacts 33. When contacts 32 and 33 are engaged, current can flow through the relay between the #1 and #3 pins and between the #6 and #8 pins.

Referring now to FIG. 6, there is shown an electromagnetic structure which is intended to be used in place of that shown in the embodiment of FIGS. 1–5. An inverted U-shaped bracket 64 is provided with a pair of feet 65 which are adapted to be connected to base plate 10 in a manner similar to that by which bracket 36 is mounted upon the base plate. Bracket 64 includes an L-shaped tongue 66 which is struck out of one of the legs of the bracket and supports a U-shaped yoke 67. The yoke straddles the bobbin of an electromagnet 68 and supports the electromagnet on bracket 64. A movable plunger 69 extends through electromagnet 68 and is biased upwardly by a compression spring 70. The plunger is provided with an enlarged head 71 so that spring 70 bears against the under surface of head 71 and against the upper surface of the cross member of bracket 64. The bottom of plunger 69 is provided with an actuator 72 which, when the relay is assembled, abuts the movable contact arms 25 and 28 so that in response to actuation of the relay, the contact arms are moved to actuate the contact arrangement.

Plunger 69 moves along a line that is perpendicular to

base plate 10 so that such movement is also substantially perpendicular to the movement of the contact arms. Upon de-energization of electromagnet 68, the forces exerted by the movable contact arms and spring 70 cause the plunger to move upwardly into the position shown in FIG. 6. When the relay is then energized by passing a suitable current through the electromagnet, the plunger, by solenoid action, moves downwardly against the force of spring 70 and thereby moves movable contact arms 25 and 28 downwardly to actuate the contact arrangement in a manner similar to that described with reference to the embodiment of FIGS. 1–5.

Referring now to FIG. 7, there is shown an inverted U-shaped bracket 74 having a pair of feet 75 adapted to be connected to base plate 10 in a manner similar to that of bracket 36 and of bracket 64. An A.C. electromagnet 76 is mounted upon the crossbar of bracket 74 by means of a screw 77 and a spacer washer 78 so that electromagnet 76 extends downwardly from the crossbar of bracket 74 and has its axis perpendicular to the plane of the base plate, when the electromagnet and bracket are connected to the base plate. An L-shaped field member 79 has one leg clamped between washer 78 and the upper end of the bobbin of electromagnet 76 and has its other leg arranged to extend downwardly and parallel to the legs of bracket 74 and to the axis of electromagnet 76. A restoring spring 80 has one end connected to field member 79 and has its other end connected to an armature 81 which carries a flat, rectangular pusher 82 of insulation material.

Armature 81 is pivotable about the lower end of the vertical leg of field member 79, such movement being in response to energization and de-energization of electromagnet 76. When bracket 74 is mounted upon base plate 10, the lower edge of pusher 82 extends transversely across and engages movable contact arms 25 and 28 in a manner similar to that by which pusher 62 engages these contact arms. When the relay is de-energized, spring 80 biases armature 81 away from engagement with the core of electromagnet 76 so that pusher 82 holds contacts 32 and 33 in engagement with each other and separates contacts 34 and 35. When the relay is energized, the armature 81 pivots in a clockwise direction, as viewed in FIG. 7, into engagement with the core of electromagnet 76, such pivotal movement causing pusher 82 to move in a generally upward direction and thereby allow contacts 34 to move into engagement with contacts 35 and to allow contacts 32 to disengage contacts 33. Obviously, such movement of the contacts is caused by the inherent spring action of the contact arms upon which the contacts are mounted. In this case, note that the force of the solenoid which causes the upward movement of the pusher is also aided by the upward forces exerted on pusher 82 by the movable contact arms. When the relay is subsequently de-energized, spring 80 moves the armature away from engagement with electromagnet 76 and thereby operates or actuates the switch structure.

With reference to FIGS. 8 and 9, a contact arm 84 is mounted upon a post 85 by means of an angle member 86. The angle member has an inverted L shape and includes a flat, vertical leg 87 which is secured to post 85 by solder 88 or other suitable means such as welding. The angle member also includes a horizontal leg 88 which is flat and of substantially the same width as that of contact arm 84, the contact arm being secured thereto by fused metal, such as by welding, soldering or brazing.

Referring now to FIGS. 10 and 11, a post 91 has, at its upper end, a head 92 which extends transversely of the post and has a flat upper surface which abuts the flat under surface of a contact arm 93, the contact arm being secured to the head by means such as soldering, welding or brazing. Head 92 extends from the vertical axis of post 91 toward the free end of the contact arm so that, in effect, it shortens the length of the contact arm and thereby makes it stiffer. In contrast, leg 69 extends away from the free end of contact arm 84 and in effect lengthens the contact arm to thereby increase its flexibility.

There is shown in FIG. 15 an embodiment in which a contact arm 95 is secured to a post 96 solely by mechanical means. An inverted cup-shaped bushing 97 is press fitted over the upper end of post 96 to frictionally secure the bushing on the post. Bushing 97 has a head 98 of reduced diameter, which extends through an aperture in contact arm 95 and is staked or otherwise deformed so that the contact arm 95 is secured by a positive interlock to bushing 97 and extends transversely of post 96 at the upper end thereof.

With reference to FIG. 12, a movable contact arm 101 is mounted upon the head 102 of a post of the type similar to post 22. Contact arm 101 has an elongated, rectangular, flat body portion 103 which at its free end has or carries a contact 104 and which at its other end has a circular end portion 105 of a diameter greater than the width of body portion 103 and of head 102. When, during the operation of the relay, the movable contact is moved, stresses are developed within the contact arm which stresses are the greatest at the intersection of the movable contact arm and that portion of the post which is located adjacent to the movable portions of the contact arm. Thus, it has been found that providing the movable contact arm with an enlarged end portion such as portion 105, the life of the contact arm is increased because such end portion reduces the stresses due to the flexing of the contact arm.

When it is desired to weld the contact arms and posts, the posts are advantageously constructed as shown in FIGS. 13 and 14 and are preferably provided with a plurality of weld dimples 107 which, prior to connecting the contact arms to the post, extend slightly above the upper surface 108 of the head of the post. When the contact arm is welded to the post, the weld dimples melt and fuse so that the under surface of the contact arm lies flush with surface 108 of the post.

To minimize or eliminate contact bounce, contact arms 26 and 27 can be constructed in a manner similar to that illustrated in FIGS. 16 and 17. With reference to these figures, a J-shaped contact arm 109 is secured to the enlarged head 110 of a post 111, the contact arm carrying a pair of contacts 112 and 113 riveted to the arm. Contact arm 109 includes an inclined portion 114 which lies between those portions of the contact arm carrying contacts 112 and 113 so that such portions lie in parallel planes whereby contact 113 is slightly above contact 112. By making contacts 112 and 113 of smaller mass than contacts 33 and 34 and by providing the inclined portion 114, it has been found that the contact bounce has been minimized or eliminated during relay operation.

With reference to FIG. 17, note that the post can also be provided with a circular flange 115 which is below the head of the post a distance such that the flange 115 would be embedded in the potting material when the relay is assembled. The flange 115 serves as a stop member when the posts are inserted into the base pins to properly locate the head 110 of the post at the desired height above the base.

Thus, as shown in FIG. 18, a post 116 has a head 117 on which a contact arm 118 is mounted. Post 116 has a medial flange 119 which abuts the bent over top of a hollow base pin 120 secured to a base 121, the base being similar to base 16 and being filled with potting material 122. The lower end of post 116 extends coaxially with and inside pin 120 and is soldered thereto, the solder filling the lower end of the pin at at 123. Flange 119 is similar to 115. When such flanges are not provided, it is more difficult to properly position the fixed ends of the contact arms at the desired height above the base. Pin 120 includes a medial bulge 124 which abuts the bottom of base 121 so that when the top of the pin is bent over, the base is clamped between the top and bulge 124 to fixedly secure the pin to the base.

While the invention has been illustrated applied to an octal base plug-in relay having one form of contact arrangement, the invention is also applicable to other types of relays and forms of contact arrangements. It will be apparent to those skilled in the art that many changes can be made in the details of construction and arrangements of the parts without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. In a plug-in type electromagnetic relay, the combination of

a flat base plate having an opening;

a base assembly comprising

a base of insulation material disposed in said opening and rigidly secured to said base plate to support said base plate on said base, said base having an aligning plug, and

a plurality of base pins rigidly secured to said base and arranged in parallel relation at angularly spaced points on a circle concentric to said aligning plug;

a plurality of posts each connected to one of said base pins and projecting from said base on the side thereof opposite to said base pins;

contact means including

a plurality of contact arms each mounted on one of said post and projecting therefrom generally parallel to said base and transversely of said posts;

a bracket mounted on said base plate and projecting on the same side thereof as said posts and said contact arms, said bracket including

at least one leg portion which extends substantially perpendicular to said base plate;

electromagnetic operating means mounted on said bracket and including

an electromagnet parallel to said base above said contact arms and substantially perpendicular to said leg portion of said bracket,

a field member having one leg parallel to said electromagnet and providing a pivot, and another leg parallel to said leg portion of said bracket,

an armature pivotally mounted on said pivot and including a leg portion which is generally parallel to said contact arms and movable generally perpendicular thereto; and

a restoring spring connected to said armature; and

means connecting said armature to actuate said contact means in response to actuation of said electromagnet.

2. In a plug-in type electromagnetic relay, the combination of

a rigid base assembly comprising

a body of insulating material,

an aligning member fixed to said body and projecting away from one side of said base assembly, and

a plurality of electrically conductive pins arranged in a circular series extending about said aligning member,

said pins being rigidly secured to said body and all projecting, parallel to each other and to said aligning member, away from said one side of said base assembly;

a plurality of electrically conductive contact-supporting posts each secured to a different one of said pins,

said posts all projecting away from the other side of said base assembly,

each of said posts being connected electrically to its respective pin;

contact means comprising

a movable spring contact arm carried by and electrically connected to one of said posts,

a stationary contact member supported by and electrically connected to another of said posts and disposed to cooperate with said movable spring contact arm,

said spring contact arm extending generally transversely of said posts and generally parallel to said base assembly;

a motor support rigidly carried by said base assembly and comprising

a first portion fixed to said base assembly at a point outside of said circular series and projecting away from said other side of said base assembly, and

a second portion joined to said first portion and projecting generally transversely of said pins, said second portion being spaced a substantial distance from said contact means;

an electromagnetic motor structure mounted on one of said first and second portions of said motor support and disposed between said second portion of said support and said contact means, said motor structure comprising

a field member having a first leg adjacent said one portion of said motor support and a second leg projecting away from said one portion and providing a pivot,

an electromagnet projecting away from said one portion of said motor support and beside said second leg of said field member,

an armature mounted on said pivot for pivotal actuation by said electromagnet, said armature including a portion extending generally transversely of said pins and disposed between said electromagnet and said contact means, and

a restoring spring operatively connected to said armature; and

means connecting said portion of said armature to actuate said movable spring contact arm in response to operation of said motor structure.

3. A relay in accordance with claim 2 and wherein

said motor structure is mounted on said first portion of said motor support with said second leg of said field member extending generally transversely of said pins,

said armature being generally L-shaped and said portion thereof being disposed between said second leg of said field member and said contact means.

4. A relay in accordance with claim 3 and wherein

said portion of said armature includes a pair of spaced parallel arms disposed with their free tips projecting toward said first portion of said motor structure, and

said means connecting said armature to actuate said movable spring contact arm is a flat pusher card having apertures in which said arms are engaged,

said pusher card extending transversely of said arms and having one edge engaged with said spring contact arm, the opposite edge of said pusher card engaging said second leg of said field member when said electromagnet is deenergized.

5. A relay in accordance with claim 3 and wherein

said motor structure is mounted on said second portion of said motor support with said second leg of said field member projecting toward said base assembly.

6. A relay in accordance with claim 3 and wherein

said motor support is a generally U-shaped bracket disposed with the end portions of the legs of the U thereof in engagement with and fixed to said base assembly,

said motor structure being disposed between the legs of the U of said bracket.

7. A relay in accordance with claim 3 and wherein

said pins are hollow and said posts each include an end portion extending within and fixed to a different one of said pins.

8. In a plug-in type electromagnetic relay character-

ized by make-before-break contact operation, the combination of

a base assembly comprising

a body of insulating material,

an aligning member fixed to said body and projecting away from one side of said base assembly, and

a plurality of electrically conductive pins arranged in a circular series extending about said aligning member, said pins being rigidly secured to said body and all projecting, parallel to each other and to said aligning member, away from said one side of said base assembly;

a plurality of electrically conductive contact-supporting posts each secured to a different one of said pins,

said posts all projecting away from the other side of said base assembly,

each of said posts being connected electrically to its respective pin;

contact means comprising

a generally J-shaped spring contact arm having its shorter end fixed to a first one of said posts, the stem of the J of said arm extending generally chordwise of said circular series,

a first contact carried by the free end portion of the stem of the J of said arm, and a second contact carried by said stem intermediate the length thereof, said arm being spaced from said base plate and said contacts facing away from said base assembly,

a relatively shorter spring contact arm having one of its ends fixed to a second one of said posts, the other end of said shorter arm being disposed adjacent said second contact,

a third contact carried by said other end of said shorter arm and facing said second contact, the relative lengths of said first and second posts and the shapes and dispositions of said J-shaped and shorter arms being such that, when said arms are relaxed, said second and third contacts are in engagement,

a relatively longer spring contact arm having one of its ends fixed to a third one of said posts, the free end portion of said longer arm being disposed adjacent said first contact, and

a fourth contact carried by the free end portion of said longer arm and facing said first contact, the length of said third post and the shape and disposition of said longer arm being such that, when said longer arm is relaxed, said fourth contact is held disengaged from said first contact;

a motor support rigidly secured to said base assembly and projecting away from said other side thereof; and

an electromagnetic motor structure mounted on said motor support and spaced from said contact means, said motor structure including an electromagnet and a movable operating member connected to distort said longer contact arm toward said base assembly in response to energization of said electromagnet, such distortion of said longer contact arm first causing said first and fourth contacts to be engaged and then causing said second and third contacts to be disengaged.



9. In a plug-in type electromagnetic relay, the combination of

a rigid base assembly comprising

a body of insulating material,

an aligning member fixed to said body and projecting away from one side of said base assembly, and

a plurality of hollow electrically conductive pins arranged in a closed series extending about said aligning member, said pins being rigidly secured to said body and all projecting, parallel to each other and to said aligning member, away from said one side of said base assembly;

a plurality of electrically conductive posts each having an end portion disposed within and fixed to a different one of said pins,

said posts all extending through said base assembly and projecting away from the other side thereof,

each of said posts being electrically connected to its respective pin;

contact means comprising a plurality of spring contact arms fixed each to a different one of said posts and extending generally transversely of said posts on the side of said base assembly opposite said pins;

a motor support rigidly connected to said base assembly and projecting away from said other side thereof; said

an electromagnetic motor structure mounted on said motor support and spaced from said contact means, said motor structure comprising

an electromagnet, and

a movable operating member arranged to actuate said contact means in response to operation of said electromagnet.


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