United States Patent

[11] 3,587,011

[72] Inventor **Edward A. Kurz**
Flemington, N.J.

[21] Appl. No. **1,593**
[22] Filed **Jan. 9, 1970**
[45] Patented **June 22, 1971**

[73] Assignee **Pyrofilm Corporation**
Whippany, N.J.

[54] REED SWITCH AND RELAY

15 Claims, 3 Drawing Figs.

[52] U.S. Cl. 335/151, 335/202
[51] Int. Cl. H01h 50/04, H01h 51/28
[50] Field of Search 335/151-154, 202

[56] **References Cited**

UNITED STATES PATENTS

3,214,534	10/1965	Pihl	335/154
3,233,062	2/1966	Dal Bianco et al.	335/154 X

Primary Examiner—Bernard A. Gilheany
Assistant Examiner—R. N. Envall, Jr
Attorney—Popper, Bain, Bobis & Gilfillan

ABSTRACT: Reed relays, both normally closed and normally open circuits, are disclosed as comprising a novel switch section, a bobbin section and a coil means wound on the bobbin section. The switch section and bobbin section can be manufactured independently and thereafter assembled so as to reduce manufacturing costs, facilitate calibration and expedite assembly. The reed relay is structured to provide a total shield around the reed elements to eliminate the effect of random environmental magnetic fields.

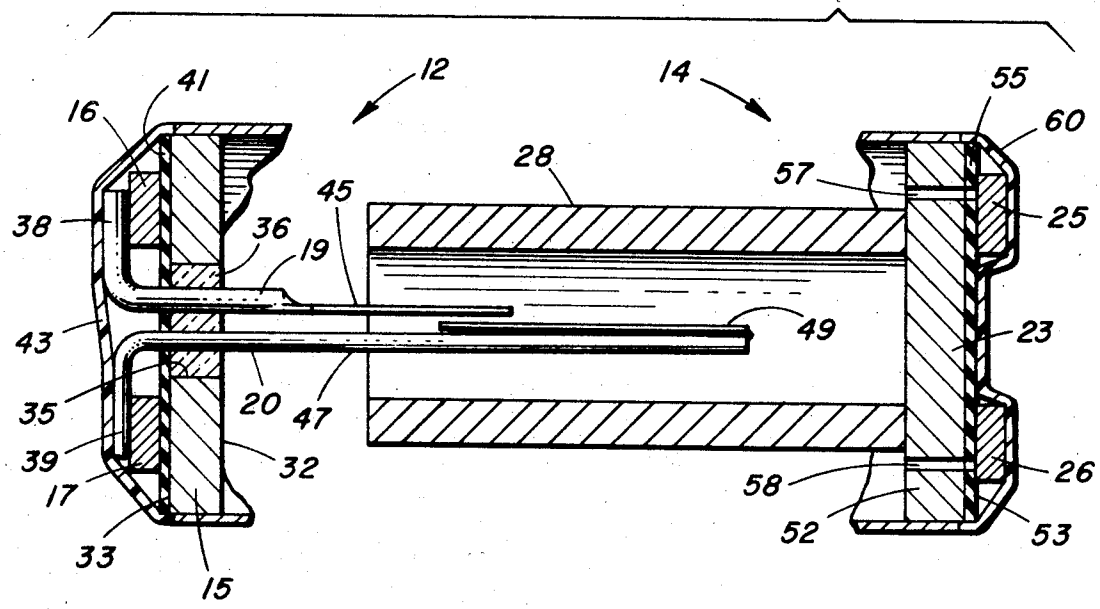


FIG. 1

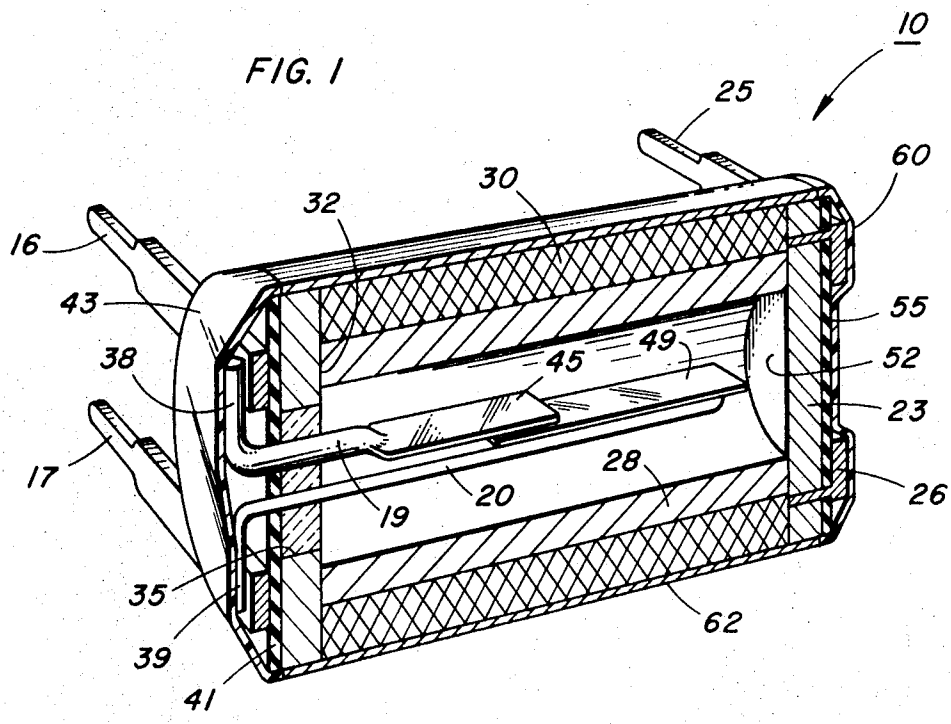
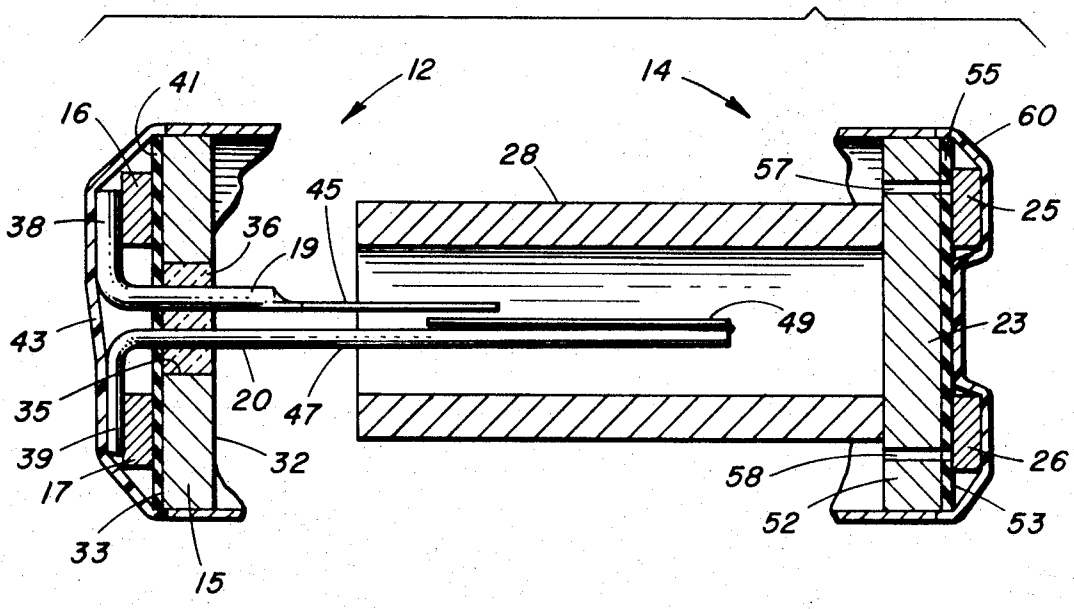
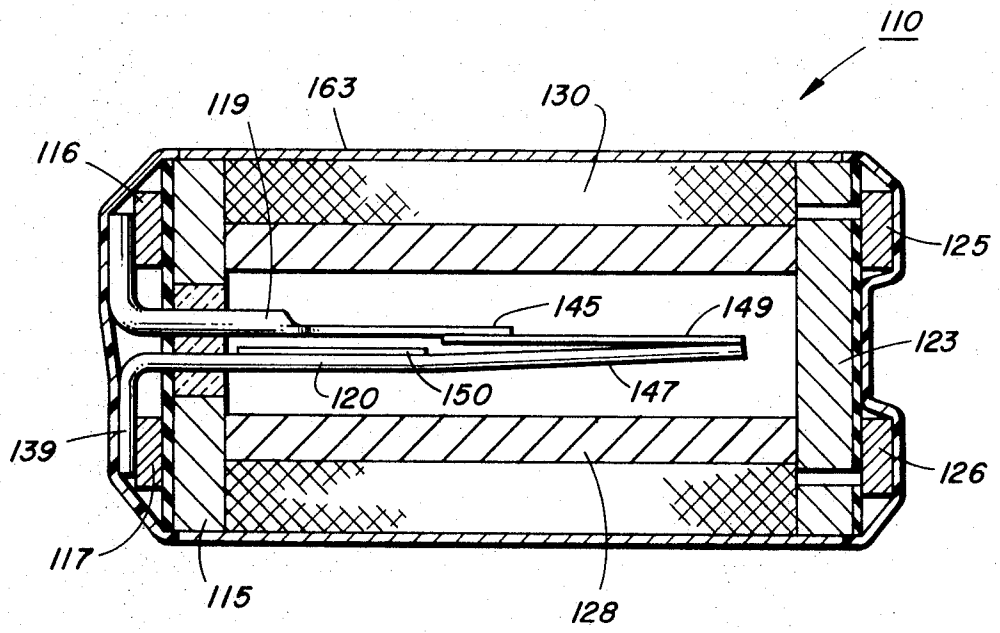


FIG. 2



INVENTOR
EDWARD A. KURZ
BY MARN & JANGARATHIS
ATTORNEYS

FIG. 3


110
119
163
130
116
125
145
149
123
120
150
147
139
126
117
115
128

REED SWITCH AND RELAY

BACKGROUND OF THE INVENTION

This invention relates to reed switches and reed relays.

Reed switches and relays are well-known devices in electrical circuitry and have experienced widespread use in various areas of the electrical arts.

Developments in the electrical arts wherein reed switches and relays are utilized in low current circuits have resulted in known switches and relays being adversely effected by outside electrical interference, i.e. environmental magnetic forces. Additionally, the fact that such reed switches and relays have been used in relatively great numbers while at the same time being subject to the requirement that they be accurately calibrated has increased the expense of manufacture and cost of assembly. Further, the general trend in the electrical arts toward miniaturization has required the development of progressively smaller relays and switches.

It is the principal object of this invention, therefore, to provide reed switches and reed relays which are inexpensive to manufacture, uncomplicated in construction and of smaller physical size than known relays for accomplishing a comparable function.

It is a further object of the invention to provide totally shielded reed switches and reed relays which are not subject to environmental magnetic forces and therefore particularly useful in applications wherein small currents are accommodated and accuracy is required.

SUMMARY OF THE INVENTION

The foregoing and other objects are achieved by a reed relay incorporating a reed switch according to the present invention, one embodiment of which may include a reed switch section having a baseplate, first and second conductor elements connected to terminals and a reed element secured to one of the conductors for engagement with the other conductor, a bobbin section including a base, bobbin and coil terminals, and coil means wound on the bobbin for establishing a magnetic field in response to which the reed is either caused to be displaced to close the reed circuit or cause to be displaced to open the reed circuit, depending upon whether the switch is normally open or closed.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention may be had from the following detailed description, particularly when considered in the light of the attached drawings wherein:

FIG. 1 is a cross-sectional perspective view of normally open embodiment of a reed relay according to the invention;

FIG. 2 is a cross-sectional elevational view of the reed relay of FIG. 1; and

FIG. 3 is a cross-sectional elevational view of a normally closed reed relay according to the invention.

DETAILED DESCRIPTION

Referring to FIG. 1, a reed relay according to the invention is designated generally by the reference numeral 10. Switch 10 includes a reed switch section designated generally by the reference numeral 12 (FIG. 2) and a bobbin section designated generally by the reference numeral 14 (FIG. 2).

Switch section 12 comprises a baseplate 15 on which is mounted a pair of terminal elements 16, 17 which are electrically secured to a pair of reed elements 19, 20 as is discussed below in detail. Bobbin section 14 comprises a bobbin baseplate 23 on which is mounted a pair of terminal elements 25, 26 which define connector element for the ends of a wire wound on a tubular bobbin 28 to form a magnetic winding 30.

Considering the structures of switch section 12 and bobbin section 14 in detail, and referring particularly to FIG. 2 wherein switch section 12 and bobbin section 14 are shown in axially spaced relation, switch section 12 can be seen to comprise generally circular baseplate 15 having an inner radial surface 32 and an outer radial surface 33. Extending longitudinally axially through baseplate 15 is a bore 35 through which there extends longitudinally the reed elements 19 and 20. The reed elements 19, 20 are disposed in spaced relation and rigidly secured to baseplate 15 within bore 35 by a hermetic seal 36 which may be of suitable dielectric material such as glass or ceramic as is generally known in the art. The outer ends 38, 39 of reed elements 19, 20 are formed to extend radially and are secured to terminal elements 16 and 17 respectively by suitable means such as spot welding.

Disposed between the outer radial surface 33 of baseplate 15 and terminal element 16 and 17 is a layer of insulating material 41, which material precludes electrical contact between the material of baseplate 15 and that of terminals 16 and 17. Similarly, the end of switch section 12 is also covered with a layer of insulating material 43.

Considering reed elements 19 and 20 in detail, reed element 19 is a single-piece structure having a generally cylindrical end which extends from the above-mentioned connection to terminal 16 and through bores 35 into the inner volume of switch 10 defined by the interior of tubular bobbin 28. The inner end of reed element 19 is flattened for example by upsetting to define a flat portion 45, the lower surface of which defines the contact surface for reed 19.

Reed element 20 is a compound structure comprising a conductor portion 47 having an outer end which is secured to terminal element 17 and an inner end which extends through bore 35 into the inner volume of switch 10. Secured to the extreme inner end of conductor 47 such as by spot welding is a generally flat contact section 49. Contact section 49 is of sufficient length to extend between the upper surface of conductor surface 47 and the lower surface of flat portion 45. In the embodiment of FIG. 1, baseplate 15, reed element 19 and contact section 49 may be of a suitable high permeability material such as a nickel-iron alloy. The conductor section 47 of reed element 20, however, is of a low permeability conductive material such as a copper-nickel alloy.

Referring to bobbin section 14, it can be seen that the section comprising bobbin baseplate 23 normal to the surface of which is secured a generally tubular bobbin 28. Bobbin baseplate 23 in the embodiment of FIGS. 1 and 2 may be of a suitable high magnetic permeability material such as nickel-iron whereas bobbin 28 may be of a low magnetic permeability material or a suitable dielectric material such as glass or ceramic.

Bobbin baseplate 23 includes an inner radial surface 52 and an outer radial surface 53. Mounted on the outer radial surface 53 of bobbin baseplate 23, and separated therefrom by a layer of insulating material 55 are terminal elements 25 and 26. Additionally, bobbin baseplate 23 is provided with a pair of openings 57, 58 which accommodate the passage therethrough of the terminal ends of the wire which forms magnetic winding 30 (FIG. 1). In this regard, the terminal ends of the wire from magnetic winding 30 are electrically secured to terminal elements 25 and 26 by suitable means such as soldering. The outer end of bobbin section 14 is provided with a layer of insulating material 60.

The manufacture of a reed relay 10 according to the invention may be accomplished in the following manner. Initially, reed elements 19 and 20 may be positioned within bore 35 of baseplate 15 and secured therein in spaced relationship by the provision of hermetic dielectric seals 36 in a manner known to those skilled in the art. Thereafter, layer 41 of insulating material may be positioned on the outer radial surface 33 of baseplate 15. In this regard, the insulating material 41 may be any of the suitable materials known to those skilled in the art, for example, a fiber glass tape with a B-stage (semicured) epoxy impregnation. With respect to insulating layer 41, the tape would be provided as a ring-shaped element, the opening in the center of which being suitable for the passage of reed elements 19 and 20 therethrough. With the layer 41 of insulating material positioned on baseplate 15, terminal 16 and 17

would then be positioned in surface-to-surface contact with insulating material **41**. Thereafter, the ends **38** and **39** of reed elements **19** and **20** are bent to extend radially as shown in FIGS. **1** and **2**, so as to be in physical engagement with terminals **16** and **17** respectively, and thereafter secured to respective terminals such as by spot welding. With the elements of the switch section so assembled, layer **43** of insulating material, which may be fiber glass, is positioned over the entire end of the switch section after which the section can be finally cured so as to set the epoxy of the insulating material.

Assembly of bobbin section **14** comprises initially the securing of bobbin **28** to the inner radial surface **52** of bobbin baseplate **23**. This securing may be accomplished for example by furnace brazing with silver solder, or a like method as is known to those skilled in the art. Thereafter, layer **55** of insulating material is provided over the outer radial surface **53** of bobbin baseplate **23**, terminal elements **25** and **26** are positioned thereon, and the section may be cured so as to set the epoxy of the insulating material.

With switch section **12** and bobbin section **14** so assembled, the flat contact sections **45** and **49** of reed elements **19** and **20** may be calibrated by any of the known methods. Upon the completion of calibration, bobbin section **14** may be positioned telescopically over reeds **19** and **20** so that the end of tubular bobbin **28** comes into contact with the inner radial surface **32** of baseplate **15**. The joint defined by the bobbin and baseplate is then suitably hermetically sealed by any of the methods known generally in the art.

With switch section **12** and bobbin section **14** so assembled and secured, wire for forming winding **30** may be electrically secured at one end to terminal **25** through opening **57** in bobbin baseplate **23**, wound around the outer surface of bobbin **28** and secured at its other end to terminal element **26** through opening **58** in bobbin baseplate **23**. Thereafter, outer layer of insulating material **60** is positioned over the entire end of bobbin section **14** and cured so as to set the epoxy of the insulating material. With the magnetic winding so wound, the entire circumferential surface of reed switch **10** may be provided with an outer covering **62** (FIG. **1**) which may be, for example, a metal foil tape or like material of high magnetic permeability.

The reed switch of the invention, manufactured in the manner described above, is now ready for operation. Thus, with terminal elements **16** and **17** in electrical connection with a circuit to be served, the impression of a control voltage on terminals **25** and **26** will energize winding **30** to generate a magnetic field causing contact sections **45**, **59** of reed elements **19** and **20** to be magnetically attracted thereby closing the switch circuit and allowing the passage of current therethrough.

As was discussed generally above, a desirable feature of the present invention is that a reed relay or switch manufactured in accordance with this teaching may be smaller than reed relays and switches structured in accordance with prior art teachings. This capability for miniaturization is accomplished by the fact that reed element **20** and contact section **49** cooperate to define a U-shaped member which, by reason of its configuration, defines an element of greater effective length than would otherwise be possible in a reed relay of comparable overall length. The increase in effective length allows the contact section **49** to be displaced into contact with contact section **45** in response to the exertion of less magnetic force than would otherwise by required thereby reducing the number of turns required in coil **30** and effecting a substantial reduction in size of the reed relay as compared with reed relays of comparable capacity. A further desirable feature of the present invention is that the contact sections of reed elements **19** and **20** may be substantially isolated from environmental conditions which may induce magnetic forces in contact sections **45** and **49** by the provision of a substantially total shield of high permeability material around the operating reed elements. In this regard, in the embodiment of FIG. **1** baseplate **15**, bobbin baseplate **23**, and outer covering **62** are all manufactured of high permeability materials and as such cooperate to define a protective casing around the reed contact sections **45** and **49**. Further, the only portion of the reed elements exposed to environmental conditions and capable of magnetization is that portion of reed element **19** which extends outwardly of bore **35** in baseplate **15**. Thus, the effect of environmental magnetism on reed relay **10** is substantially negligible.

The contact sections **45** and **49** of relay **10** can be totally isolated from environmental conditions by structuring both reed elements as compound structures rather than just reed element **20**. More specifically, reed element **19** could be provided with a conductor portion manufactured of low permeability, highly conductive material connected to a contact section **45** of high permeability, conductive material. By structuring the reed elements in this manner, no high permeability material would extend outside the confines of the volume defined by base sections **15** and **23** and bobbin **28**.

Another approach to achieving total isolation of the reed elements from environmental conditions can be achieved by structuring the reed elements in the general manner disclosed with respect to the alternative embodiment of reed relay disclosed in FIG. **3**.

More particularly, FIG. **3** discloses a reed relay designated generally by reference numeral **110** having exactly the same structure as that of relay **10** with the exception of the reed elements. More specifically, relay **110** is provided with a lower reed element **120** and an upper reed element **119**. Upper reed element **119** is structured in exactly the same manner as that described with respect to upper reed element **19** of relay **10**, with the exception that the reed element is manufactured from a low permeability, highly conductive material, for example, alloys of copper-nickel. The inner end of upper reed element **119** is flattened to form a contact section **145** which extends longitudinally of the cavity defined within bobbin **128**.

Lower reed element **120** comprises a conductor element, manufactured of a low magnetic permeability highly conductive material, having an outer radially extending section **139** and a generally longitudinally extending section **147**. One portion of longitudinally extending section **147** is formed to extend away from the longitudinal and toward the extended axis of upper reed element **119**. Rigidly secured such as by spot welding to the extreme end of longitudinal element **147** is a contact section **149** which is manufactured of high permeability material. Contact section **149** is of sufficient length to overlap the substantially flat contact section **145** of upper reed section **119** so as to be capable of electrical contact therewith. In this regard, because of the bend in the longitudinal portion **147** of lower reed **120**, contact sections **145** and **149** are normally in contact thus rendering reed relay **110** a normally closed circuit switch. Mounted on the upper surface of longitudinal section **147** between baseplate **115** and the bend in longitudinal section **147** is a substantially flat element **150** of high permeability material. Element **150** defines an attractor element which in the operation of relay **110** may be magnetized to establish an attraction with contact element **149** thereby causing the contact between elements **145** and **149** to be broken. In this regard, in the operation of relay **110**, terminal sections **116** and **117** are electrically connected to a circuit to be served by relay **110**. During normal operation, current flows through the switch in an uninterrupted manner. Upon the introduction of a current through terminals **125**, **126** a current through magnetic winding **130** is established thereby generating a magnetic field in the switch. High permeability sections **149** and **150** are magnetized and attracted, thereby causing contact element **149** to be deflected toward attractor element **150** and away from contact section **145**. In this manner the switch circuit is opened and remains so until such time as the forces tending to attract contact section **149** to attractor section **150** are relieved.

With regard to the isolation of the high permeability material elements within relay **110** from environmental magnetic forces, it can be seen that the inner volume of relay **110**, as

defined by the cylindrical cavity within bobbin **128** in which reed elements **119** and **120** are mounted, is substantially totally encased by high permeability material. More specifically, bobbin baseplate **123**, baseplate **115** and outer covering **160** are all manufactured of high permeability materials so as to shield the structure contained therein from environmental magnetic forces. Additionally, in that reed elements **119** and **120** are formed of low permeability, highly conductive material with the exception of attractor section **150** and contact section **149**, it can be seen that no high permeability material in the switch extends through baseplate **115** to be exposed to environmental conditions. Accordingly reed relay **110** provides a switch wherein the high permeability operating sections are totally isolated from environmental magnetic forces thereby providing a relay of heretofore unheard of reliability, performance capability and repetitive accuracy.

It is to be recognized that although the present invention has been disclosed in terms of a reed relay, a shielded switching section with compound reed elements without the coil-actuating structure may be manufactured within the scope of the invention. Further, it is considered to be manifest that many other modifications and changes can be made to the disclosed embodiments without departing from the spirit and scope of the present invention.

What I claim is:

1. A reed relay comprising:
a switch section including;
a baseplate,
first and second conductor elements secured to and extending through said baseplate;
first and second terminal means secured to said first and second conductor elements respectively, and
a reed element secured to said first conductor element in overlapping relation with said second conductor element;
a bobbin section including;
a bobbin base,
bobbin means secured to said bobbin base, and said baseplate
first and second coil terminal means mounted on said bobbin base and electrically insulated therefrom;
coil means wound on said bobbin means, said coil means being electrically connected to said first and second coil terminal means; and wherein
said reed element is displaceable to make electrical contact with said second conductor element in response to the passage of electrical current through said coil means.

2. The reed relay of claim **1** and further including high permeability means surrounding said coil means.

3. The reed relay of claim **1** wherein said baseplate, said bobbin base and said second conductor element are of high permeability material, and further including;
high permeability means surrounding said coil means.

4. The reed relay of claim **1** wherein said second conductor element is provided with a reed element for contacting said reed element of said first conductor element.

5. The reed relay of claim **4** wherein said baseplate and said bobbin base are of high permeability material, said first and second conductor elements are of low permeability electrically conductive material, and further including:
high permeability means surrounding said coil means.

6. The reed relay of claim **1** wherein said reed element is secured to said first conductor element at their ends such as to define a U-shaped configuration.

7. A reed relay comprising:
a switch section including;
a baseplate having an inner surface and an outer surface;
first and second conductor elements extending through and secured to said baseplate in electrically insulated spaced relationship;
a reed element secured to one end of said first conductor element, said reed element being in overlapping relation with and displaceable to contact one end of said second conductor element;
insulation means mounted on said outer surface of said baseplate; and
first and second terminal means secured to the other ends of said first and second conductor elements, respectively, and in surface-to-surface engagement with said insulation means on said baseplate;
a bobbin section including;
a bobbin base having an inner surface and an outer surface;
bobbin means secured to said inner surface of said bobbin base and said inner surface of said baseplate base;
insulation means mounted on said outer surface of said bobbin base;
first and second coil terminal means secured to said insulation means on said bobbin base; and
coil means wound on said bobbin means, said coil means being electrically connected to said first and second coil terminal means.

8. The reed relay of claim **7** wherein said reed element is displaceable to make electrical contact with said second conductor element in response to the passage of electrical current through said coil means.

9. The reed relay of claim **7** wherein said reed element is displaceable out of electrical contact with said second conductor element in response to the passage of electrical current through said coil means.

10. The reed relay of claim **7** and further including high permeability means surrounding said coil means.

11. The reed relay of claim **8** wherein said baseplate, said bobbin base and said second conductor element are of high permeability material, and further including:
high permeability means surrounding said coil means.

12. The reed relay of claim **7** wherein said second conductor element is provided with a reed element for contacting said reed element of said first conductor element.

13. The reed relay of claim **12** wherein said baseplate and said bobbin base are of high permeability material, said first and second conductor elements are of low permeability electrically conductive material, and further including:
high permeability means surrounding said coil means.

14. The reed relay of claim **9** wherein said baseplate and said bobbin base are of high permeability material, said first and second conductors are of low permeability material, and further including:
attractor means secured to said first conductor element between said inner surface of said baseplate and said reed element, said attractor means being of high permeability material.

15. The reed relay of claim **14** and further including:
high permeability means surrounding said coil means.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,587,011 Dated June 22, 1971

Inventor(s) Edward A. Kurz

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 22, cancel "base".

Signed and sealed this 7th day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334