Sept. 13, 1966 V. C. HUCKABEE 3,273,087

MINIATURIZED RELAY

Filed April 22, 1963 2 Sheets-Sheet 1

FIG. 1.

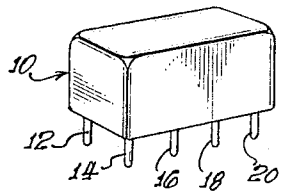


FIG. 2.

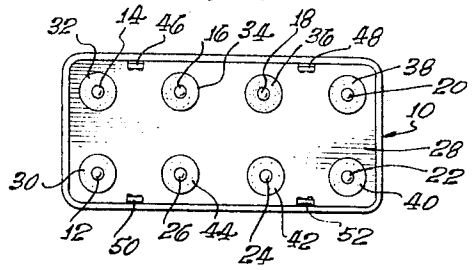


FIG. 3.

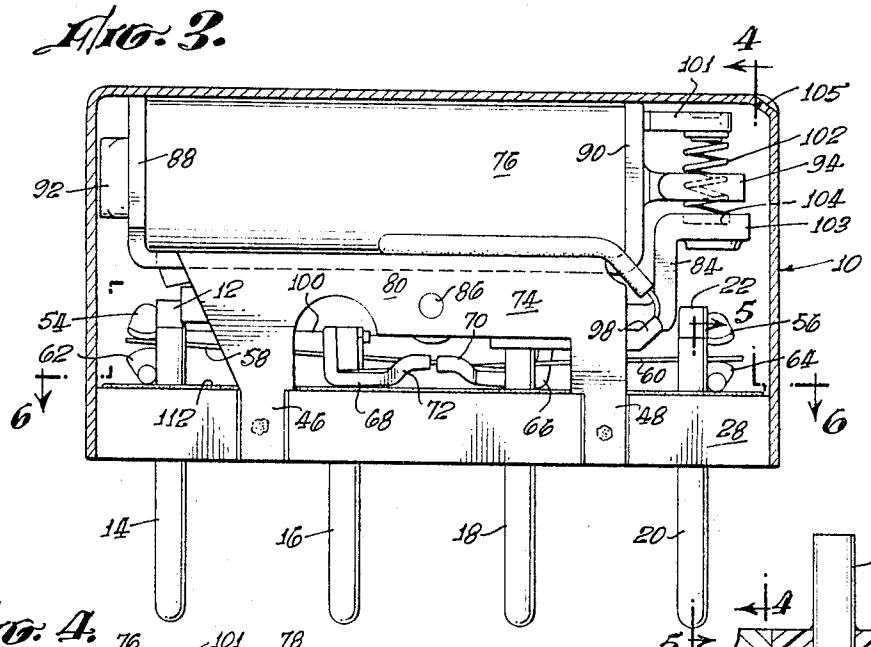


FIG. 4.

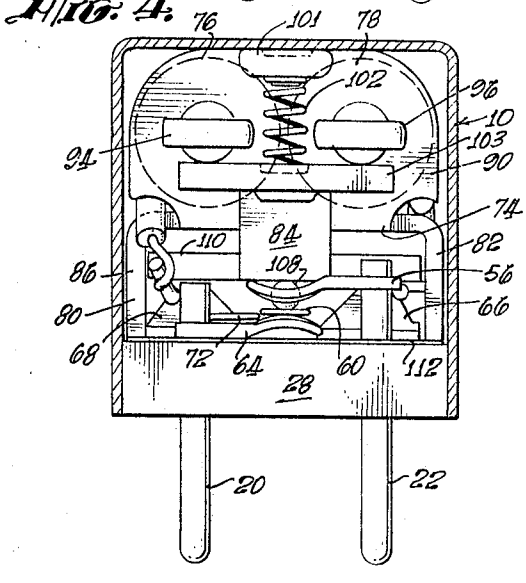
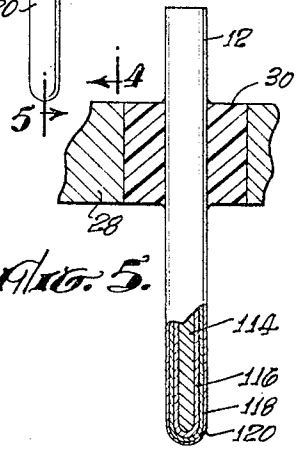


FIG. 5.



VANDEL CURTIS HUCKABEE,

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Sept. 13, 1966 V. C. HUCKABEE 3,273,087

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FIG. 6.

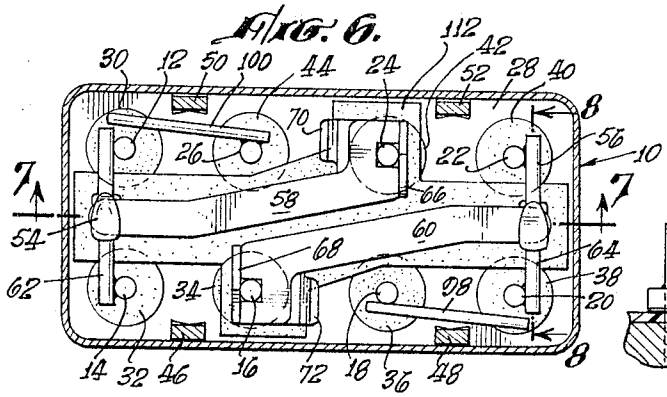


FIG. 8.

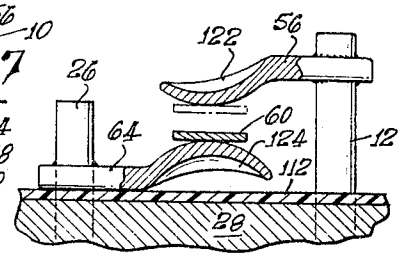


FIG. 7.

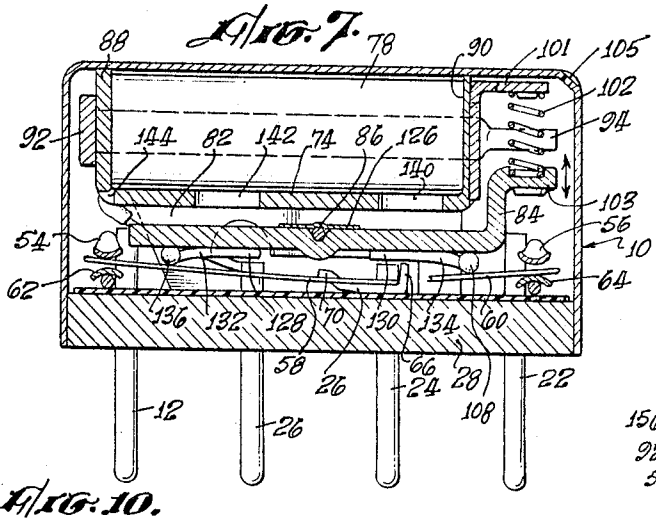


FIG. 9.

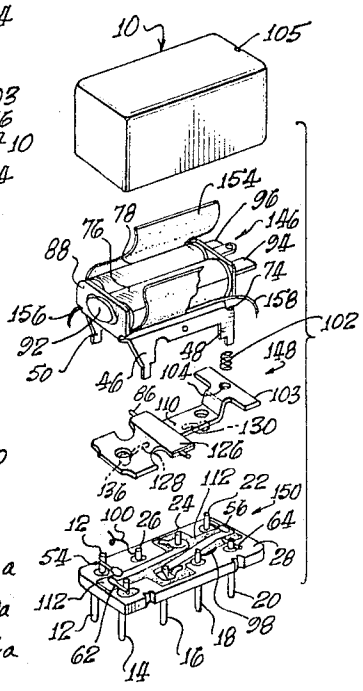


FIG. 10.

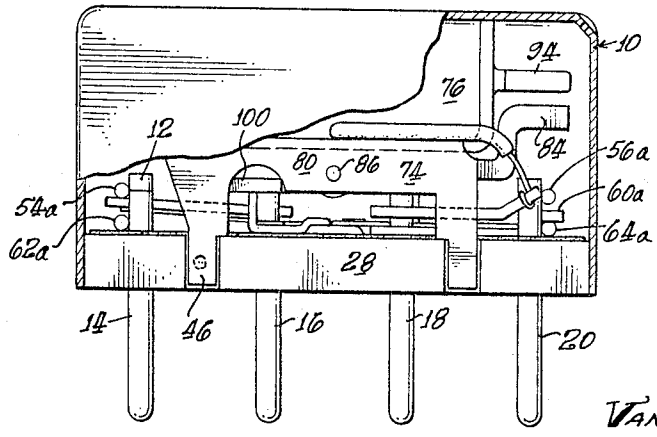
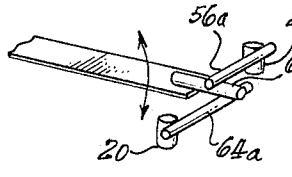


FIG. 11.



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United States Patent Office

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Patented Sept. 13, 1966

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MINIATURIZED RELAY

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Filed Apr. 22, 1963, Ser. No. 274,671

8 Claims. (Cl. 335—128)

This invention relates to relays and more particularly to an improved miniaturized electromechanical relay.

With the advent of high speed aircraft, missiles and space vehicles, all requiring complex electronic systems, it has become necessary to greatly reduce the size of individual components from both a size and weight standpoint. This is in order to permit them to be carried within the limitations of space and weight requirements of the carrying vehicle. To merely make smaller each of the individual parts of a given component by a scaling factor is not always possible or desirable.

It is therefore a primary object of the present invention to provide a highly reliable miniaturized relay of improved design.

Another object of the present invention is to provide an improved electromagnetic relay capable of switching over a wide range of input currents.

A further object of the present invention is the provision of a miniaturized relay that is simple yet reliable in operation, light weight yet rugged and durable in construction, and compact yet convenient and easy to fabricate.

Other objects will become apparent as the description of the drawings proceeds, wherein:

In the drawings:

FIGURE 1 is a perspective view of the presently preferred embodiment of a relay constructed in accordance with the present invention;

FIGURE 2 is a bottom view, somewhat enlarged, of the relay of FIGURE 1;

FIGURE 3 is a side elevation, partly in section, greatly enlarged of the relay of FIGURE 1;

FIGURE 4 is a view taken along line 4—4 of FIGURE 3;

FIGURE 5 is a view taken along line 5—5 of FIGURE 3;

FIGURE 6 is a view taken along line 6—6 of FIGURE 3;

FIGURE 7 is a view taken along line 7—7 of FIGURE 6;

FIGURE 8 is a view taken along line 8—8 of FIGURE 6;

FIGURE 9 is an exploded assembly view in perspective of the relay of FIGURE 1;

FIGURE 10 is a side elevation, partly in section of an alternate embodiment of the present invention relay; and

FIGURE 11 is a perspective view of the contact portion of the relay of FIGURE 10.

Referring now to FIGURE 1 which shows the switch ready for use, there is shown a switch housing or can **10** with contact pins **12, 14, 16, 18, 20, 22, 24** and **26** extending therefrom, pins **22, 24** and **26** not being visible in the figure. This can, consisting of a shell having a top and sides, is preferably formed from nickel silver approximately 0.1 inch thick. The outer diameters of the can are on the order of .79 inch long, .385 inch wide and .40 inch high. This can be adapted to be inserted over the coil assembly, armature assembly and header and contact assembly as will be hereinafter described. This housing is of about the same width and length as conventional microminiature relays now in use that are popularly known as "crystal can" relays which derives its name from its size comparable to the normal size of the can in which

radio crystals are shipped. The height of the can in the present invention, however, is about half the height of the microminiature relay. Since it is approximately one-half the size of a microminiature relay, it is properly entitled by the inventor as a "Pico Relay" or a "half-size crystal can relay."

The pins protruding from beneath the can are laid out on a 0.2 inch grid system which is standard for printed circuit board design and therefore the present switch, although small, is readily adaptable and interchangeable with other switches in the printed circuit art. These pins are insertable in convenient openings in printed circuit boards. Circuit boards normally are spaced or stacked one inch apart in housing racks because of the almost one inch height of previously used crystal can relay switches. However, with the present micromicrominature or Pico switch of approximately .40 inch in height, the circuit boards may now be spaced one-half inch apart, resulting in a total saving of half the space heretofore required in the stacking of circuit boards in their racks.

A bottom view of the relay switch is shown in FIGURE 2 wherein the uniform symmetrical spacing of the contact pins **12, 14, 16, 18, 20, 22, 24** and **26** is apparent. These pins extend through a base or header plate **28** to which they are mounted in spaced insulating relationship by means of hermetically sealed glass ring spacers **30, 32, 34, 36, 38, 40, 42** and **44**. One pin **18** is retained in glass insulation **36** of a color different than the other pins to indicate the pin to be connected to a positive D.C. bias for coil energization when a diode is used. If a diode is to be inserted in series or in parallel with the coil, all to be hereinafter explained, the diagonally opposed inner pin **26** on the opposite row of pins, as indicated by the arrow on the plate, identifies the pin which is connected to the other end of the coil winding. Without the diode, because of symmetry, the switch may be turned around such that pin **20** may be inserted into circuit board opening formerly occupied by pin **12**. Pins **16** and **24** are connected to the two blades of a double-throw switch, the preferred embodiment illustrative of the present invention. The blade connected to pin **24** switches contact between pins **12** and **14** while the blade connected to pin **16** switches between pins **20** and **22**. Legs **46, 48, 50** and **52** extend down from a coil assembly frame within the can and are welded to the header plate **28**.

Reference is now made to FIGURE 3 wherein is shown a side elevation with the housing in section. Here the upper row of pins in FIGURE 2, pins **14, 16, 18** and **20** are shown extending through the header plate **28**. Pins **12, 26, 24** and **22** are directly behind and therefore cannot be shown. The upper portions of pins **12** and **22** extend higher than pins **14** and **20** and therefore the top portions can be seen. These pins respectively have upper blade contacts **54, 56** mounted thereon which engage blades **58, 60** respectively when they are in their uppermost position. Lower blade contacts **62, 64** extend from pins **14, 20** respectively and engage blades **58** and **60** when they are in their lowermost position. Blades **58** and **60** are of Phosphor-bronze spring temper materials for currents up to about one-ampere, silver, nickel or magnesium being preferred for higher current carrying capabilities. The blades **58** and **60** are connected at their ends to pins **18** and **16** respectively through blade brackets **66, 68**. These blades are so positioned by adjustment with tabs **70, 72** on brackets **66, 68** as to engage upper blade contacts **54, 56** except when in a depressed condition. A coil assembly frame **74**, mounted by legs **46, 48, 50** and **52**, extends over the blades **58, 60** to support the coils **76, 78**, of which coil **76** is shown. Between the legs are downwardly extending sides **80, 82** from which armature **84** is pivotally mounted through

pivot pin **86**. The frame **74** has upturned ends **88**, **90** between which the coils are positioned. A U-shaped core **92** extends through ends **88**, **90** and coils **76**, **78**. The ends **94**, **96** of the U-shaped core **92**, after extending through the coils, terminate in flattened end portions of which portion **94** is shown. Armature **84** is normally urged clockwise about pivot pin **86** by spring **102** so as to permit blade **58** to contact upper blade contact **54** and blade **60** to be urged downwardly into contact with lower blade contact **64**, as shown in the drawing. Coil **76** is connected to pin **18** through jumper **98**. A similar jumper **100** connects the other end of the coil to pin **26** which is positioned behind pin **16**. Extending from end **90** of frame **74** is a projection **101** beneath which is positioned a four-turn closed ended spring **102** which engages crossbar **103** of armature **84**. A recessed portion **104** on the crossbar maintains the spring in position. A vent hole **105** is provided for a purpose to be hereinafter described. Can **10** fits snugly over header plate **28** and is soldered thereto to effect a hermetic seal.

FIGURE 4 shows an end view of the coil assembly, armature assembly, header and contact assembly, with the can housing shown in section. Connecting pins **20** and **22** extend downwardly from header plate **28**. Pin **22** extends upwardly therethrough a distance greater than the pin **20** to accommodate upper blade contact **56**. Lower blade contact **64** is shown extending from contact pin **20**. Blade **60** is positioned between the contacts **56** and **64**. In the unenergized condition of the switch, armature **84** is positioned downwardly. A glass insulated actuator **108**, extending downwardly from armature **84** holds blade **60** against lower blade contact **64**. The body portion **110** of armature **84** pivots on pin **86** and, when core ends **94**, **96** have been magnetized, armature crossbar **103** is upwardly thereagainst. Ends **94** and **96** have flat undersurfaces to provide for good contact with crossbar **103**. Otherwise the magnetization strength of the ends will not be great enough to retain the armature in position. Flattening of the ends also prevents withdrawal of the core from its position through ends **88** and **90**. Spring **102** extending downwardly from projection **101** is particularly useful on the heavier current model as it provides for a fast snap and break away upon energization and de-energization of the coils, to avoid arcing and to avoid contact bouncing upon actuation. The spring also assists in holding the armature in position when the switch is subjected to a vibrational environment. In this manner, the coil and spring work together for positive positioning of switch blade **60**. In FIGURE 4, pins **20** and **22** block pins **18** and **24** from view. However, the end view of the blade brackets **66** and **68** connected thereto can be seen. Insulation **112**, consisting of a layer of Teflon dielectric material separates the lower blade contacts **62**, **64**, blades **58**, **60** and blade brackets **66**, **68** from the header plate **28**.

One outstanding feature of the present invention resides in the contact pin construction and assembly of the pins to the header plate, a fragmentary view of which is taken along the line **5—5** of FIGURE 3 and shown in FIGURE 5. Here pin **12** is bonded to header plate **28** through a glass insulation ring spacer **30** which is an excellent hermetic-sealing dielectric material which will not permit arcing between pin **12** and plate **28**. This pin consists of a copper center core **114** surrounded by a steel cylindrical jacket **116** over which is plated a layer of nickel **118**. Jacket **116** provides strength and mechanical resistance against accidental bending during plug-in of the switch into the circuit board. Core **114** is a good current conductor and the nickel **118** serves as a foundation for the gold flashing **120** which is applied after the pin has been mounted. Nickel is also very compatible with glass for a glass-to-metal seal. While this pin is of the plug-in type, it should be understood that the lower end could be curved or looped to provide a solder hook end which is preferable when permanent installation is desired.

Reference is now made to FIGURE 6 which is a plan view taken along line **6—6** of FIGURE 3 and showing in plan view the header and contact assembly and the blade assembly. The legs **46**, **48**, **50**, **52** of coil assembly frame **74** and can **10** are shown in section. An insulating material, such as a Teflon sheet for example, which is a good dielectric and has excellent insulating qualities, is shown positioned over header plate **28** at all points where portions of the contact or blade assembly might make contact or cause an arc with the header plate **28**. Upper contact **56** is shown welded to pin **22** and lower blade contact **64** is shown welded to pin **20**. Similarly, upper blade contact **54** is welded to the upper part of pin **12** and lower blade contact **62** is shown welded to the upper part of pin **14**. Jumpers **98** and **100** are welded to pins **18** and **26** respectively, and serve to connect these pins to the coil leads in a manner shown in FIGURE 3 after the coils have been positioned on the coil assembly frame **74**. It is noted that when the coils are positioned on the frame over the contact assembly and armature assembly, welding of the coil leads to these pins would be quite difficult if not impossible; hence, the jumper connections. Positioned over the insulation **112** and over pins **16** and **24** are the blade brackets **66**, **68**. These brackets have flat base portions to which the end of blades **58** and **60** may be welded and upturned portions to which the pins **16**, **24** can make an excellent weld contact. Blades **58** and **60** are positioned between the upper and lower blade contacts as shown and may be adjusted vertically between the contacts by proper adjustment of tabs **70** and **72** of the blade brackets. Normally, these blades will engage the under surfaces of the upper blade contacts **54**, **56**.

An enlargement of the upper and lower blade contacts and blade is shown in FIGURE 8 which is taken along line **8—8** of FIGURE 6. The flattened disc-like ends **122**, **124** with edges curved away from blade **60** provide for a relatively larger surface contact to insure longer life with the heavier current operation. These contacts are of fine silver with a gold flashing to reduce the contact resistance.

FIGURE 7 is a side elevation view similar to FIGURE 3, but taken in section along the line **7—7** of FIGURE 6, in order to better show the relationship of the parts during switch operation. Coil **78** is positioned on the coil assembly frame **74** between ends **88**, **90** and retained therein by core **92**. End **90** has a bracket projection **101** from which extends spring **102**. The bracket projection **101** may be integral with the frame **74** or, as in the illustrated embodiment, may be a separate bracket welded to the end **90**. Blades **58**, **60**, positioned between upper blade contacts **54**, **56** and lower blade contacts **62**, **64** respectively, urge the blades upwardly against the upper brackets **54**, **56** as a result of blade adjustment of brackets **66** and **68**. Armature **84** is pivotally mounted on the coil assembly frame **74** by hinge pin **86**, over which is spot welded a hinge pin retainer **126**. Mounted on the body portion **110** of armature **84** and on either side of hinge pin **86** are blade actuators **128** and **130**, each consisting of a small wire **132**, **134** welded to the bottom of the armature and a glass insulating head **136**, **108** which contacts the blades. In the unenergized position, spring **102** urges the armature **84** to rotate in a clockwise position and glass head **108** urges blade **60** downwardly in contact with lower contact **64**. Blade **58** is not depressed and accordingly it contacts upper blade contact **54** at the other end of the switch. Upon energization of the coils and actuation of the armature, the states are reversed and glass head **136** urges blade **58** downwardly in contact with lower blade contact **62**, while glass head **108** moves upwardly with the counterclockwise rotation of the armature, permitting blade **60** to contact the upper blade contact **56**. Openings **140**, **142** and **144** in the base of the coil assembly frame **74** permit insertion therethrough of coil windings if desired although leads preferably extend

through the end as shown in FIGURES 3 and 4. It is thus seen the rocking motion of armature **84**, insuring an upper and lower blade contact at all times, operates as a double-throw, double-pole switch.

FIGURE 9 is an exploded assembly view showing the can **10**, the coil assembly **146**, the armature assembly **148** and the header and contact assembly **150**, before final assembly, to show the interrelationship between the various parts. The header and contact assembly **150** includes the header plate **28** with the eight-contact pins extending therethrough and in insulated relationship. Lower blade contacts **62**, **64** and upper blade contacts **54**, **56** have been welded to pins **14**, **20**, **12** and **22**, respectively. Jumpers **98** and **100** are connected to pins **18** and **26** to facilitate connection with the coil leads after their assembly. Blades **58** and **60** have been connected through blade brackets **66** and **68** to pins **24** and **16** and are insulated from header plate **28** by means of insulation **112**. The armature assembly **148** consists of a crossbar **103** which is attracted to the core ends **94**, **96** on energization and a body portion **110** extending on both sides of the pivot pin **86**. Glass-beaded actuators **128** and **130** on either side of the pivot pin **86** are fastened to the underneath side. Suitable cutout portions are provided to prevent accidental contact or shorting across to other surfaces. Spring **102** fits into a recess at the end of armature **56**. In the coil assembly **146**, a piece of insulator material **154** is positioned over the top of coil assembly frame **74** and two coils **76** and **78** are positioned thereover. U-shaped core **92** is inserted through end **88** and the ends of core **94**, **96** protrude through the other end **90** of the frame. These ends are then flattened for the purposes earlier mentioned. Insulator material **154** serves conveniently for holding the coil assembly while its legs **46**, **48**, **50** and **52** are spotwelded on the header plate **28**. This material also protects the coils from sharp edges and forms a barrier between the coils and the can **10**. Leads **156** and **158** from the coils are next welded to the jumpers **100** and **98** to complete the assembly, after which can **10** is inserted thereover and soldered. After assembly, vent hole **105** in the can is used to evacuate the inside. Air is pumped out, preferably at a high temperature, such as 120° C., and when a desired vacuum is achieved, dry nitrogen is released and drawn into the can as the vacuum is released. The vent hole is then sealed. In this manner, there is no moisture inside to cause corrosion. Also, nitrogen prevents dielectric breakdown and arcing, resulting in greater reliability with more closely spaced parts.

An optional modification (not shown) resides in the insertion of a diode in parallel with the coils for the purpose of cutting down the back electromotive force and the inductive load for the coil when the power has been turned off. With this diode, it is also possible to fabricate a bridge network so that the coil may be energized with an A.C. voltage.

While the foregoing preferred embodiment is adapted to handle higher currents, such as a two-ampere variety, certain modifications shown in FIGURES 10 and 11 are made for "dry circuit" or low current operation, such as the one-ampere type. The end **60***a* of the blade and the upper and lower contacts **56***a* and **64***a* are of tubular material to provide point-to-point contact for extremely dry, that is, low current and voltage circuit operations. As an example, 15 millivolts at 10 milliamperes might be the energy that is to be passed through these contacts. These contacts are of pure gold, because of its low resistance characteristic, and round, to prevent the foreign material buildup. While this type of contact is very effective in the one-ampere region, they will not hold up under a two-ampere requirement because the two-ampere current would weld the contacts together. Pure gold also deteriorates under the higher amperage. No spring is used in this embodiment.

It is apparent from the foregoing description that the switch comprising the present invention has particular utility where small size is desired and which, because of its low mass, performs well in adverse environment conditions. Because of its symmetry in construction, the relay switch can be reversed in the circuit board without trouble, the only requirement being that if a diode is used, the coil extending to the contact pin embedded through the plate with a glass of a different color than the others must be connected to the positive side of the power supply. The dual coil configuration makes the coils small in size, but maintains the necessary ampere turns to hold the armature when energized. The armature actuation is vertical instead of the customary horizontal movement which permits smaller packaging, withstands shock and vibration better and is easier to adjust, as well as to initially fabricate.

Having thus described my invention and the preferred embodiments within which it may be utilized, it will become obvious to those skilled in the art that other improvements and modifications are foreseeable. It is therefore to be understood that these modifications and improvements are intended to be within the scope of my invention as defined by the following claims.

What is claimed is:

1. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing, said header and contact assembly including a header plate, connector pins, said pins protruding through said header plate in insulated relationship therewith, one end of said pins protruding below said header plate for connection with external circuitry, the other end of said pins extending above said header plate serving as contacts for upper and lower blade contacts, contacts through which coils may be energized, and for connection of switching blades, coils connected to selected pins, said blade assembly including switching blades connected to selected pins, said coil assembly including a frame having downwardly extending legs connected to said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends, a core inserted through said coils, the ends of said core magnetizing said armature upon energization of said coils, said armature assembly consisting of a crossbar for contact with said ends of said core, a body portion pivotally mounted on said frame, and insulated actuators on each side of the pivotal point of said body portion and mounted to the undersurface thereof for movement of said blades between upper and lower blade contacts upon energization of said coil.

2. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing, said header and contact assembly including a header plate, glass insulating connector pins protruding through said header plate, the lower ends of said pins protruding below said header plate being adapted for connection with external circuitry, the upper ends of said pins extending above said header plate serving as upper and lower blade contacts, contacts through which the coils may be energized, and contacts for switching blades, said coil assembly including a frame having downwardly extending legs for mounting on said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends, said ends having holes therein, a core inserted through said holes, said blade assembly including switching blades connected to selected pins and extending to selectively engage said upper and lower contacts, said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion pivotally mounted on said frame, and insulated actuators on each side of the pivot point of said body portion and mounted to the undersurface thereof for movement of said blades between upper and lower blade contacts upon actuation of said coil.

3 A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing, said header and contact assembly including a header plate, contact pins, said pins protruding through said header plate in insulated re-

lationship therewith, the ends of said pins protruding below said header plate being for connection with external circuitry, the ends of said pins extending above said header plate being for switch connections, upper and lower blade contacts connected to the upper ends of selected ones of said pins, selected other pins having contacts through which coils may be energized, said blade assembly including switching blades connected to selected other of said pins, said coil assembly including a frame having downwardly extending legs mounted on said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends, a core adapted for insertion through said coils, the ends of said core magnetizing said armature upon energization of said coils, said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion having pivotal means for mounting said body portion on said frame, and insulated actuators on each side of the pivotal point of said body portion and mounted to the undersurfaces thereof for movement of said blades between upper and lower blade contacts upon energization and de-energization of said coils.

4. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing, said header and contact assembly including a header plate, contact pins, said pins protruding through said header plate in insulated relationship therewith, the ends of said pins protruding below said header plate being for connection with external circuitry, the upper ends of said pins extending above said header plate, upper and lower blade contacts connected to selected ones of said upper ends, said blade assembly including blade brackets connected to selected ones of said upper ends, switching blades connected at one of their ends to said brackets, said brackets having tabs thereon for vertically adjusting the other ends of said blades, said coil assembly including a frame having downwardly extending legs mounted on said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends and connected to selected pins, a core adapted for insertion through said coils, the ends of said core magnetizing said armature upon energization of said coils, said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion pivotally mounted on said frame, and insulated actuators mounted on the undersurfaces thereof for movement of said blades between said upper and lower blade contacts upon actuation by said coil.

5. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a nitrogen filled hermetically sealed housing, said header and contact assembly including a header plate, contact pins, said pins protruding through said header plate in insulated and sealed relationship therewith, the ends of said pins protruding below said header plate being adapted for connection with external circuitry, the upper ends of said pins extending above said header plate selectively having upper and lower blade contacts, contacts through which coils may be energized, and means for connection of switching blades, said blade assembly including switching blades connected to selected pins, said coil assembly including a frame having downwardly extending legs mounted on said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends, a core inserted through said coils, the ends of said core magnetizing said armature upon energization of said coils, said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion pivotally mounted on said frame, and insulated actuators on each side of the mounting connection of said body portion with said frame, said actuator being extended from said body portion for movement of said blades between upper and lower blade contacts.

6. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing,

said header and contact assembly including a header plate, insulated connector pins protruding through said header plate, the lower ends of said pins protruding below said header plate being adapted for connection with external circuitry, the upper ends of said pins extending above said header plate serving as upper and lower blade contacts, contacts through which the coils may be energized, and contacts for switching blades,

said coil assembly including a frame with end portions supported within said housing, coils positioned between the end portions of said frame, said end portions having holes therein, a core inserted through said holes,

said blade assembly including switching blades connected to selected pins and extending to selectively engage said upper and lower contacts,

said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion pivotally mounted on said frame, and insulated actuators mounted to said body portion on each side of said body portions mounting on said frame for movement of said blades between upper and lower blade contacts upon actuation of said coil.

7. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing, said header and contact assembly including a header plate, glass insulating connector pins protruding through said header plate, the lower ends of said pins protruding below said header plate being adapted for connection with external circuitry, the upper ends of said pins extending above said header plate serving as upper and lower blade contacts, contacts through which the coils may be energized, and contacts for switching blades, said coil assembly including a frame having downwardly extending legs for mounting on said header plate and upwardly turned ends for positioning coils therebetween, coils positioned between said ends, said ends having holes therein, a core inserted through said holes, said blade assembly including switching blades connected to selected pins and extending to selectively engage said upper and lower contacts, said armature assembly consisting of a crossbar for contact with the ends of said core, a body portion pivotally mounted on said frame, and insulated actuators on each side of the pivot point of said body portion and mounted to the undersurface thereof for movement of said blades between upper and lower blade contacts upon actuation of said coil, said actuators having rounded surfaces at the points of actuation.

8. A relay switch comprising a header and contact assembly, a blade assembly, an armature assembly, a coil assembly, and a suitable housing,

said header and contact assembly including a header plate, insulated connector pins protruding through said header plate being adapted for connection with external circuitry, the upper ends of said pins extending above said header plate serving as upper and lower blade contacts, contacts through which the coils may be energized, and contacts for switching blades,

said coil assembly including a frame with end portions supported within said housing, coils positioned between the end portions of said frame, said end portions having holes therein, a core inserted through said holes,

said blade assembly including switching blades connected to selected pins and extending to selectively engage said upper and lower contacts,

said armature assembly consisting of a crossbar for contact with the ends of said bore, a body portion pivotally mounted on said frame, and insulated actuators mounted to said body portion on each side

of said body portions mounted on said frame for movement of said blades between upper and lower blade contacts upon actuation of said coil, said actuators having rounded surfaces at the point of actuation.

References Cited by the Examiner

UNITED STATES PATENTS

2,464,591	3/1949	Larsen et al.	200—166
2,547,947	4/1951	Kleis et al.	200—166
2,955,174	10/1960	Richert	200—104
3,017,532	1/1962	Talmey	200—166
3,033,957	5/1962	Dean	200—104
3,042,775	7/1962	Jordan	317—197
3,060,292	10/1962	Moenke	200—104
3,121,149	2/1964	Richert	200—93

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