Aug. 9, 1966 W. F. BARTON 3,265,825

ELECTRICAL RELAY

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Fig. 1.

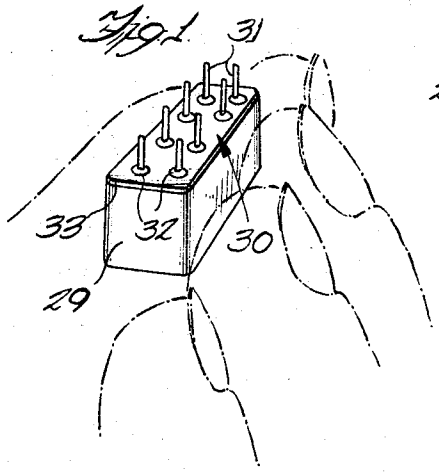



Fig. 2.

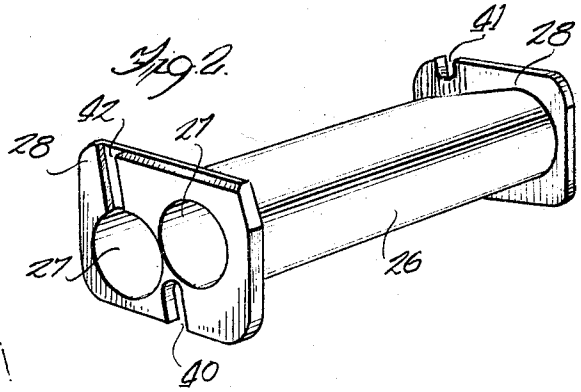



Fig. 3.

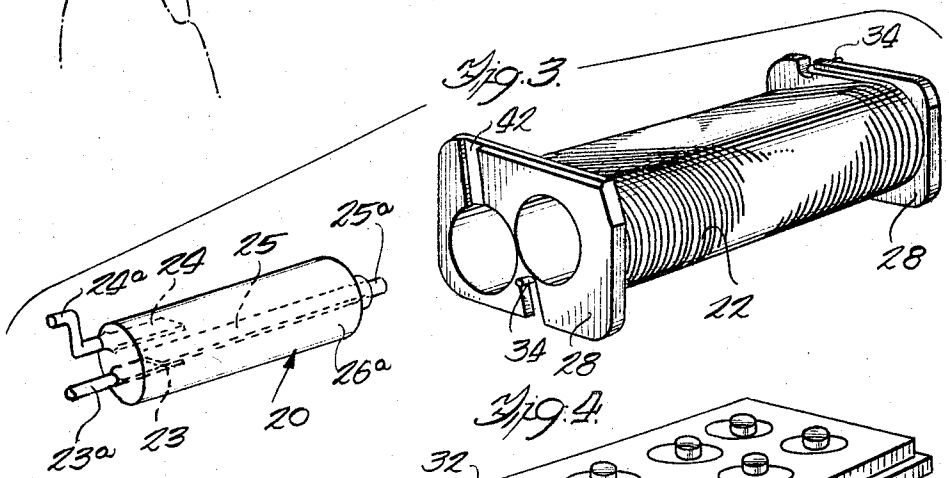



Fig. 4.

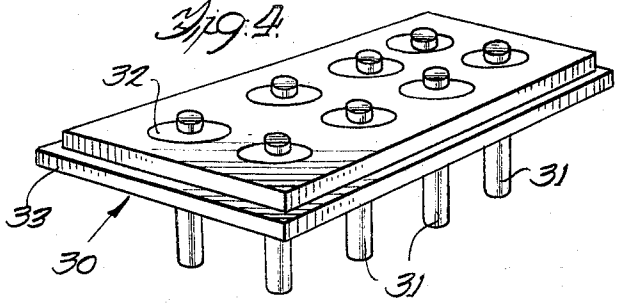



Fig. 6.

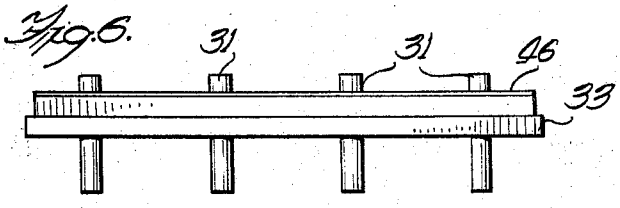
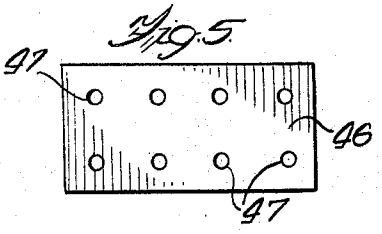



Fig. 5.




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Fig. 7.

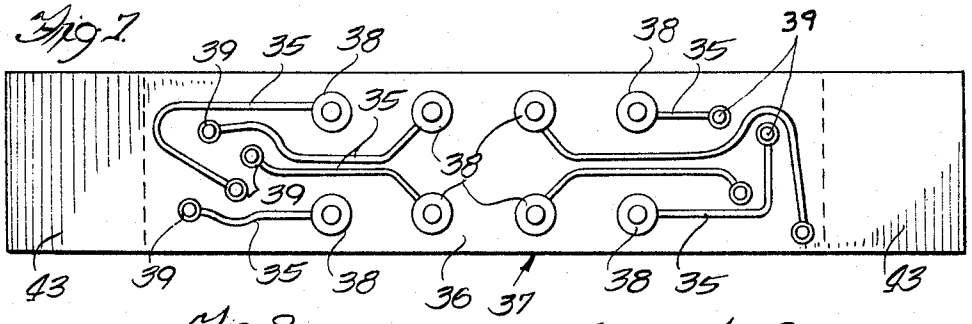



Fig. 8.

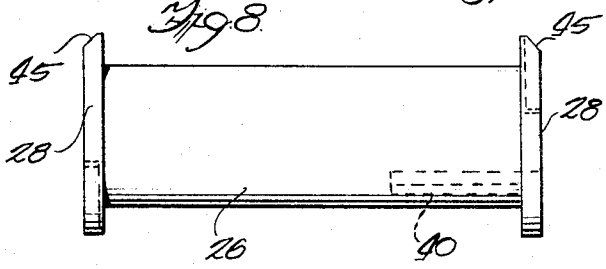



Fig. 9

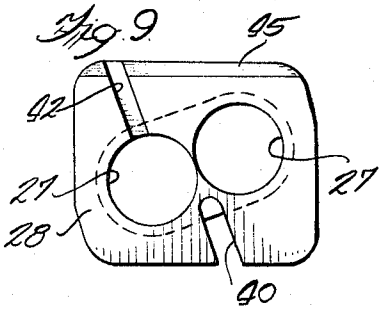



Fig. 10.

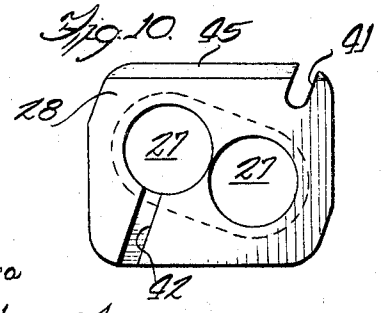



Fig. 11.

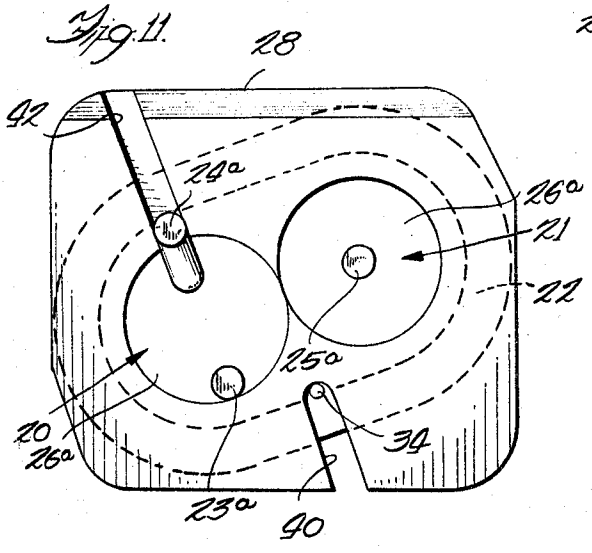
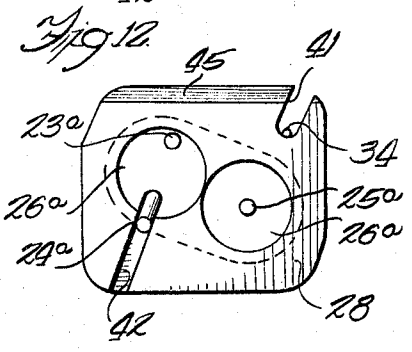



Fig. 12.




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Fig. 13.

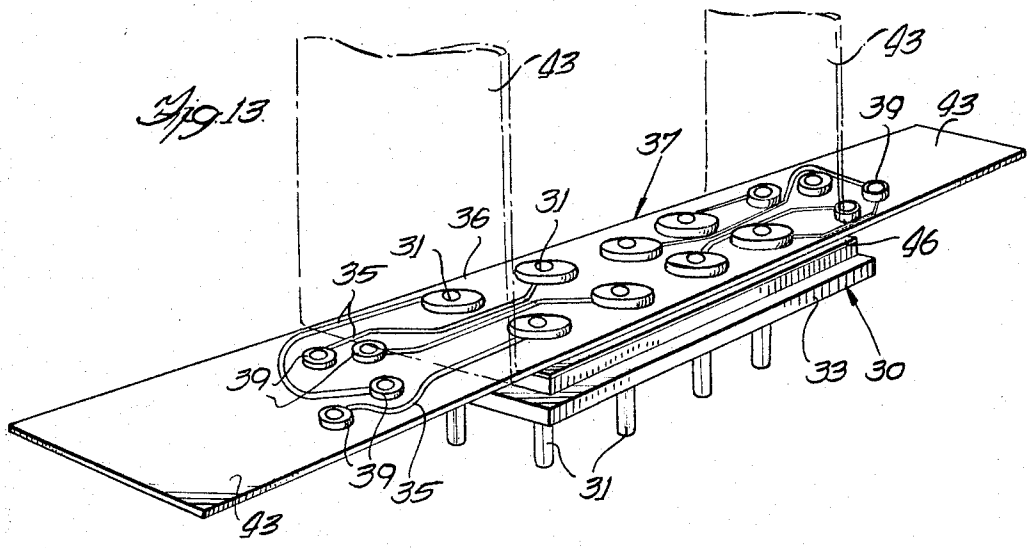



Fig. 14.

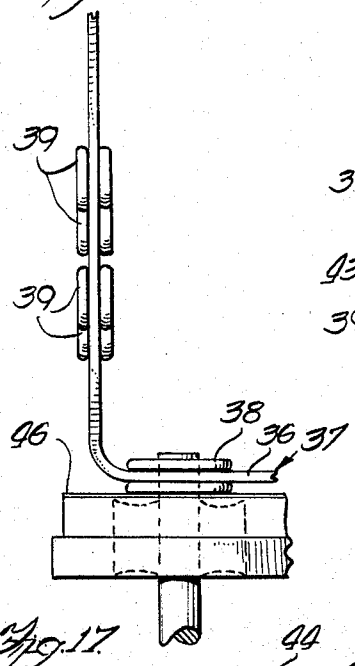



Fig. 15.

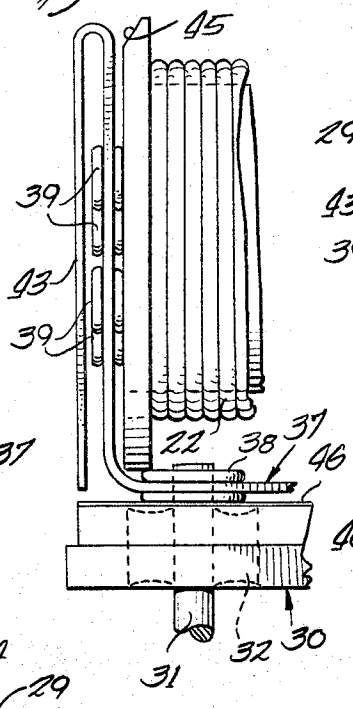



Fig. 16.

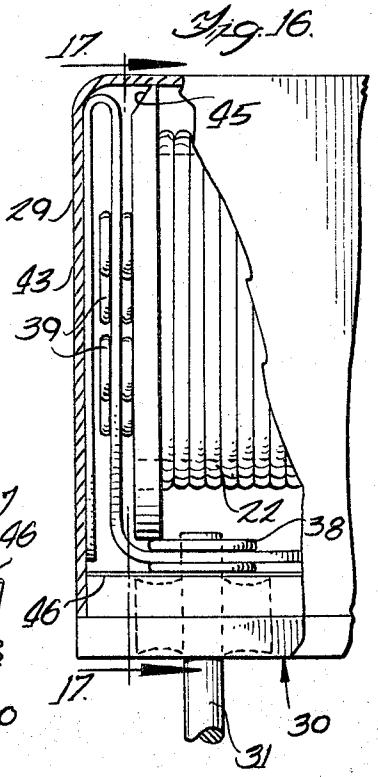
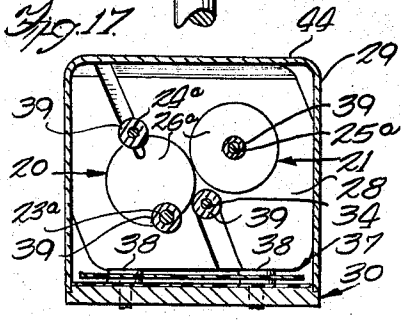



Fig. 17.




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United States Patent Office 3,265,825 Patented August 9, 1966



3,265,825

# ELECTRICAL RELAY

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Filed June 29, 1964, Ser. No. 378,551
15 Claims. (Cl. 200—87)

The present invention relates generally to relays of the so-called reed type having a switch formed of elongated metal contact members or reeds enclosed within a tube of insulating material such as glass and projecting toward each other into overlapping relation from opposite ends of the tube, there being at least two reeds of magnetic material having their overlapping ends normally spaced apart with one movable into contact with the other when subjected to a magnetic field resulting, for example, from direct current energization of a coil wound on a bobbin and encircling the tube. In one form of such a relay designated Form C, the switch has three reeds arranged as a single throw, double pole switch with normally open and normally closed contacts, one type of Form C having a movable reed of magnetic material normally engaging a fixed reed of non-magnetic material but movable away from that reed and into engagement with another fixed reed of magnetic material upon energization of the coil.

The primary object of the present invention is to provide a novel relay construction enabling one or more switches and an associated coil to be assembled in a very small compact package.

Another object is to provide a novel arrangement of two reed switches and a coil enabling the same to be packaged in a so-called one-half crystal can of rectangular shape and small dimensions with a terminal board or header closing an open side of the can and supporting terminal pins which are connected to the reeds and coil.

A further object is to connect the reeds and coil to the terminal pins in a novel manner to simplify the connections and facilitate assembly of the parts in a small space.

A more detailed object is to utilize a flexible printed circuit member to connect the reeds and coil to the terminal pins and to arrange the parts of the member in a novel manner permitting the terminal board, coil and reed switches to form a sub-assembly which may be inserted easily in the can in a final assembly of the relay.

The invention also resides in the novel construction of a bobbin for the coil to provide a large winding space for the coil and permit each of two reed switches to be mounted in only one predetermined position relative the bobbin.

Another object is to arrange the coil ends and reeds in a novel manner providing different predetermined connection patterns at different ends of the bobbin for cooperation with correspondingly patterned connecting elements on the flexible printed circuit to insure assembly of the parts in only one desired relationship.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a bottom perspective view of an electrical relay embodying the novel features of the present invention;

FIG. 2 is a perspective view of a bobbin for the relay;

FIG. 3 is an exploded perspective view of the bobbin with the winding in place and one switch ready for insertion;

FIG. 4 is a perspective view of the terminal board;

FIG. 5 is a plan view of an insulation sheet for the terminal board;

FIG. 6 is a side elevational view of the terminal board with the insulating sheet in assembled position;



FIG. 7 is a plan view of a flexible printed circuit member;

FIG. 8 is a side elevational view of the bobbin;

FIG. 9 is an elevational view of one end of the bobbin;

FIG. 10 is an elevational view of the other end of the bobbin;

FIG. 11 is an enlarged view of one end of the bobbin and switch sub-assembly;

FIG. 12 is a reduced elevational view of the other end of the bobbin and switch sub-assembly;

FIG. 13 is a perspective view of the terminal board with the printed circuit assembled thereon;

FIG. 14 is a fragmentary side elevational view of the terminal board and printed circuit sub-assembly;

FIG. 15 is a fragmentary side elevational view of the terminal board printed circuit, bobbin and switch sub-assembly;

FIG. 16 is a fragmentary side elevational view of the completed relay with the casing broken away; and

FIG. 17 is a fragmentary sectional view taken along the line 17—17 of FIG. 16.

The invention is shown in the drawings for purposes of illustration embodied in a relay having two reed switches **20** and **21** of the single pole double throw Form C type with a single operating coil **22**. In each switch there are three reeds **23**, **24** and **25** (FIG. 3) enclosed within and extending through opposite sealed ends of a hollow tube **26***a* of insulating material such as glass. At their inner ends, the reeds overlap to form the contacts of the switch and, at their outer ends, they project beyond the tube to form terminals **23***a*, **24***a* and **25***a*. Two of the reeds **23** and **24** extend through one end of the tube and a short distance into the tube to form fixed contacts of the switch. One of these is a normally closed contact and is formed of non-magnetic material. The other fixed reed **24** is a normally open contact of magnetic material spaced transversely of the tube from the normally closed contact and its terminal **24***a* is bent laterally and then outwardly into parallelism with the terminal **23***a* of the non-magnetic contact, the lateral bend identifying the normally open contact. The third reed **25** is formed of magnetic material and projects through and inwardly from the other end of the tube into overlapping contact with the non-magnetic or normally closed contact. Upon energization of the coil, the third reed moves away from the non-magnetic contact and into engagement with the magnetic normally open contact.

The coil **22** is wound on a bobbin **26** having an elongated core with two longitudinal openings **27** receiving the respective reed switches, the tube **26***a* of each switch being a little shorter than the core but of the same cylindrical shape and only slightly smaller in diameter than its core opening. Flanges **28** project radially and outwardly from opposite ends of the core. The bobbin, coil and switches **23** and **24** all are enclosed within a rectangular casing **29** open on only one side which is closed by a terminal board or header **30**. Terminal pins **31** project through the board and are secured within grommets **32** of insulating material secured within holes in the board. A flange **33** around the edge of the board is flush on its outer edge with the walls of the casing and abuts the edges of such walls to limit entry of the board and position the board within the opening. In the present instance, the casing is a so-called half size crystal can which, with the terminal board in place, has exterior dimensions of .800 of an inch in length, .400 of an inch in height and .400 of an inch in width.

In one aspect, the present invention contemplates connecting the ends **34** of the coil **22** and the switch terminals **23***a*, **24***a*, and **25***a* to the terminal pins **31** in a novel manner facilitating assembly of the parts while making available for the bobbin **26** and switches **20** and **21** as much

space as possible. To these ends, the coil ends and switch terminals extend beyond the flanges **28** at opposite ends of the bobbin and into electrical contact with different elongated conducting elements **35** which extend from the ends of the bobbins and around the edges of the flanges to the pins located between the flanges. The conducting elements are flexible strips of conducting material sandwiched and heat-sealed between two thin sheets **36** of insulating material such as "Teflon" to form a flexible printed circuit **37**. Connections between the conducting strips and the respective pins are facilitated by the provision of eyelets **38** and **39** which are connected to the respective ends of the strips and telescope over the upper ends of the pins at the inner ends of the strips and over the switch terminals and coil ends at the outer sides of the flanges. The parts preferably are held in such assembled telescoping relation by solder which also insures proper electrical contact.

In the present instance, there are eight terminal pins **31**, one for each of the coil ends **34** and switch terminals **23***a*, **24***a* and **25***a*, and there are a corresponding number of flexible strips **35** in the printed circuit **37**. The inner eyelets **38** which telescope over the terminal pins, are larger than the outer eyelets **39** and are arranged in a regular pattern of two rows of four eyelets each to correspond to the same pattern of equally spaced pins. To permit assembly of the printed circuit in only one predetermined position with respect to the switch terminals and coil ends and thereby insure connection of each of the coil ends and terminals to the proper inner eyelet, the pattern of the terminals and coil ends at one end of the bobbin is different from the pattern at the other end and the patterns of the outer eyelets are correspondingly different, these eyelets being somewhat smaller than the inner eyelets because the coil ends and switch terminals are smaller than the terminal pins.

The different patterns of the coil ends **34** and switch terminals **23***a*, **24***a* and **25***a* at the different ends of the bobbin **26** are obtained simply by providing the same orientation of the switch terminals with different locations of the coil ends **34**. Thus, the inner or starting end of the coil projects through its flange at a point close to the center of the bobbin as shown in FIG. 11 and the outer or finishing end is located nearer the periphery of its flange as shown in FIG. 12. To facilitate injection molding of the bobbin, the coil ends project through the inner ends of slots **40** and **41** extending inwardly from the peripheries of the respective flanges different distances, the longer slot **40** for the starting coil end also extending inwardly along the bobbin core as indicated in FIG. 8.

Novel means is provided to insure that the terminals **23***a*, **24***a* and **25***a* of the switches **20** and **21** always will be oriented in the same positions with respect to the flanges **28** to fit into the intended outer eyelets **39**. This means comprises recesses **42** formed in the outer sides of the flanges and projecting radially and outwardly from the respective core openings **27** to receive the offset parts of the normally open magnetic switch terminals **24***a* of the switches, one recess being located in each flange and projecting outwardly from a different one of the openings than the other recess. Each recess, in receiving its offset terminal portion, not only positions each switch angularly in its respective opening, but also locates the offset within the flange so that only the end of the terminal projects beyond the flange for insertion into an eyelet.

The different patterns of coil ends **34** and switch terminals **23***a*, **24***a* and **25***a* are apparent in FIGS. 7, 11 and 12. Referring to FIGS. 7 and 11, the outer eyelets **39** in the left portion of FIG. 7 are patterned to telescope over the switch terminals and inner coil end shown in FIG. 11. The outer eyelets in the right hand portion of FIG. 7 are patterned to telescope over the switch terminals and outer coil end as shown in FIG. 12.

In addition to providing an easily assembled, space saving means for connecting the terminal pins **31** to the coil ends **34** and the switch terminals **23***a*, **24***a* and **25***a*, the printed circuit member **37** may be utilized in a simple and convenient manner for insulating the small outer eyelets **39**, the coil ends and switch terminals from contact with the ends of the metal casing **29**. For this purpose the insulating sheets **36** are extended beyond the outer eyelets as indicated at **43** at least far enough to cover the eyelets when bent reversely to lie against the outer sides of the eyelets (FIGS. 15 and 16). Preferably, the bent back end insulating sections are made slightly longer so as to cover substantially all of the inner sides of the end walls of the casing above the terminal board **30**. Having some resilience, the bent back portions of the insulating sheets also serve as a yieldable filler for the space between the casing ends and the outer eyelets.

Although the casing **29** in this instance is of square cross section, the part of the terminal board **30** within its flange **33** projects into the interior of the casing a short distance. This coupled with the printed circuit **37** leaves a space of oblong rectangular cross section for the bobbin.

In another aspect particularly adapted for a case like this where the bobbin space is of oblong rectangular shape, the invention contemplates a novel construction of the bobbin **26** to insure a tight fit in the available space as well as provide maximum winding space for the coil **22**. To this end, the flanges **28** are complementary in size and shape to the available space. Each flange thus is of horizontally elongated rectangular profile and the longer upper and lower edges of the flanges engage the inner sides of the larger eyelets **38** and the inner side of the top casing wall **44** opposite the eyelets (FIG. 16). Also, the core openings **27** are very close together and their axes parallel each other in a plane which is inclined toward the long axes of the flanges and away from a plane through diagonal corners of the flanges. The offset is far enough that the outer periphery of the core is spaced approximately equal distances from all four edges of the flanges thereby providing a winding space of substantially uniform thickness for the coil.

In the present instance, the corners of the flanges **28** are rounded and beveled to accommodate the rounded interior corners of the casing **29** and facilitate separating of the parts for injection molding of the bobbin **26**. Bevels also are formed along the outer sides of the upper edges of the flanges as indicated at **45** to accommodate the rounded casing corners.

In the assembly of the improved relay, the parts of the terminal board **30** including the insulating heads **32** and terminal pins **31** are secured together as a sub-assembly. Also, after the coil **22** is wound on the bobbin core and covered with suitable insulating tape (not shown) with the coil ends **34** projecting through their respective slots **40** and **41** and beyond the flanges **28**, another sub-assembly of the switches **20** and **21** and the bobbin is completed by inserting the switch tubes **26***a* into their openings **27** with the offset portions of the terminals **24***a* at opposite ends of the bobbin. During the insertion of each switch, it is turned until its offset terminal portion **24***a* registers with the locating recess **42** and then is given a final axial-inserting movement to position the offset portion in the recess thereby orienting the switch terminals properly with respect to the flange.

After the first two sub-assemblies are completed, the terminal board **30** is covered by a thin sheet **46** of insulating material such as "Teflon" having apertures **47** (FIG. 5) to receive the inner ends of the terminal pins **31** closely and insure against contact of the large eyelets **38** with the board around the beads **32**. Next, the large eyelets in the central portion of the printed circuit member **37** are telescoped over and soldered to the terminal pins as shown in FIG. 13, the insulating sheet preventing contact of the eyelets with the board. Then, the bobbin and switch sub-assembly is placed on the central portion of the printed circuit with the flanges **28** contacting the large eyelets (FIG. 15). Next, the inter-

mediate portions of the circuit member with the outer smaller eyelets **39** are bent up as shown in full in FIG. 14 and in phantom in FIG. 13 to lie along the outer sides of the bobbin flanges **28** and those eyelets are telescoped over and soldered to the coil ends **34** and switch terminals **23***a*, **24***a* and **25***a* projecting beyond the flanges. Because the coil end and terminals at one end of the bobbin have a different pattern than those at the other end with corresponding patterns for the different sets of outer eyelets, the latter can be secured to their respective switch and coil terminals only if the bobbin and switch sub-assembly is oriented properly end for end with respect to the printed circuit member.

The sub-assembly of the terminal board **30**, printed circuit member **37**, bobbin **26** and switches **20** and **21** is completed by bending the insulating end portions **43** of the member reversely to lie against the outer sides of the intermediate portions as shown in FIG. 15 and the outer eyelets therein. The entire sub-assembly then is inserted into the open end of the casing **29** to bring the flange against the edges of the casing walls as shown in FIG. 16. The relay is completed by soldering the board and walls together around their junction.

It will be apparent that, due to the novel arrangement of the printed circuit member **37** and the locations of the switch openings **27**, it is possible to locate two class C switches **20** and **21** with a common coil **22** of large cross sectional area in a relatively small casing **29** with terminal pins **31** for the switch terminals **23***a*, **24***a* and **25***a* and coil ends **34** located on the same side of the casing. Also, there are few parts which may be assembled quickly and easily. The improved construction is further advantageous by virtue of the different patterns of terminals and coil ends at the ends of the bobbin which insure connection of these parts to the proper terminal pins.

During the final assembly as well as in service use, the insulating end portions **43** of the printed circuit member **37** prevent the eyelets from contacting the end casing walls. This makes it possible to locate the switch terminals very close to the end walls and to utilize the casing as a return path for magnetic flux simply by utilizing a magnetic material for the can. The close proximity of the terminals to the end walls results in very small air gaps in the magnetic circuits extending from one end wall to the other through the top wall **44**, across one air gap to one reed **25** of each switch and through the cooperating magnetic reed **24** and gap to the first end wall. A suitable magnetic material for the casing is annealed steel. By utilizing the can to provide the return path, the switches are more sensitive and fewer ampere turns are required for their actuation.

I claim:

**1.** In a relay, the combination of a bobbin having a hollow core and two flanges of rectangular shape projecting radially and outwardly from opposite ends of the core, said core providing two longitudinal openings having axes arranged in parallel in a plane extending generally diagonally with respect to the flanges, two reed switches supported in said openings and each having teminals extending at opposite ends a short distance beyond the flanges, means on one flange defining a recess on the outer side of the flange extending radially and outwardly from one of said openings, one of said terminals of the one of said switches in said one opening being bent laterally and lying in said recess to orient the switch angularly in the opening, means on the other of said flanges defining a second recess on the outer side of the flange extending radially and outwardly from the other of said openings, one of said terminals of the other of said switches in said other opening being bent laterally and lying in said second recess to orient the switch angularly in the opening, a winding encircling said core and having leads at opposite ends of the core extending through openings formed in the flanges and located in different positions with respect to the edges of the flanges to form with said terminals different patterns of conducting members projecting from each flange, terminal pins extending outwardly from said winding between said flanges, an elongated flexible printed circuit having a central portion extending between said flanges adjacent said terminal pins, spaced portions connected to and bent up from opposite ends of said central portion and lying against the outer sides of said flanges adjacent said conducting members, and elongated flexible conducting elements extending along said portions between said conductive members and the respective terminal pins and connected individually at opposite ends to the pins and the members, said ends of said elements connected to said conductive members having different patterns corresponding to said different patterns of the members projecting from the respective flanges of said bobbin.

**2.** In a relay, the combination of a bobbin having a hollow core and two flanges projecting radially and outwardly from opposite ends of the core, said core providing a longitudinal opening, a reed switch supported in said opening and having terminals extending at opposite ends a short distance beyond the flanges, means on one flange defining a recess on the outer side of the flange extending radially and outwardly from said opening, one of said terminals of said switch being bent laterally and lying in said recess to orient the switch angularly in the opening, a winding encircling said core and having leads at opposite ends of the core extending through openings formed in the flanges and located in different positions with respect to the edges of the flanges to form with said terminals different patterns of conducting members projecting from each flange, terminal pins extending outwardly from said winding between said flanges, an elongated flexible printed circuit having a central portion extending between said flanges adjacent said terminal pins, spaced portions connected to and bent up from opposite ends of said central portion and lying against the outer sides of said flanges adjacent said conducting members, and elongated flexible conducting elements extending along said portions between said conductive members and the respective terminal pins and connected individually at opposite ends to the pins and the members, said ends of said elements connected to said conductive members having different patterns corresponding to said different patterns of the members projecting from the respective flanges of said bobbin.

**3.** In a relay, the combination of a bobbin having a hollow core and two flanges projecting radially and outwardly from opposite ends of the core, said core providing two longitudinal openings, two reed switches supported in said openings and each having terminals extending at opposite ends a short distance beyond the flanges, means on one flange defining a recess on the outer side of the flange extending radially and outwardly from one of said openings, one of said terminals of the one of said switches in said one opening being bent laterally and lying in said recess to orient the switch angularly in the opening, means on the other of said flanges defining a second recess on the outer side of the flange extending radially and outwardly from the other of said openings, one of said terminals of the other of said switches in said other opening being bent laterally and lying in said second recess to orient the switch angularly in the opening, an elongated flexible printed circuit having a central portion extending between said flanges and spaced portions connected to and bent up from opposite ends of said central portion and lying against the outer sides of said flanges adjacent said conducting members, terminal pins projecting outwardly from said central portion of said printed circuit, a winding encircling said core and having leads connected to certain of said pins, and elongated flexible conducting elements extending along said circuit portions between said switch terminals and others of said terminal pins and connected

individually at opposite ends to the other pins and the terminals.

4. In a relay, the combination of a bobbin having a hollow core and two flanges projecting radially and outwardly from opposite ends of the core, said core providing two longitudinal openings, two reed switches supported in said openings and each having terminals at opposite ends extending through the flanges, means on one flange defining a recess on the outer side of the flange extending radially and outwardly from one of said openings, one of said terminals of the one of said switches in said one opening being bent laterally and lying in said recess to orient the switch angularly in the opening, and means on the other of said flanges defining a second recess on the outer side of the flange extending radially and outwardly from the other of said openings, one of said terminals of the other of said switches in said other opening being bent laterally and lying in said second recess to orient the switch angularly in the opening.

5. In a relay, the combination of a bobbin having a hollow core and two flanges projecting radially and outwardly from opposite ends of the core, said core having a longitudinal opening, a reed switch supported in said opening and having terminals extending at opposite ends a short distance beyond the flanges, a winding encircling said core and having leads at opposite ends of the core extending through openings in the flanges and forming with said terminals different patterns of conducting members projecting from each flange, terminal pins extending outwardly from said winding between said flanges, an elongated flexible printed circuit having a central portion extending between said flanges adjacent said terminal pins, spaced portions connected to and bent up from opposite ends of said central portion and lying against the outer sides of said flanges adjacent said conducting members, and elongated flexible conducting elements extending along said portions between said conductive members and the respective terminal pins and connected individually at opposite ends to the pins and the members, said ends of said elements which are connected to said conductive members having different patterns corresponding to said different patterns of the members projecting from the respective flanges of said bobbin.

6. A relay having, in combination, a rectangular casing having a bottom opening and a terminal plate closing said opening and supporting conducting terminal pins in spaced relation, said pins extending through said plate and being insulated from each other and the plate, a thin first strip of insulating material covering the inner side of said plate and having apertures receiving the inner ends of said pins, a flexible printed circuit member comprising a second strip of insulating material and having a center portion lying against said first strip and supporting conducting first eyelets, said eyelets telescoping over and contacting said inner ends of said pins, a bobbin having a hollow core extending longitudinally of said casing and flanges projecting radially and outwardly from the ends of said core and engaging said center portion of said member adjacent the ends of the casing, a reed switch supported within and extending longitudinally through said core and having terminals projecting outwardly beyond said flanges, a winding encircling said core between said flanges and having terminals extending through and beyond the flanges, said circuit member having intermediate portions bent up from opposite ends of said center portion to lie against the outer side of said flanges and supporting conducting second eyelets secured in telescoping relation over said winding and switch terminals and connected individually to different ones of said first eyelets by flexible strips of conducting material within said second strip of insulating material, and end portions of said member comprising integral extensions of said second insulating strip connected to and bent down from the upper ends of said intermediate portions to lie against the outer sides of the intermediate portions and provide an insulating covering for said second eyelets and said winding and switch terminals.

7. A relay having, in combination, a rectangular casing having a bottom opening and a terminal plate closing said opening and supporting conducting terminal pins in spaced relation, said pins extending through said plate and being insulated from each other, a flexible printed circuit member comprising a strip of insulating material and having a center portion supporting conducting first eyelets, said eyelets telescoping over and contacting said inner ends of said pins, a bobbin having a hollow core extending longitudinally of said casing and flanges projecting radially and outwardly from the ends of said core adjacent the ends of the casing and said center portion of said member, a reed switch supported within and extending longitudinally through said core and having terminals projecting outwardly beyond said flanges, a winding encircling said core between said flanges and having terminals extending through and beyond the flanges, said circuit member having intermediate portions bent up from opposite ends of said center portion to lie against the outer side of said flanges and supporting conducting second eyelets secured in telescoping relation over said winding and switch terminals and connected individually to different ones of said first eyelets by flexible strips of conducting material within said strip of insulating material, and end portions of said member comprising integral extensions of said insulating strip connected to and bent down from the upper ends of said intermediate portions to lie against the outer sides of the intermediate portions and provide an insulating covering for said second eyelets and said winding and switch terminals.

8. In a relay, the combination of a bobbin having a hollow core and two flanges projecting radially and outwardly from opposite ends of the core, said core providing a longitudinal opening, a reed switch supported in said opening and having terminals extending at opposite ends through said flanges, a winding encircling said core and having terminals at opposite ends of the core extending through openings formed in the flanges, terminal pins extending outwardly from said winding between said flanges, and an elongated flexible printed circuit having a central portion extending between said flanges adjacent said terminal pins, spaced portions connected to and bent up from opposite ends of said central portion and lying against the outer sides of said flanges adjacent said conducting members, elongated flexible conducting elements extending along said space portions between said terminals and the respective terminal pins and connected individually at opposite ends to the pins and the terminals, and insulating end portions connected to and bent reversely from the outer ends of said spaced portions to provide an insulating cover for said terminals.

9. A relay having, in combination, a casing having an opening and a terminal plate closing said opening and supporting conducting terminal pins in spaced relation, said pins extending through said plate and being insulated from each other, a bobbin having a hollow core extending longitudinally of said casing and flanges projecting radially and outwardly from the ends of said core adjacent the ends of the casing, a flexible printed circuit member comprising a strip of insulating material and having a center portion extending between said flanges and adjacent said pins, a reed switch supported within and extending longitudinally through said core and having terminals projecting outwardly through said flanges, a winding encircling said core between said flanges, said circuit member having intermediate portions bent up from opposite ends of said center portion to lie against the outer side of said flanges and having elongated flexible conducting elements connected at opposite ends to said switch terminals and said pins, and end portions of said member comprising integral extensions of said insulating strip connected to and bent down from the outer ends of said intermediate portions to lie against the outer sides of the

intermediate portions and provide an insulating covering for said switch terminals.

10. A relay having, in combination, a rectangular casing having a bottom opening and a terminal plate closing said opening and supporting conducting terminal pins in spaced relation, said pins extending through said plate and being insulated from each other, a flexible printed circuit member comprising a strip of insulating material and having a center portion supporting conducting first eyelets, said eyelets telescoping over and contacting said inner ends of said pins, a bobbin having a hollow core extending longitudinally of said casing and flanges projecting radially and outwardly from the ends of said core adjacent the ends of the casing, a reed switch supported within and extending longitudinally through said core and having terminals projecting outwardly beyond said flanges, and a winding encircling said core between said flanges and having terminals extending through and beyond the flanges, said circuit member having other portions bent up from opposite ends of said center portion to lie against the outer side of said flanges and supporting conducting second eyelets secured in telescoping relation over said winding and switch terminals and connected individually to different ones of said first eyelets by flexible strips of conducting material within said strip of insulating material.

11. A relay having, in combination, a rectangular casing having a bottom opening and a terminal plate closing said opening and supporting conducting terminal pins in spaced relation, said pins extending through said plate and being insulated from each other, a flexible printed circuit member comprising a strip of insulating material and having a center portion supporting conducting first eyelets in spaced relation, said eyelets telescoping over and contacting said inner ends of said pins, a bobbin having a hollow core extending longitudinally of said casing and flanges projecting radially and outwardly from the ends of said core adjacent the ends of said center portion of said member, a reed switch supported within and extending longitudinally through said core and having terminals projecting outwardly beyond said flanges, a winding encircling said core between said flanges and having terminals connected to corresponding ones of said terminal pins, said circuit member having other portions bent up from opposite ends of said center portion to lie against the outer side of said flanges and supporting conducting second eyelets secured in telescoping relation over said switch terminals and connected individually to different ones of said first eyelets by flexible strips of conducting material within said strip of insulating material.

12. A relay having, in combination, a rectangular casing supporting spaced conducting terminals on its exterior and having an interior of rectangular cross section, a bobbin having a core and rectangular end flanges projecting radially and outwardly from opposite ends of the core to provide a peripheral outline complementary in shape to said cross section of the casing interior, said core having two openings extending throughout its length with their axes parallel to each other and in a common plane normal to said flanges, two reed switches, one disposed in each of said core openings and each having reeds connected to different ones of said terminals, and a winding encircling said core within the peripheral outlines of said flanges and having ends connected to others of said terminals, said openings being disposed closely adjacent to each other and said plane of said axes of the openings being disposed diagonally with respect to said flanges to space the core substantially equal distances from adjacent edges of the flanges and provide a large cross sectional area of space available for said winding.

13. A relay having, in combination, a casing supporting spaced conducting terminals on its exterior and having an interior of rectangular cross section, a bobbin having a core and rectangular end flanges projecting radially and outwardly from opposite ends of the core to provide a peripheral outline complementary in shape to said cross section of the casing interior, said core having two openings extending throughout its length with their axes parallel to each other and in a common plane normal to said flanges, two reed switches, one disposed in each of said core openings and each having reeds connected to different ones of said terminals, said flanges being of oblong rectangular shape with parallel long axes defining a plane and with diagonal corners lying in intersecting planes, and a winding encircling said core within the peripheral outlines of said flanges and having ends connected to others of said terminals, said openings being disposed closely adjacent to each other and said plane of said axes of the openings being offset from one of said planes through diagonal corners of said flanges and toward said plane through the long axes of the flanges to space the core substantially equal distances from adjacent edges of the flanges and provide a large cross sectional area of space available for said winding.

14. A relay having, in combination, a rectangular casing supporting spaced conducting terminals on its exterior and having an interior of rectangular cross section, a bobbin having a core and oblong rectangular end flanges projecting radially and outwardly from opposite ends of the core to provide a peripheral outline complementary in shape to said cross section of the casing interior, said core having two openings extending throughout its length with their axes parallel to each other and in a first common plane normal to said flanges, two reed switches, one disposed in each of said core openings and each having reeds connected to different ones of said terminals, said flanges having parallel long axes in a second common plane and diagonal corners in other common planes normal to the flanges and intersecting each other and said first and second planes and a winding encircling said core within the peripheral outlines of said flanges and having ends connected to others of said terminals, said openings being disposed closely adjacent to each other and said first plane of said axes of the openings being offset from one of said other planes through diagonal corners of said flanges and toward said second plane through the long axes of the flanges to provide a large cross sectional area of space available for said winding.

15. A relay having, in combination, a rectangular casing open on one side and having closed walls at opposite ends and on the other three sides, a bobbin having a core extending longitudinally of and supported within said casing, said core having a longitudinal opening, a reed switch supported within said opening and having reeds of magnetic material with terminals at opposite ends of said casing extending toward and closely adjacent said end walls of the casing, an electromagnetic winding supported on said core and encircling the core and said switch, and a terminal board secured within and closing said open side of said casing and having terminal posts connected to said winding and said reed terminals, said casing being of magnetic material and forming a return path for magnetic flux in said reeds resulting from energization of said winding.

**References Cited by the Examiner**

UNITED STATES PATENTS

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|---|---|---|---|
| 2,938,982 | 5/1960 | Brown et al. | 200—87 X |
| 3,121,148 | 2/1964 | Wells et al. | 200—93 |
| 3,171,918 | 3/1965 | Killion | 200—85 |
| 3,174,009 | 3/1965 | Deeg | 200—87 |

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