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MULTIPLE LEAF SPRING ELECTROMAGNETIC SWITCH

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July 28, 1964

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MULTIPLE LEAF SPRING ELECTROMAGNETIC SWITCH

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4 Sheets-Sheet 2

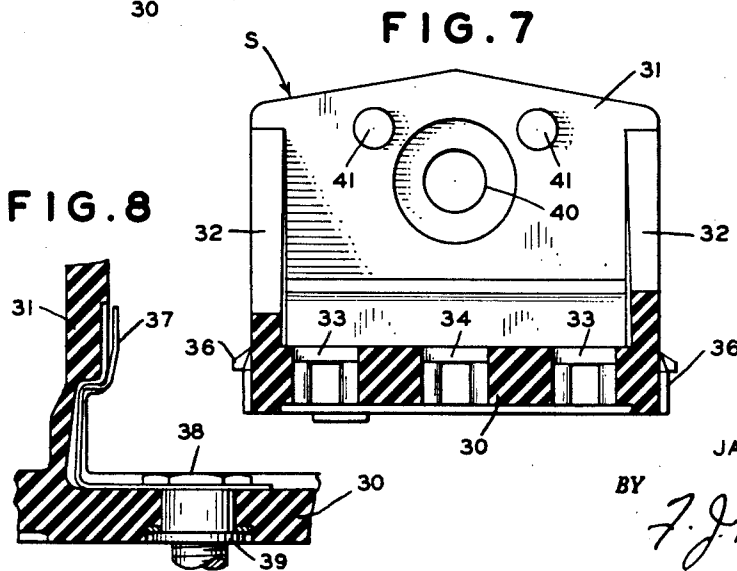
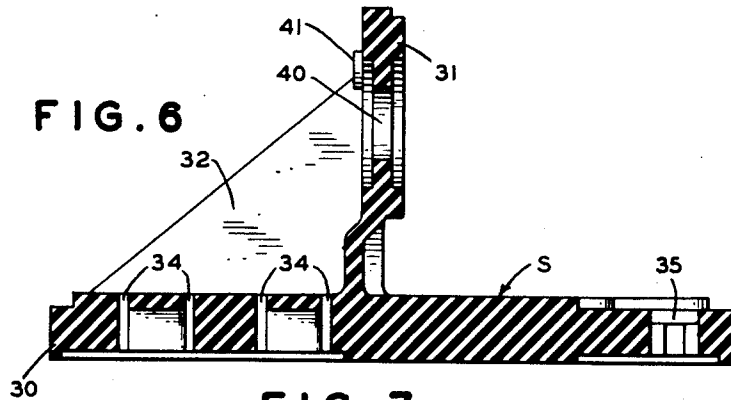
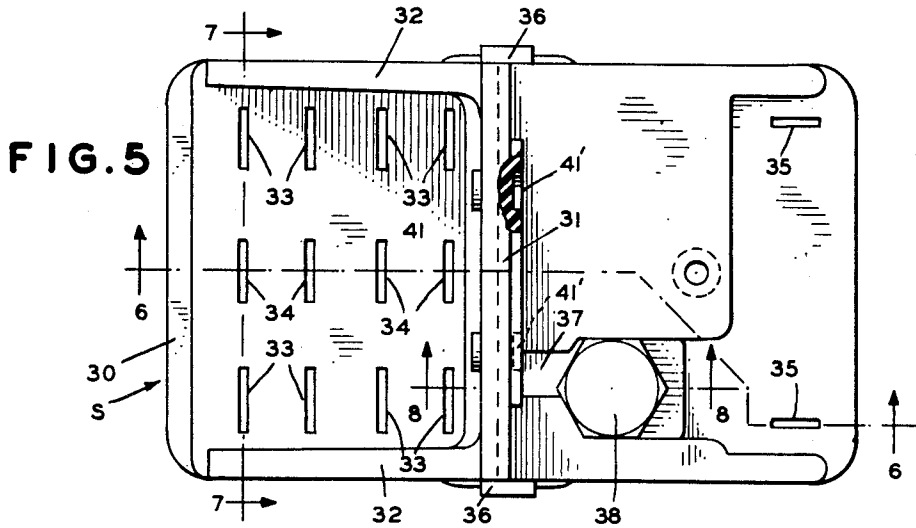
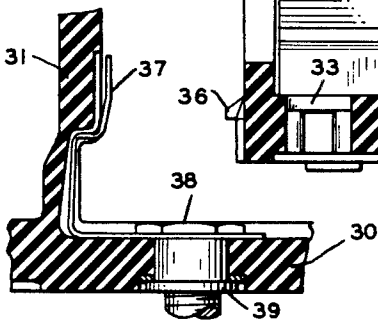


FIG. 8



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FIG. 9

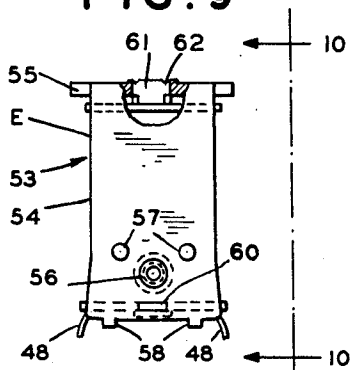


FIG. 11

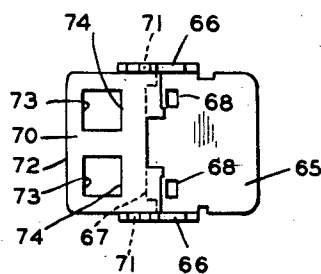


FIG. 10

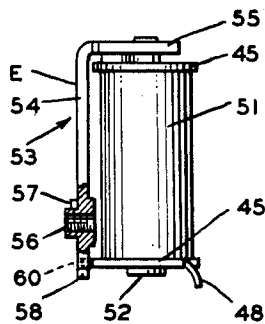


FIG. 12

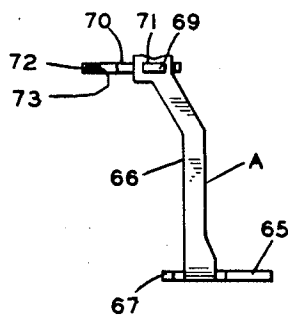


FIG. 13

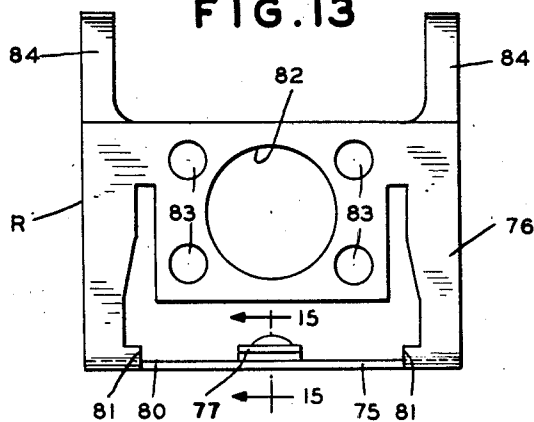


FIG. 14

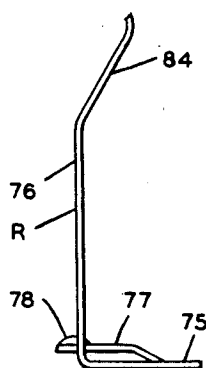
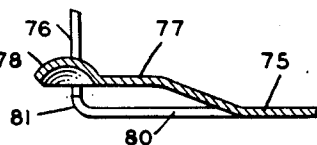


FIG. 15



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FIG. 16

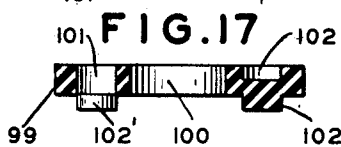
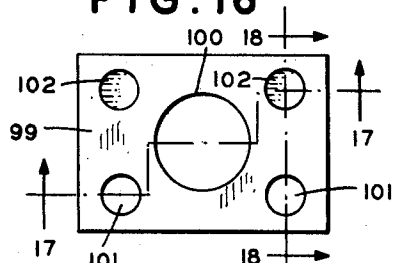


FIG. 18

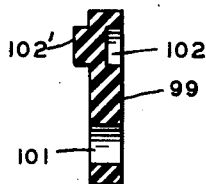


FIG. 19

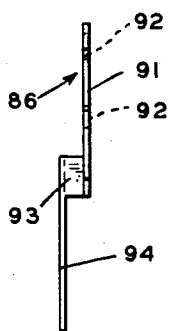


FIG. 20

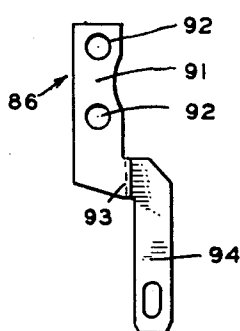


FIG. 25 FIG. 21 FIG. 22

FIG. 23

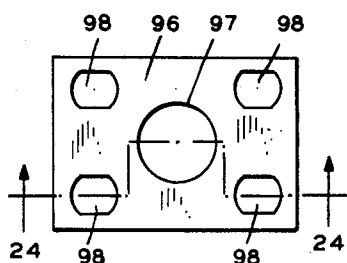


FIG. 24

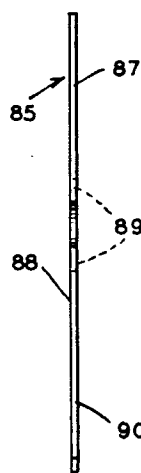
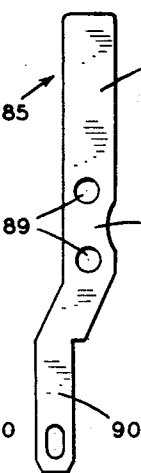
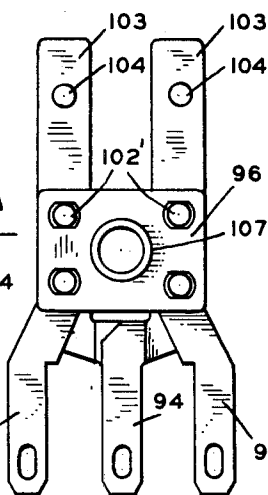
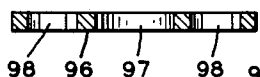
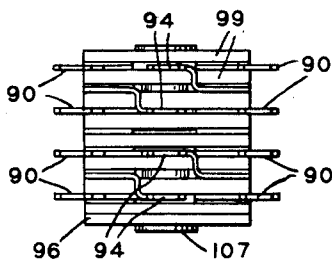


FIG. 26



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MULTIPLE LEAF SPRING ELECTROMAGNETIC SWITCH

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9 Claims. (Cl. 200-104)

This invention relates to the art of electromagnetic devices and, more particularly, to an electromagnetic relay or switch having improved features of design and construction. The invention pertains, in one of its specific aspects, to an electromagnetic relay that is adapted to be readily made in small and miniature sizes and that is capable of rendering satisfactory service over extended periods of time. The invention pertains, in another specific aspect, to an improved relay contact pile-up assembly.

The relay of this invention has wide application in the electronics field. It is especially useful as a component in electronic computers, telephone systems and the like.

The instant relay may be advantageously employed with a wide variety of switch arrangements, i.e., various forms of single pole or multi-pole switches which may be either single throw or double throw. The detailed description herein and the accompanying drawings are directed, by way of example, to a relay embodying the invention and having a 4-pole double throw switch arrangement incorporated therein.

The primary object of this invention is to provide an electromagnetic device having improved features of design and construction.

Another object of the invention is to provide a relay wherein certain parts may be readily and conveniently joined together to form independent units or assemblies which are subsequently brought together and interconnected to obtain the complete relay.

Another object of the invention is to provide a relay contact pile-up assembly in which individual components are arranged and bonded together so as to prevent relative bodily movement of any of such components.

Another object of the invention is to provide a relay including substantially rigid contact members which serve the dual functions of (1) snubbers to effectively dampen vibrations of corresponding flexible contact arms and (2) terminals which are adapted to be readily plugged into a suitable socket.

A further object of the invention is to provide a relay including a retainer unit which is so constructed and arranged with respect to a rockable armature unit and other elements as to support and maintain the armature unit in open position, when the relay is in unenergized condition, and prevent rebound of the armature unit at the time the relay is deenergized.

A still further object of the invention is to provide a relay of the character indicated that is small, compact and lightweight in design; that is sturdy and durable in construction; that is reasonable in manufacturing cost and that is capable of rendering long-term, trouble-free service.

The enumerated objects and other objects, together with the advantages of this invention, will be readily understood by persons trained in the art from the following detailed description and the annexed drawings which respectively describe and illustrate a recommended form of the invention.

In the drawings, wherein like reference characters denote corresponding parts throughout the several views:

FIG. 1 is a top plan view of a relay constructed in accordance with the invention and utilizing a 4-pole double throw switch arrangement, the cover of the relay being

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shown in cross section for better illustration of parts positioned therein;

FIG. 2 is a view taken along line 2-2 of FIG. 1;

FIG. 3 is a view taken along line 3-3 of FIG. 2;

FIG. 4 is a bottom plan view of FIG. 3;

FIG. 5 is a top plan view in enlargement of a support unit which forms a part of the relay;

FIG. 6 is a view taken along staggered line 6-6 of FIG. 5;

FIG. 7 is a view taken along line 7-7 of FIG. 5;

FIG. 8 is a fragmentary view taken along line 8-8 of FIG. 5;

FIG. 9 is a side elevation view on a reduced scale of an electromagnet unit which is included in the relay, parts being broken away for better illustration of other parts;

FIG. 10 is a view taken along line 10-10 of FIG. 9, parts shown in cross section for better illustration;

FIG. 11 is a top plan view on a reduced scale of an armature unit which forms a part of the relay;

FIG. 12 is a view in side elevation of the armature unit shown in FIG. 11;

FIG. 13 is an enlarged view in elevation of a retainer unit which forms a part of the relay;

FIG. 14 is a side elevation view of the retainer unit shown in FIG. 13;

FIG. 15 is an enlarged fragmentary view taken along line 15-15 of FIG. 13;

FIG. 16 is an enlarged view in front elevation of an insulating plate which constitutes an element of a contact pile-up assembly that is shown in other views;

FIG. 17 is a view taken along staggered line 17-17 of FIG. 16;

FIG. 18 is a view taken along line 18-18 of FIG. 16;

FIG. 19 is a side elevation view of a contact member which is an element of the contact pile-up assembly;

FIG. 20 is a view in front elevation of the contact member shown in FIG. 19;

FIGS. 21 and 22 correspond to FIGS. 20 and 19, respectively, and illustrate another form of contact member that is an element of the contact pile-up assembly;

FIG. 23 is an enlarged elevation view of an end plate that is an element of the contact pile-up assembly;

FIG. 24 is a view taken along staggered line 24-24 of FIG. 23;

FIG. 25 is an end elevation view of the contact pile-up assembly; and

FIG. 26 is a bottom plan view of FIG. 25.

The illustrated form of the invention is made up of seven principal units, assemblies or parts, namely a support unit S, a cover or housing H, an electromagnet unit E, an armature unit A, a retainer unit R, a contact pile-up assembly P and a connector C. These items are assembled to obtain the complete relay which is depicted in FIGS. 1, 2 and 3.

Support unit S, which is best shown in FIGS. 5 through 8, is preferably molded from a suitable electric insulating material, such as a phenol formaldehyde resinous composition that is available under the trade-name Bakelite. This unit comprises an oblong base 30, an upstanding partition 31, extending across the base and positioned approximately midway between its ends, and parallel side elements 32 which serve as stiffeners for the partition and define with the base and the partition a compartment for contact pile-up assembly P. Base 30 is provided with a total of twelve slots to one side of the partition and consisting of eight slots 33 and four slots 34. The slots are arranged as shown in FIG. 5, each set of four slots 33 being equi-spaced and aligned in a corresponding row and the four slots 34 being equi-spaced and aligned in a row which is midway between the rows of slots 33. Moreover, each slot 34 is equi-spaced from a corresponding pair of slots 33. A pair of slots 35 is

formed in the base to the other side of the partition. The base is formed with a pair of oppositely disposed integral lugs 36.

An angular ground strip 37 registers in part with a groove in the support unit (FIG. 8). A mounting bolt 38 extends through an opening in the ground strip and an aligned opening in the base. The bolt and ground strip are rigidly affixed to the base by a rivet 39.

Partition 31 is provided with a through opening 40 and a pair of spaced bosses 41 which project to the left of the partition as viewed in FIGS. 5 and 6. The partition is also provided with a pair of spaced recesses 41' which are formed in the side of the partition opposite bosses 41. Bosses 41 and recesses 41' respectively serve to align contact pile-up assembly P and electromagnet unit E, as will be evident from the remainder of this description.

Housing H is preferably made from a suitable, transparent, synthetic plastic material and comprises a tubular side wall 42 which is closed at its upper end, as indicated at 43, and is open at its lower end. The housing is adapted to be placed over support unit S and removably coupled to the base through the medium of lugs 36 which register with slots (not shown) adjacent the lower end of the housing side wall.

Reference is next had to FIGS. 3, 9 and 10 for an understanding of the construction of electromagnet unit E. This unit includes an upstanding bobbin having end flanges 45, an electromagnet coil 46 which is wound around the bobbin, and a core member 47 which extends through the opening defined by the bobbin. Coil 46 has a pair of electric leads 48, each of which is connected, preferably by soldering as indicated at 49, to an electric terminal 50 (FIG. 3). Terminals 50 extend through and below corresponding base slots 35 and are anchored to the base in any desired manner known to the art. These terminals are adapted to be connected to a suitable source of electric energy supply (not shown). The coil is ensheathed in a protective outer wrap 51. The lower end 52 of core member 47 serves as a pole piece.

The electromagnet unit also includes an L-shaped frame or bracket 53 consisting of a vertical side arm 54 and a horizontal top arm 55. Arm 54 has a tapped through opening 56, a pair of spaced integral bosses 57 and a pair of extensions 58 at its lower end. The lower flange of the bobbin projects into a slot 60 in bracket arm 54 and is affixed thereto. The upper end 61 of the core member extends through an opening in horizontal bracket arm 55 and is secured to that bracket arm by swaging, as indicated at 62 in FIG. 9.

Armature unit A, which is best shown in FIGS. 11 and 12, includes a plate type armature 65 having a pair of integral, spaced, parallel, upstanding arms 66. The armature is formed with an integral tongue 67 which is adjacent arms 66 and a pair of openings 68 for reception of bracket extensions 58. A slot 69 is formed in the upper end of each arm 66. A planar actuator plate 70 is carried by the armature arms. This plate is preferably made of Bakelite and is substantially parallel to armature plate 65. Plate 70 is provided with a pair of oppositely extending lateral tongues 71 which register with and are anchored in armature arm slots 69. Plate 70 has a forward edge 72 and is formed with a pair of openings 73 that are defined in part by edges 74.

FIGS. 13, 14 and 15 illustrate details of construction of retainer unit R. This unit is generally L-shaped and is fabricated from a relatively thin sheet of a suitable resilient metal, such as brass. The retainer unit comprises a bottom flange 75 and a side flange 76. Struck from bottom flange 75 is an upwardly and rearwardly projecting resilient finger 77 which terminates in a rounded bearing tip 78. The side flange is cut out to obtain a slot 80, which extends between shoulders 81, a main opening 82 and a plurality of spaced smaller openings 83.

The side flange is further cut out to obtain a pair of bent, parallel arms 84.

Contact pile-up assembly P will now be described having reference to FIGS. 1, 2, 3 and 16 through 26. This assembly includes a total of twelve (12) electrically conductive, relatively stiff, snubber springs which serve as electric terminals and as dampeners for relatively flexible contact arms. The snubber springs consist of eight planar contact members 85 (FIGS. 21 and 22) and four non-planar contact members 86 (FIGS. 19 and 20). Each contact member 85 consists of an upper part 87, a central part 88, having a pair of spaced openings 89, and a lower part 90 which constitutes an electric terminal and which is adapted to register with and project below a corresponding base slot 33.

Each contact member 86 has an upper part 91, which is provided with a pair of openings 92, a bent intermediate part 93 and a lower part 94 which constitutes an electric terminal and which is adapted to register with and project below a corresponding base slot 34.

The pile-up assembly also includes an outer metallic plate 96 (FIGS. 23 and 24), which has a central through opening 97 and a plurality of spaced openings 98, and a plurality of insulating plates 99 (FIGS. 16, 17 and 18), which are also preferably made of Bakelite. Plates 99 are substantially the same in size as plate 96 and each plate 99 has a central through opening 100 and a pair of spaced openings 101 and a pair of recesses or blind openings 102. Each plate 99 also has a pair of integral bosses 102' which are aligned with corresponding recesses 102.

A flexible stationary contact arm 103 is provided for each contact member 85. The lower end of each contact arm 103 is in intimate contact with the central part 88 of its contact member, the upper end of each arm 103 extends above its contact member and is equipped with a contact button 104. A flexible movable contact arm 105 is provided for each contact member 86 and is in intimate contact with its upper part 91. The upper end of each contact arm 105 extends above its contact member and is equipped with a contact button 106.

Contact members 85 and 86, contact arms 103 and 105 and plates 96 and 99 are arranged as shown in FIGS. 3, 25 and 26 and are maintained in assembled relationship by a tubular connector or eyelet 107. With the parts so arranged, openings 97 and 100 of plates 96 and 99, respectively, are aligned and eyelet 107 extends therethrough; bosses 102' of plate 99, which is immediately adjacent plate 96, register with corresponding openings 98 in plate 96; and bosses 102' of succeeding plates 99 register with corresponding recesses 102 in immediately preceding plates 99. These several bosses extend through corresponding openings 89 and 92 in contact members 85 and 86, respectively, and through similar openings (not shown) in contact arms 103 and 105.

When the above-described pile-up elements are assembled and preferably prior to clamping the several plates and contact elements together by turning the ends of eyelet 107, exposed surfaces of contiguous portions of insulating plates 99, contact members 85 and 86 and contact arms 103 and 105 are coated with a bonding material which preferably consists of a suitable thermosetting composition. Experience has indicated that epoxy resin cements and Bakelite may be advantageously used as bonding materials for the purposes of this invention. In any case, the bonding material is applied to the indicated portions of the pile-up assembly in a liquid state with the aid of a suitable applicator, such as a hypodermic type needle. The ends of the eyelet 107 are then riveted over, and the assembly is placed in an oven and subjected to heat treatment at a temperature of about 125° C. for a minimum of two hours. The insulating plates and coating are thereby cured and the bonding material is set and firmly adheres to the indicated

parts. As a consequence of this treatment, the individual elements of the completed pile-up assembly are restrained against relative bodily movement. In other words, the coating of the indicated portions of the several elements with the bonding material prevents relative movement of any of those elements. Experience has demonstrated that omission of the coating of bonding material allowed relative movement of the parts of the pile-up assembly, thereby creating difficulties at the time of assembly and/or use of the relay.

Connector C preferably consists of a screw which is adapted to be inserted through eyelet 107, opening 40 in support unit S and opening 82 in retainer unit R, in the order named, and engage tapped opening 56 of electromagnet unit E.

For the purpose of outlining the operation of the herein described form of the invention, it is first assumed that the relay is assembled and that the parts are in the relative position shown in FIGS. 1, 2 and 3. To this end, contact pile-up assembly P is mounted on support unit S so that its terminals 90 and 94 extend through and below base slots 33 and 34, respectively, the inner end of eyelet 107 bears against the left side of partition 31 (FIG. 3) and the passage defined by the eyelet is aligned with partition opening 40. Also partition bosses 41 register with recesses 102 of the innermost insulating plate 99. Retainer unit R is disposed to the right of partition 31 as viewed in FIG. 3 with its vertical flange bearing against the partition and its bottom flange extending to the right of the partition. Electromagnet unit E is positioned to the right of the partition with its tapped opening 56 aligned with retainer unit opening 82 and partition opening 40. Frame side wall 54 bears against the retainer unit side flange. Frame bosses 57 extend through upper openings 83 of the retainer unit and project into corresponding recesses 41' of the partition.

Armature unit A is positioned as illustrated with armature 65 disposed below pole piece 52 and above bottom flange 75 of the retainer unit. Armature tongue 67 registers with the slot 80 of the retainer unit and is positioned between shoulders 81. Also extensions 58 of frame 53 register with armature openings 68. This forms a pivotal connection and permits rocking movement of the armature unit relative to the electromagnetic unit. Each arm 84 of the retainer unit bears against a corresponding arm 66 of the armature unit and normally and yieldingly imparts clockwise pivotal or rocking movement to the armature unit, as viewed in FIG. 3. It will thus be noted that the retainer unit not only cooperates with other parts to maintain the armature unit in the illustrated relative position but also normally biases the armature unit so as to maintain armature 65 away from pole piece 52. Actuator plate 79 engages the free ends of movable contact arms 105, as shown in FIGS. 1 and 3, and normally permits contact between the buttons of those arms and certain contact buttons of corresponding stationary arms 103.

Contact members 85 and 86 serve the dual functions of snubber springs and connectors. In the latter regard, terminal portions 90 and 94 of the contact members may be plugged into a suitable mating socket unit (not shown). This eliminates the need for conventional soldering connections. Of course, the contact terminals may be soldered to electric leads, if desired.

When terminals 50 are connected to a suitable source of electric energy supply, magnetizing coil 46 is energized and pole piece 52 exerts sufficient attracting force on armature 65 to impart counter-clockwise rocking movement to the armature, as viewed in FIG. 3, against the action of retainer unit arms 84. The pole piece limits counter-clockwise rocking movement of the armature unit. This movement of the armature unit imparts corresponding movement to the actuator plate 70 thereby flexing

movable contact arms 105 to the left. This causes contact buttons 106 to break contact with the buttons of certain of the stationary contact arms and make contact with other contact buttons of the stationary arms. When the magnetizing coil is again deenergized, the parts return to the relative position shown in FIGS. 1, 2 and 3.

From the foregoing, it is believed that the objects, advantages, construction and operation of my present invention will be readily comprehended by persons skilled in the art without further description. Although the invention has been herein shown and described in a simple and practicable form, it is recognized that certain parts thereof are representative of other parts which may be used in substantially the same manner to accomplish substantially the same results. Therefore, it is to be understood that the invention is not to be limited to the exact details described herein, but is to be accorded the full scope and protection of the appended claims.

I claim:

1. In an electromagnetic device, a support unit comprising a base and an upstanding partition carried by and positioned intermediate the ends of the base, the part of the base to one side of the partition being provided with a plurality of spaced slots; an electromagnet unit mounted on the support unit to the other side of the partition and comprising a frame, an electromagnet coil secured to the frame, a core member extending through the coil and a pole piece at one end of the core member; an armature unit mounted for rocking movement relative to the electromagnet unit and comprising an armature disposed to said other side of the partition and cooperatively associated with the pole piece and actuator means carried by the armature; a retainer unit disposed to said other side of the partition and including a resilient arm which bears against the armature unit; a contact assembly disposed to said one side of the partition and comprising a plurality of spaced contact members extending through corresponding slots in the base, electrically non-conductive means insulating the contact members from each other, a plurality of resilient stationary contact arms in intimate contact with corresponding contact members and at least one movable contact arm in intimate contact with one of the contact members; and connector means affixing the electromagnet unit, the retainer unit and the contact assembly to the support unit, said connector means extending through openings defined by the contact assembly, the partition, the retainer unit and the armature unit and being secured to the frame of the electromagnet unit, the above-mentioned parts being so constructed and arranged that the arm of the retainer unit normally and yieldingly imparts rocking movement to the armature unit in one direction relative to the electromagnet unit whereby the armature is positioned away from the pole piece and the actuator means is disposed in a predetermined position relative to the movable contact arm, said armature unit, upon energization of the coil, being rocked in a reverse direction against the action of the arm of the retainer unit due to the armature being attracted to the pole piece whereby the actuator means engages and moves the movable contact arm relative to a corresponding stationary contact arm.

2. In an electromagnetic device, a support unit comprising a base and an upstanding partition carried by and positioned intermediate the ends of the base, the part of the base to one side of the partition being provided with a plurality of spaced slots; an electromagnet unit mounted on the support unit to the other side of the partition and comprising a frame, an electromagnet coil secured to the frame, a core member extending through the coil and a pole piece at one end of the core member; an armature unit mounted for rocking movement relative to the electromagnet unit and comprising an armature cooperatively associated with the pole piece, a pair of substantially parallel spaced arms integral with the armature and extending generally upwardly there-

from and actuator means secured to the upper ends of the arms; a retainer unit including a resilient arm which bears against the armature unit; a contact assembly disposed to said one side of the partition and comprising a plurality of spaced contact members extending through corresponding slots in the base, electrically non-conductive means insulating the contact members from each other, a plurality of resilient stationary contact arms in intimate contact with corresponding contact members and at least one movable contact arm in intimate contact with one of the contact members; and connector means affixing the electromagnet unit, the retainer unit and the contact assembly to the support unit, the above-mentioned parts being so constructed and arranged that the arm of the retainer unit normally and yieldingly imparts rocking movement to the armature unit in one direction relative to the electromagnet unit whereby the armature is positioned away from the pole piece and the actuator means is disposed in a predetermined position relative to the movable contact arm, said armature unit, upon energization of the coil, being rocked in a reverse direction against the action of the arm of the retainer unit due to the armature being attracted to the pole piece whereby the actuator means engages and moves the movable contact arm relative to a corresponding stationary contact arm.

3. An electromagnetic device according to claim 2 wherein the armature comprises a plate of a magnetic material and the actuator means comprises a plate of an electric insulating material, said plates being substantially parallel and projecting to opposite sides of the arms of the armature unit.

4. An electromagnetic device according to claim 2 wherein the retainer unit is generally L-shaped and includes a bottom flange, a side flange and a pair of spaced, resilient arms carried by the side flange, the parts being so constructed and arranged that the bottom flange underlies the armature, the side flange is positioned adjacent the arms of the armature, and each resilient arm bears against a corresponding arm of the armature unit and normally imparts rocking movement to the armature in one direction relative to the electromagnet unit.

5. In an electromagnetic device, a support unit; an electromagnet unit mounted on the support unit and comprising a frame, an electromagnet coil secured to the frame, a core member extending through the coil and a pole piece at one end of the core member; an armature unit mounted for rocking movement relative to the electromagnet unit and comprising an armature cooperatively associated with the pole piece, a pair of substantially parallel, spaced arms integral with the armature and extending generally upwardly therefrom and actuator means secured to the upper ends of said arms; a generally L-shaped retainer unit comprising a bottom flange which underlies the armature, a side flange which is positioned adjacent the arms of the armature, a pair of spaced resilient arms carried by the side flange, each of the resilient arms bearing against a corresponding arm of the armature; and a resilient finger which bears against the under surface of the armature; a contact assembly comprising a plurality of spaced contact members, electrically non-conductive means

insulating the contact members from each other, a plurality of resilient stationary contact arms in intimate contact with corresponding contact members and at least one movable contact arm in intimate contact with one of the contact members; and connector means affixing the electromagnet unit, the retainer unit and the contact assembly to the support unit, the above-mentioned parts being so constructed and arranged that the arms of the retainer unit normally and yieldingly impart rocking movement to the armature unit in one direction relative to the electromagnet unit whereby the armature is positioned away from the pole piece and the actuator means is disposed in a predetermined position relative to the movable contact arm, said armature unit, upon energization of the coil, being rocked in a reverse direction against the action of the arms of the retainer unit due to the armature being attracted to the pole piece whereby the actuator means engages and moves the movable contact arm relative to a corresponding stationary contact arm.

6. An electromagnetic device according to claim 5 wherein the non-conductive means of the contact assembly comprises a plurality of insulating plates, the insulating plates, contact members, stationary contact arms and movable contact arm being arranged in a unitary pile-up in which the contact members are supported in spaced relation to each other and in which the stationary contact arms and the movable contact arm are held in intimate contact with the designated contact members, exposed surfaces of contiguous portions of the insulating plates, contact members, stationary contact arms and movable contact arm being provided with coatings of a bonding material to prevent relative bodily movement of any of the herein referred-to parts.

7. An electromagnetic device according to claim 6 wherein the bonding material comprises a thermosetting composition.

8. An electromagnetic device according to claim 6 wherein the contact assembly includes a tubular connector which extends through aligned openings formed in the insulating plates.

9. An electromagnetic device according to claim 6 wherein the contact assembly includes a tubular connector which extends through aligned openings formed in the insulating plates and wherein the bonding material comprises a thermosetting composition.

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