

June 12, 1962

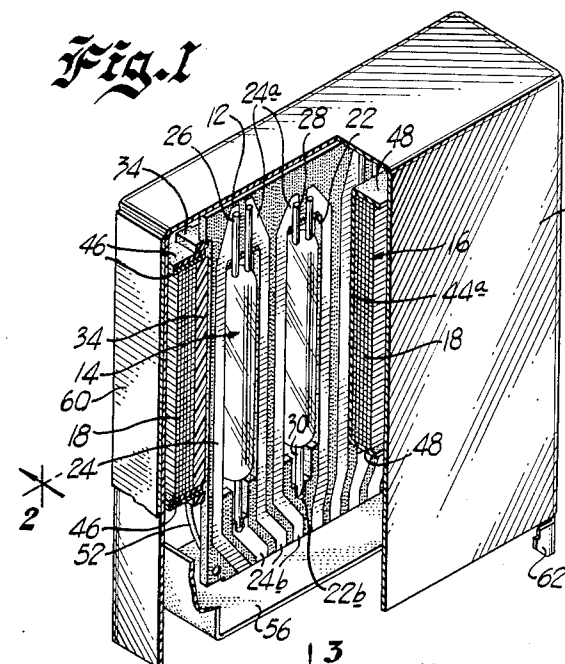
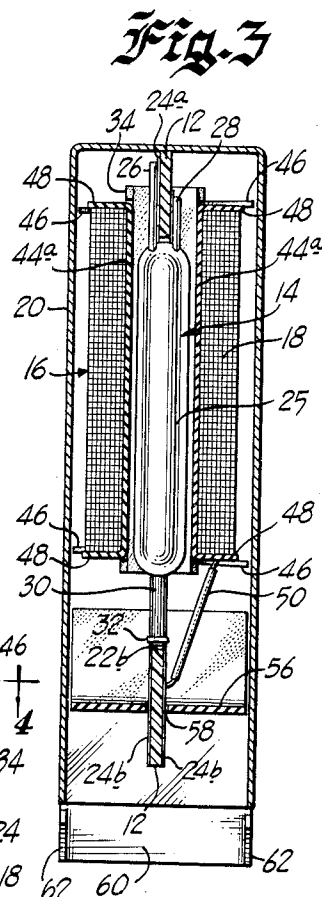
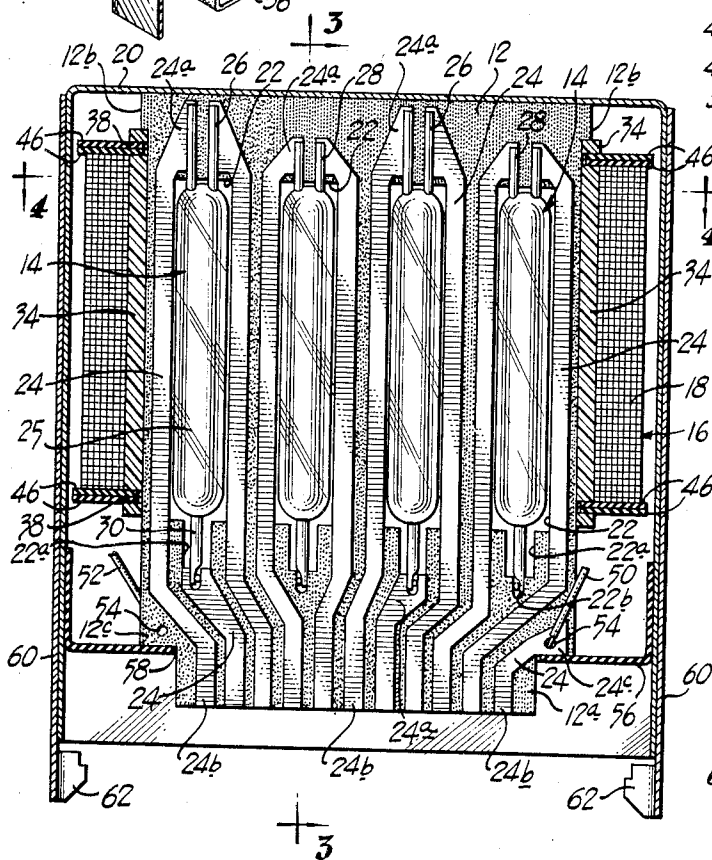
A. J. KODA

3,038,976

RELAY CONSTRUCTION

Filed April 28, 1958

2 Sheets-Sheet 1



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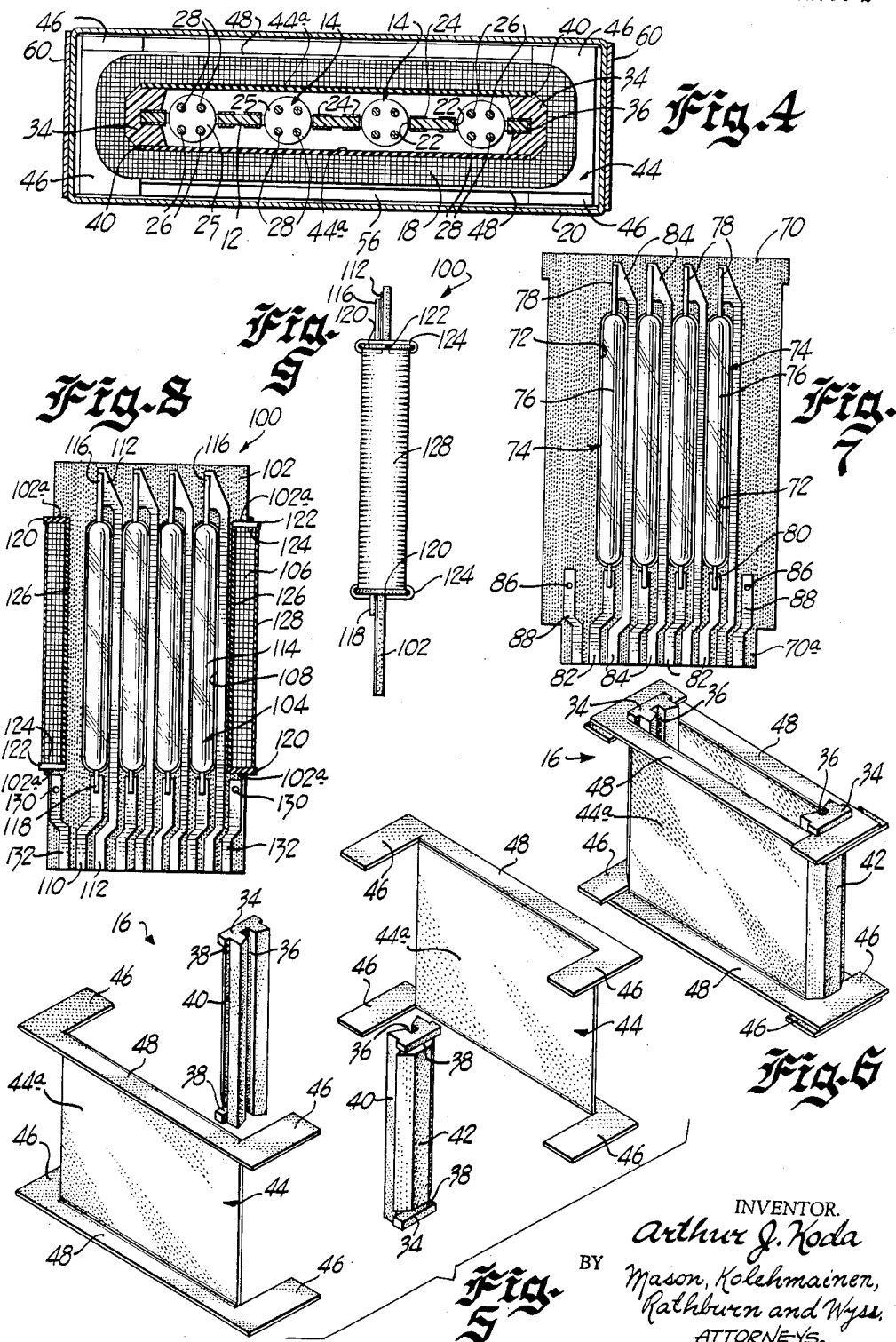
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2 Sheets-Sheet 2



INVENTOR.
Arthur J. Koda
 BY *Mason, Kolehmainen,
 Rathbun and Wyss,*
 ATTORNEYS.

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3,038,976

RELAY CONSTRUCTION

Arthur J. Koda, Morton Grove, Ill., assignor to C. P. Clare & Company, Chicago, Ill., a corporation of Delaware

Filed Apr. 28, 1958, Ser. No. 731,390

21 Claims. (Cl. 200-87)

This invention relates to a switch construction and, more particularly, to a relay including a plurality of sealed switch units.

Because of the desirable operating characteristics of individual sealed switch units, such as mercury contact switches or dry reed switches, various devices have been proposed for using a plurality of these sealed units to provide a switch having a switching capacity approximating that of conventional multiple contact electromagnetic relays. In some of the prior devices, a plurality of sealed units are enclosed within a single operating coil so that all of the units are concurrently operated by the energization of the coil. However, many of these prior devices are costly to fabricate because of the variety of separate parts used and the number of assembly operations required. This is particularly true of the parts and operations required for making connections to the plurality of individual switch units and for properly positioning the sealed units within the common operating winding.

Accordingly, one object of the present invention is to provide a new and improved switching assembly.

Another object is to provide a switch construction using a plurality of separate sealed switch units.

A further object is to provide new and improved means for supporting and making electrical connections to a plurality of sealed switch units.

A further object is to provide a relay construction having a printed circuit panel to which a switch unit is physically and electrically connected and on which an operating coil is mounted.

Another object is to provide a switch assembly having an apertured printed circuit panel to which a plurality of sealed switch units are electrically and physically connected and on which a common operating winding is disposed.

A further object is to provide a method of assembling a plural unit switch.

A further object is to provide a new and improved coil bobbin construction.

Another object is to provide a plural unit switch assembly in which a plurality of sealed switch units are physically and electrically connected to a printed circuit board by dip soldering operations.

In accordance with these and many other objects, one embodiment of the invention comprises a dielectric panel having a plurality of spaced apertures. A printed circuit pattern is formed on one or both sides of the panel to include portions extending from adjacent the ends of the openings to a projecting edge portion of the panel. A plurality of shealed switch units having projecting terminal pins are disposed in the openings with the terminal pins positioned immediately adjacent portions of the conductive pattern. One end of the panel is then dipped in solder to physically support the sealed switch units on the panel and to electrically interconnect the terminal pins with the printed circuit pattern.

To provide means for operating a plurality of sealed

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switch units, a coil and bobbin assembly is provided comprising a pair of bobbin frame elements each including a longitudinally extending slot and a pair of transversely extending grooves. A pair of bobbin cards with flanged or projecting ends are mounted on the two spaced frame elements with the flanged ends disposed in an overlapping relationship within the grooves, thereby to provide a bobbin assembly. An operating winding is wound on the bobbin assembly in the area between the flanged end portions. The printed circuit panel containing the assembled sealed switch units is then inserted into the slots formed on the bobbin frame elements so that the switch units are disposed within the axially extending opening defined by the coil and bobbin assembly. The leads to the operating winding are disposed adjacent to segments of the conductive printed circuit pattern and the other end of the panel is dipped in solder to physically and electrically secure the remaining terminal pins of the switch units to the printed circuit. This soldering operation also connects the input leads for the operating winding to the printed circuit.

The assembled printed circuit panel and coil and bobbin are then disposed within a housing with the projecting edge of the panel extending downwardly through an aperture provided in a base plate which secures the relay construction within the housing. This projecting edge to which the ends of the conductive segments forming the printed circuit pattern extend provides a male connector for insertion into a female connector to provide a means for electrically interconnecting the switch units and the operating winding therefor with external circuits. The housing may be provided with latching means for securing the relay construction to a supporting frame or chassis.

In a second embodiment of the invention, a dielectric panel is provided having a plurality of transversely spaced openings and a pair of notched or recessed edges. One or more of the surfaces of the dielectric panel are provided with a printed circuit pattern comprising conductive segments including end portions disposed adjacent the openings and opposite end portions extending to one edge of the panel. Sealed switch units are disposed in the openings with their terminal pins extending over the adjacent portions of the conductive pattern, and one end of the panel is then dipped in solder to electrically and physically interconnect one group of terminal pins with the conductive pattern.

To provide an operating winding for the switch assembly, a pair of slotted bobbin end plates are placed on the printed circuit panel in engagement with the shoulders defined by the recessed edges. The slotted ends of the bobbin plates are then joined, preferably by stapling. A web of dielectric material is wound around the sealed switch units and the printed circuit panel at a position between the bobbin end plates, and the operating winding is then wound around the recessed portion of the panel to overlie the insulating web and the switch units. The leads to the operating winding are attached to two conductive segments forming a portion of the printed circuit pattern, and the other end of the panel is dipped in solder to complete the electrical interconnection of the switch units and the operating coil with the printed circuit pattern. This also physically supports the other end of the sealed switch units on the dielectric panel. This assembly can then be inserted in a housing, if desired,

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with the lower end of the panel to which the ends of the conductive segments extend providing a male connector for electrically and physically interconnecting the switch assembly with external circuits.

Many other objects and advantages of the present invention will be apparent from a consideration of the following detailed description when considered in conjunction with the following drawings wherein:

FIG. 1 is a perspective view in partial section illustrating a relay construction embodying the present invention;

FIG. 2 is an enlarged sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 in FIG. 2 assuming that the entire relay structure is shown therein;

FIG. 4 is a sectional view taken along line 4—4 in FIG. 2 again assuming that the entire relay construction is illustrated therein;

FIG. 5 is an exploded view of a coil bobbin assembly forming a part of the relay structure of the present invention;

FIG. 6 is a perspective view of the assembled coil bobbin construction;

FIG. 7 is a plan view of another printed circuit and switch unit assembly used in the relay construction shown in FIG. 1;

FIG. 8 is a plan view in partial section of an embodiment of the present invention in which the operating coil is wound directly on the printed circuit panel; and

FIG. 9 is a side elevational view of the relay shown in FIG. 8.

Referring now more specifically to FIGS. 1—6 of the drawings, a relay construction, indicated generally as 10, which embodies the present invention comprises a dielectric panel 12 on which a plurality of sealed switch units 14 are mounted. The switch units 14 are connected to a conductive printed circuit pattern carried on one or both sides of the dielectric panel 12, preferably by a dip soldering operation, so that the panel 12 not only physically supports the switch units 14 in predetermined positions but also provides means for easily extending electrical connections thereto. To provide a means for selectively operating the individual switch units 14, the panel 12 is disposed within a new and improved bobbin assembly 16 (FIGS. 5 and 6) on which an operating coil 18 is wound. The bobbin assembly 16 is slidably mounted on the printed circuit panel 12 so that this panel not only supports the individual switch units 14 but also the bobbin assembly 16 and the operating winding 18. The assembled switch units and operating winding are enclosed within a housing 20 with a lower edge portion 12a of the panel 12 extending outwardly to provide a male connector which can be inserted into a female connector to provide detachable means for electrically interconnecting the operating winding 18 and the switch units 14 with external circuits.

Referring now more specifically to the panel 12, this panel or base piece preferably is formed of a suitable dielectric material, such as a phenolic impregnated fiber or paper. To provide means for receiving the plurality of switch units 14, the plate 12 is provided with a plurality of transversely spaced and longitudinally extending openings 22, the lower end of each of which is provided with a pair of smaller width openings 22a and 22b. To provide a printed circuit pattern for extending electrical connections to the switch units 14, one or both of the surfaces of the dielectric panel 12 are provided with electrically conductive metallic segments 24, preferably formed of copper foil, which are bonded to the panel 12. The provision of the segments or layers 24 on one or both of the sides of the panel 12 is largely determined by the number of connections that must be made to the units 14 and by the spacing required between the segments 24. Each of the conductive segments 24 includes an enlarged end portion 24a which is disposed adjacent an end of the opening 22 and another end portion 24b which is located on the projecting edge portion 12a of the panel 12. The intermediate por-

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tions of the conductive segments 24 extend between the transversely spaced openings 22 in the panel 12. As illustrated in FIG. 2, the enlarged end portions 24a disposed adjacent the ends of the openings 22 may be any suitable configuration in accordance with the position and shape of the connecting means provided on the individual switch units 14. In the relay construction shown in FIGS. 1 and 2, the opposite side of the panel 12 is provided with a printed circuit pattern of conductive segments 24 that is identical to that shown in FIG. 2.

Although a variety of methods well known in the art can be used to provide the printed circuit pattern on the panel 12, the pattern preferably is provided by stamping or otherwise forming the openings 22, 22a and 22b in a panel 12 to the front and back surfaces of which a layer of metallic foil, such as copper, previously has been bonded. Following the formation of these openings, a resist pattern is applied to both foil surfaces corresponding to the areas at which the conductive segments 24 are desired. The panel 12 is then subjected to an etching process of any suitable type so that the copper foil other than in the areas defined by the resist pattern is removed to provide a conductive pattern of the configuration shown in FIGS. 1 and 2. However, it should be understood that the conductive segments 24 can be applied to the panel 12 by a suitable embossing operation in which the segments are concurrently severed from a sheet of foil and applied to the surfaces of the panel 12. Further, this panel could be molded with the openings 22, 22a and 22b prior to the application of the metallic foil and the subsequent selective removal thereof to form the conductive segments 24.

Referring now to the sealed switch units 14, these units can be one of the well known constructions, such as the mercury contact switch shown in Burton Patent No. 2,577,602 or the "dry reed" relay shown in Ellwood Patent No. 2,289,830, or can be of the pivoted armature type shown in the copending application of Wilhelm Juptner, Serial No. 678,236, filed August 14, 1957, which pending application is assigned to the same assignee as this application. These switch units generally comprise a sealed dielectric or glass envelope 25 containing one or more switching components which are actuated by the application of a magnetic field. The actuation of the switching components selectively completes or interrupts conductive circuits between a plurality of terminals that are carried on and extend through the dielectric envelope 25. In the switching unit 14 illustrated in the drawings, the upper end of the envelope 25 is provided with a pair of electrically conductive terminal pins 26 and a shorter pair of electrically conductive terminal pins 28. The other end of the envelope 25 is provided with an armature header tube or terminal pin 30. The selective operation of the switching unit 14 selectively extends a common connection from the terminal pin 30 to one or the other of the pairs of terminal pins 26 and 28.

When the individual switch units 14 are to be mounted on the dielectric panel 12, each of these units is disposed within one of the transversely spaced openings 22 with the terminal pins 26 and 28 disposed on opposite sides of the panel 12 and in contact with the enlarged end portions 24a of the conductive segments 24. As illustrated in FIG. 2, the longer terminal pins 26 on the switching unit 14 shown to the left are located on the front side of the panel 12 with the shorter terminals 28 disposed at the back of this panel, while the shorter terminal pins 28 on the switching unit 14 that is second from the left are positioned on the front side of the panel 12 with the longer terminal pins 26 located at the back of this panel. The interposition of the panel 12 and the enlarged portions 24a of the conductive segments 24 between the pairs of pins 26 and 28 serves to locate the switch units 14 in properly aligned vertical positions within the openings 22 so that the units 14 are centered with respect to the plane of the panel 12. The header tube or terminal pin 30 at the other end of the envelope 25 is positioned within the opening 22a so that

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the lower end of this terminal pin, which preferably is closed by a cross weld piece 32, is pressed within the smaller opening 22b. The engagement of the lower end of the terminal pin 30 with the sides of the opening 22b aids in locating the switch units 14 in a proper position within the opening 22 until such time as the switching units are secured to the panel 12.

In order to positively secure the individual switch units 14 in proper positions on the panel 12 within the openings 22, the upper end of the printed circuit card 12 preferably is dipped in a molten solder bath so that solder bonds the terminal pins 26 and 28 to the enlarged end portions 24a of the conductive segments 24. This interconnection not only physically secures the units 14 in predetermined positions on the panel 12 but also provides electrical connections between the switch units 14 and the printed circuit pattern provided on the panel 12. If desired, the dip soldering operation can be facilitated by tinning the terminal pins 26, 28 and 30 prior to placing the switch units 14 on the panel 12.

The coil bobbin assembly 16 on which the operating coil 18 is wound comprises a plurality of separate parts so that bobbin assemblies 16 of various sizes can be provided without requiring the maintenance of a stock of bobbin assemblies of each of the desired sizes. More specifically, the bobbin assembly 16 (FIGS. 5 and 6) includes a pair of identical dielectric bobbin frame elements 34 each of which includes a longitudinally extending slot 36 for slidably receiving the edges of the panel 12 and a pair of transversely extending and longitudinally spaced grooves 38. Two sides of the frame element 34 are provided with shouldered or recessed portions 40 which are joined by a generally rounded or trapezoidal end portion 42. The rounded or trapezoidal end surfaces 42 facilitate the winding of the coil 18 on the bobbin assembly 16 by removing sharp corners that may affect the inner convolutions of the coil 18.

The bobbin assembly 16 also includes a pair of identical dielectric bobbin cards 44 comprising a wall portion 44a having a pair of spaced and offset or flanged end portions. Each of the offset end portions, which is somewhat U-shaped in configuration, comprises a pair of inwardly extending legs 46 joined by a bight or web portion 48. When the coil bobbin 16 is to be assembled, the free ends of the legs 46 on both of the cards 44 are inserted into the grooves 38 and the two cards 44 are moved inwardly toward the bobbin frame elements 34 until such time as the ends of the wall portions 44a are disposed in the recessed or shouldered portions 40. In this position, the legs 46 overlie each other, and as illustrated in FIG. 6, are oppositely positioned or staggered within the grooves 38 at the opposite ends of the bobbin assembly 16. When the coil bobbin 16 is assembled as shown in FIG. 6, the engagement of the ends of the wall portions 44a and the recessed portions 40 prevents the bobbin frame elements 34 from moving inwardly toward each other and thus maintains a uniform spacing between these two elements. Similarly, the engagement of the inner edges of the legs 46 with the bottom walls of the grooves 38 prevents the bobbin frame elements 34 from moving outwardly away from each other. The web portions 48 and the legs 46 provide two spaced outer flanges between which the coil 18 is wound. The coil 18 biases the ends of the wall portions 44a into engagement with the recessed or shouldered portions 40 to hold the components of the bobbin assembly 16 in the proper relationship.

Further, the construction of the bobbin assembly 16 is such that assemblies having axial openings of various sizes for receiving printed circuit panels with different numbers of switching units 14 can easily be provided by the use of the identical bobbin frame elements 34 and of various sizes of bobbin cards 44. More specifically, when the width of the axial opening in the bobbin assembly 16 is to be varied for use with printed circuit panels 12 of varying widths and containing varying numbers of

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switch units 14, the only additional parts that are required is the provision of bobbin cards 44 in which the wall portions 44a are of different lengths. Since these cards are usually formed from fiber or paper stock, bobbin cards 44 having wall portions 44a of varying lengths easily can be provided by conventional stock scoring and severing dies.

When the coil bobbin 16 and the winding 18 are to be assembled on the printed circuit card 12, the lower end of this card is inserted into the opposed slots 36 and the card or panel 12 is advanced through the axial opening defined by the assembly 16 until the individual switch units 14 are disposed within the operating winding 18. This position is accurately determined by a pair of shouldered portions 12b formed on the upper end of the panel 12 which engages the upper edge of both of the bobbin frame elements 34. This sliding interconnection of the coil bobbin assembly and the printed circuit panel 12 permits this panel to be easily removed to facilitate the replacement of a defective switch unit 14. The operating coil 18 is provided with a pair of input leads 50 and 52 (FIGS. 1 and 2). The free ends of these leads are inserted in a pair of openings 54 in the panel 12. Each of the openings 54 is disposed within an enlarged portion 24c formed in a pair of the conductive segments 24.

When leads 50 and 52 and the terminal pins or headers 30 are to be secured to the panel 12 and to the conductive segments 24 thereon, the lower end of the panel 12 is dipped in a molten solder bath. The molten solder physically and electrically connects the lower ends of the terminal pins 30 to the enlarged portions 24a of the conductive segments 24 on the opposite sides of the panel 12. Further, the solder physically and electrically connects the free ends of the input leads 50 and 52 to the enlarged portions 24c formed in two of the conductive segments 24. This completes the assembly of the switching and operating components of the relay construction 10.

The assembled switch is then inserted into the open end of the housing 20 and advanced until the upper end of the card 12 bears against the top wall of the housing. A substantially U-shaped lower cover 56 (FIGS. 1-3) formed of insulating material is then inserted into the open end of the housing 20 and advanced so that the projecting lower edge portion 12a of the panel 12 extends outwardly through an opening 58 formed in the bight portion of the U-shaped element 56. The element 56 is advanced into the lower end of the housing until the upper surface thereof bears against a pair of shouldered portions 12c formed in the panel 12. This rigidly secures the switch assembly in a predetermined position within the housing 20 with the edge portion 12a extending outwardly from the enclosed area. Since each of the conductive segments 24 includes an end portion 24b on the edge portion 12a, this provides a male connector element which can be inserted into a suitable female connector element containing wipers for slidably engaging the end portions 24b, thereby to provide a detachable connector for the switch assembly 10. If desirable, the cover 56 can be formed of metal and an insulating grommet can be positioned in the opening 58 to insulate the segments 24 from the housing 20. Further, the interior of the housing 20 can be filled with a dielectric substance, such as wax.

In order to provide means for detachably securing the housing 20 on a supporting frame or chassis, the end walls of the housing 20 are provided with a pair of flexible latching plates 60. These plates are secured at their upper extremities to the side walls of the housing 20 so that they can be deflected outwardly at their lower ends. The lower ends of the latching elements or end plates 60 are provided with a pair of inwardly extending latch portions 62 which are adapted to move into interlocking engagement with suitable detent means carried

on the chassis, thereby to detachably mount the relay construction 10.

In applications in which only a relatively small number of connections must be extended to the switching units, it is necessary to provide a printed circuit pattern on only one side of the dielectric panel. In FIG. 7, for instance, there is disclosed a dielectric panel 70 having a plurality of transversely spaced openings 72 in each of which is disposed a sealed switch unit 74. The switch unit 74 may comprise, for example, a "dry reed" relay of the type shown in the above identified Ellwood patent and includes a dielectric envelope 76 having a pair of terminals 78 and 80 projecting from opposite ends thereof. Accordingly, the dielectric panel 70 is provided with a plurality of alternate long and short conductive segments 82 and 84 which extend from positions adjacent opposite ends of the openings 72 to a projecting edge portion 70a formed on the panel 70.

When the switch construction is assembled, a sealed switch unit 74 is disposed in each of the openings 72 with the terminal pins 78 and 80 in engagement with the conductive segments 82 and 84, respectively. Thereafter, the upper end of the panel 70 is dipped in a molten solder bath to physically and electrically connect the terminal pins 78 to the upper ends of the conductive segments 84. Following the insertion of the panel 70 into the bobbin assembly 16 and operating coil 18, the input leads 50 and 52 to the winding 18 are inserted into a pair of openings 86 which pass through the panel 70 and a pair of conductive segments 88. The lower end of the panel 70 is then dipped in the molten solder bath to secure the terminals 80 to the conductive segments 82 and to secure the leads 50 and 52 to the conductive segments 88. The panel 70 together with the bobbin and operating winding carried thereon can then be assembled in the manner described in detail above.

In the embodiment of the invention shown in FIGURES 8 and 9 of the drawings, a relay construction 100 is provided having a dielectric printed circuit panel 102 which carries a plurality of sealed switch units 104 and on which an operating winding 106 is directly wound. Thus, the switch construction 100 can be of somewhat smaller physical size and is particularly useful when the sealed switch units 104 do not require pressurized envelopes.

The dielectric panel 102 is provided with a plurality of transversely spaced, elongated openings 108 to the opposite ends of which extend alternate long and short metal segments 110 and 112 to provide a conductive pattern for extending electrical connections to the sealed switch units 104. These units, which preferably are of the type disclosed in the above identified Ellwood patent, comprise a sealed glass or dielectric envelope 114 having a pair of terminal pins 116 and 118 extending from the opposite ends thereof. The units 104 are disposed in the openings 108 with the pins 116 engaging the conductive segments 112 and with the pins 118 engaging the conductive segments 110. The upper end of the panel 102 is then dipped in solder to electrically and physically connect the terminals pins 116 to the conductive segments 112.

To provide means for operating the switch units 104, the operating winding 106 is wound directly on the dielectric panel 102. A bobbin arrangement for receiving the coil 106 is formed by notching or recessing the edges of the panel 102 to form two pairs of spaced shouldered portions 102a. A pair of insulating bobbin end elements 120 each include a centrally disposed slot 122 in which the panel 102 is disposed with the outer surfaces of the elements 120 engaging the shouldered portions 102a. The slotted ends of the elements 120 are joined by suitable securing means, such as a staple 124. A layer of insulating material 126 is then wrapped around the panel 102 and the switch units 104 in the recessed area between the bobbin end elements 120. The

operating coil 106 is wound on the layer of insulating material 126 and, if desired, a second insulating layer 128 is wrapped around the outer convolutions of the coil 106.

To provide means for electrically connecting the operating coil 106 to the printed circuit pattern on the panel 102, the ends of the leads (not shown) to the coil 106 are positioned in a pair of openings 130 which pass through the panel 102 and a pair of conductive segments 132. To complete the electrical connections to the coil 106 and the switch units 104, the other or lower end of the panel 102 is dipped in a molten solder bath so that the terminal pins 118 are electrically and physically connected to the conductive segments 110. This operation also connects the leads from the coil 106 to the conductive segments 132.

The relay construction 100 can be used in this form or can be inserted into a housing similar to the housing 20 provided in the relay construction 10. Further, as in the relay 10, the lower end of the panel 102 to which the ends of all of the conductive segments 110, 112, and 132 extend provides a male connector element for extending electrical connections from external circuits to the switch units 104 and to the operating winding 106.

In summary, the switching constructions of the present invention include an apertured printed circuit panel on which a plurality of individual sealed switch units are physically mounted and to which the terminals of these units are electrically connected by a solder dipping operation which reduces the cost of and time required for fabricating the units. Further, the apertured printed circuit panels used in the relays are capable of being easily produced in large quantities to reduce the cost of making switching constructions. By the provision of the new and improved bobbin assemblies, coil bobbins of various sizes can be provided with a minimum of effort and without requiring the maintenance of an unduly large inventory of various sizes of coil bobbins.

Although the principles of the present invention have been described with reference to various embodiments thereof, it should be understood that many other modifications can be devised by those skilled in the art which will fall within the spirit and scope of these principles.

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

1. A relay construction comprising an operating winding having an axially extending opening; a uniplanar dielectric panel having an aperture and an electrically conductive layer disposed adjacent said aperture, said panel being disposed in and extending generally along the axis of said opening; and a sealed switch unit disposed in said aperture and having terminal means secured to said conductive layer to physically and electrically interconnect said switching unit with said panel.

2. A relay construction comprising a uniplanar dielectric panel having spaced conductive portions thereon, said panel defining a plurality of spaced openings; a plurality of switch units disposed in said openings to lie generally within the plane of said panel and connected to said conductive portions; operating coil means having an axial opening; and means including cooperating structures on said panel and said coil means for slidably mounting said panel within said axial opening.

3. A relay construction comprising a uniplanar dielectric panel having a printed circuit pattern on at least one side thereof, said panel defining a plurality of spaced openings; a plurality of sealed switch units disposed in said openings to lie generally within the plane of said panel and having terminal pins connected to said printed circuit pattern; an operating coil surrounding said panel and said switch units; and a coil bobbin supporting said coil and mounted on said panel.

4. A relay construction comprising a dielectric panel having a projecting edge portion and a plurality of openings, said panel having a conductive printed circuit pattern on at least one side which extends from positions adjacent

said openings to said projecting edge portion; a plurality of sealed switch units disposed in said openings and having terminal pins connected to said printed circuit pattern, operating coil means surrounding said switch units and mounted on said panel; and a housing for receiving said panel and said operating coil means and including an aperture through which said projecting edge extends to provide an external electrical connector for said switch units.

5. The relay construction set forth in claim 4 including leads extending to said operating coil means and means for connecting said leads to said printed circuit pattern so that said projecting edge portion provides an electrical connector for said coil.

6. A relay construction comprising a generally uniplanar dielectric panel having an opening, a pair of conductive metal layers secured to said panel and including portions disposed adjacent said opening, a sealed switch unit disposed in said opening and including a pair of terminals connected to said pair of layers, and an operating coil wound around said panel and at least partially surrounding said switch unit.

7. A relay construction comprising a dielectric panel having a pair of recessed edges, a conductive circuit pattern carried on said panel, a plurality of switch units carried on said panel and connected to said pattern, a pair of spaced bobbin elements disposed in said recessed edges, and an operating coil carried on said panel and disposed between said bobbin elements to encircle said switch units.

8. A relay construction comprising a panel having a plurality of spaced elongated openings and a pair of opposite recessed edges, a conductive circuit pattern carried on said panel and including a plurality of segments extending to position adjacent spaced portions of said openings, a plurality of sealed switch units disposed in said openings and including terminals physically and electrically connected to said segments, a pair of spaced bobbin elements carried on said panel in said recessed edges, and an operating coil wound on said panel between said bobbin elements and within said recessed edges, said operating coil at least partially enclosing said switch units.

9. The relay construction set forth in claim 8 in which said bobbin elements each include a slot in which the panel is disposed, and in which means are provided for joining the slotted ends of the bobbin elements to secure said elements in predetermined positions on said panel.

10. A relay construction comprising a dielectric panel having at least one opening, a printed circuit pattern on said panel including a portion disposed adjacent said opening, a sealed switch unit disposed in said opening and including a terminal pin positioned adjacent and secured to said portion of said printed circuit pattern, a coil bobbin defining a pair of opposed grooves, and an operating winding on said bobbin, said panel being slidably mounted in said grooves with said sealed switch unit disposed within said winding.

11. A relay construction comprising a pair of spaced bobbin frame elements each defining a pair of spaced grooves and a slot, a pair of spaced bobbin cards each having two pairs of projecting members, the projecting members on both of said pair of cards being disposed in the grooves of said frame elements to provide a bobbin assembly, a winding disposed on said bobbin assembly, a dielectric panel slidably mounted in the slots in said pair of frame elements, and a switch unit carried on said panel and disposed within said winding.

12. A relay construction comprising a pair of spaced bobbin frame elements each defining a pair of spaced grooves and a slot extending transverse to said grooves, a pair of bobbin cards each comprising a wall portion and two flanged end portions, the flanged end portions on both of said pairs of cards being disposed in said grooves on said elements with the wall portion extending between said elements so that said elements and cards form a bobbin assembly, a winding disposed on said bobbin as-

sembly, a dielectric panel slidably mounted in said slots and carrying a printed circuit pattern, and a switch unit disposed on said panel and connected to said printed circuit pattern.

13. A coil construction comprising a pair of spaced bobbin frame elements each defining a pair of spaced and parallel grooves and a pair of shouldered portions, a pair of bobbin cards each comprising a wall portion having spaced transversely extending end portions, said pair of cards being mounted on said elements with the ends of said wall portions engaging said shouldered portions and with said transversely extending end portions disposed in said grooves, and a winding disposed on said wall portions between said transversely extending end portions.

14. The coil construction set forth in claim 13 in which said transversely extending end portions on the two cards are positioned in a side by side relationship in said grooves.

15. A relay construction comprising a dielectric panel having an elongated opening therein, a first electrically conductive layer secured to said panel and extending to a position adjacent one end of said opening, a second electrically conductive layer secured to said panel and extending to a position adjacent the opposite end of said opening, a sealed and elongated switch unit having a pair of electrically conductive elements projecting from one end of said unit and at least one electrically conductive element extending from the opposite end of said unit, said unit being positioned in said opening with said pair of elements embracing said panel so that one of said pair of elements is disposed adjacent said first layer, said one element being disposed adjacent said second layer, and means securing the adjacent elements to said first and second layers to connect said unit to said panel.

16. The relay construction set forth in claim 15 in which said panel includes an edge portion and in which each of said layers extends to said edge portion to provide an electrical connector for said relay construction.

17. A relay construction comprising a dielectric panel defining a plurality of spaced openings, a first plurality of electrically conductive layers secured to said panel and extending to positions adjacent one end of said openings, a second plurality of electrically conductive layers secured to said panel and extending to positions adjacent the other end of said openings, a plurality of sealed switch units each having a pair of outwardly extending terminal pins at one end and at least one outwardly extending terminal pin at its other end, said switch units being disposed in said openings by sliding portions of said panels between said pairs of terminal pins so that one pin in each of the pairs thereof is disposed adjacent one of said first plurality of electrically conductive layers and so that said one terminal pins are disposed adjacent said second plurality of layers, and means securing said terminal pins to said layers.

18. The relay construction set forth in claim 17 in which successive ones of said second plurality of layers are disposed on opposite sides of said panel and interposed between successive ones of said first layers.

19. The relay construction set forth in claim 17 in which a third plurality of electrically conductive layers are secured to said panel on the side thereof opposite to said first plurality of layers, said third plurality of layers extending to said one end of said opening and being disposed adjacent the other ones of said pairs of said terminal pins.

20. A switching assembly comprising a substantially uniplanar, dielectric panel; a conductive pattern on at least one surface of said panel, said pattern including a plurality of pairs of conductive segments having spaced end portions; a plurality of sealed switch units each including a dielectric envelope and a pair of terminals, said switch units being mounted on said panel to lie generally within a plane parallel to the plane of said panel; means

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securing the terminals of said switch units to said spaced end portions to mount said switch units on said panel and to extend electrical connections between said conductive pattern and said switch units; a winding defining an axially extending opening, said opening being elongated in a direction transverse to its axis, said panel being mounted in said opening with the plane of said panel extending in the direction of the elongation of said opening and with said switch units at least partially enclosed by said winding.

21. The switching assembly set forth in claim 20 in which the dielectric panel includes an edge portion to which the conductive pattern extends to provide an electrical connector means; and which includes a housing for receiving the assembled dielectric panel, sealed switch units, and winding, said housing having an open end; and a dielectric member having a slot therein and mounted on said housing to close said open end, said edge portion of said dielectric panel being mounted in and extending

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through said slot so that said dielectric member holds said panel within and spaced from said housing while permitting access to said electrical connector means externally of said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

2,616,994	Luhn	Nov. 4, 1952
2,630,506	Buch	Mar. 3, 1953
2,649,513	Luhn	Aug. 18, 1953
2,823,360	Jones	Feb. 11, 1958
2,849,661	Oleson	Aug. 26, 1958
2,850,681	Horton	Sept. 2, 1958
2,889,424	Glore et al.	June 2, 1959
2,902,630	Heazel	Sept. 1, 1959
2,903,627	McGarvey	Sept. 8, 1959
2,937,351	Craig	May 17, 1960
2,940,017	Murphy et al.	June 7, 1960