United States Patent

Rubenstein

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[54] ELECTRICAL SWITCH ASSEMBLY WITH IMPROVED PRINTED CIRCUIT CONTACT STRUCTURE

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**200/11 R,** 200/16 C, 200/166 PC

[51] **Int. Cl.**.....**H01h 19/58,** H05k 1/00

[58] **Field of Search**.....200/11, 24, 28, 86 R, 86 A, 200/166 F, 166 PC, 168 G, 16 C

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[57] **ABSTRACT**

An electrical switch wherein one or more contacts are provided on a first contact member which is resilient and is formed of a layer of electrically conductive material on a base layer of insulating material. This contact member is biassed into engagement with a second contact member when the switch is closed. The second contact member is preferably a similar resilient member which may be secured to one face of a supporting member. Resilient sheets from which a plurality of different contact members can be cropped are also disclosed.

8 Claims, 5 Drawing Figures

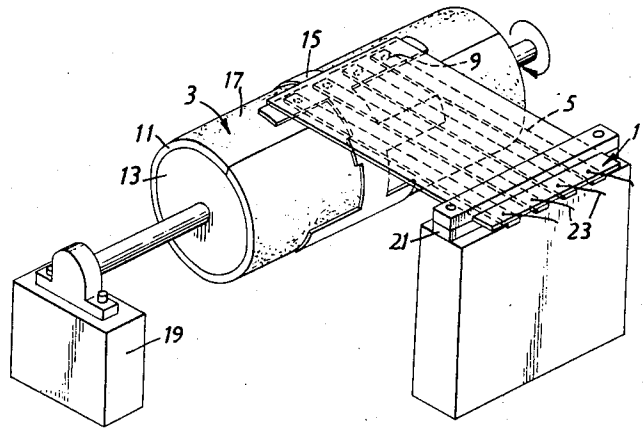


FIG. 1.

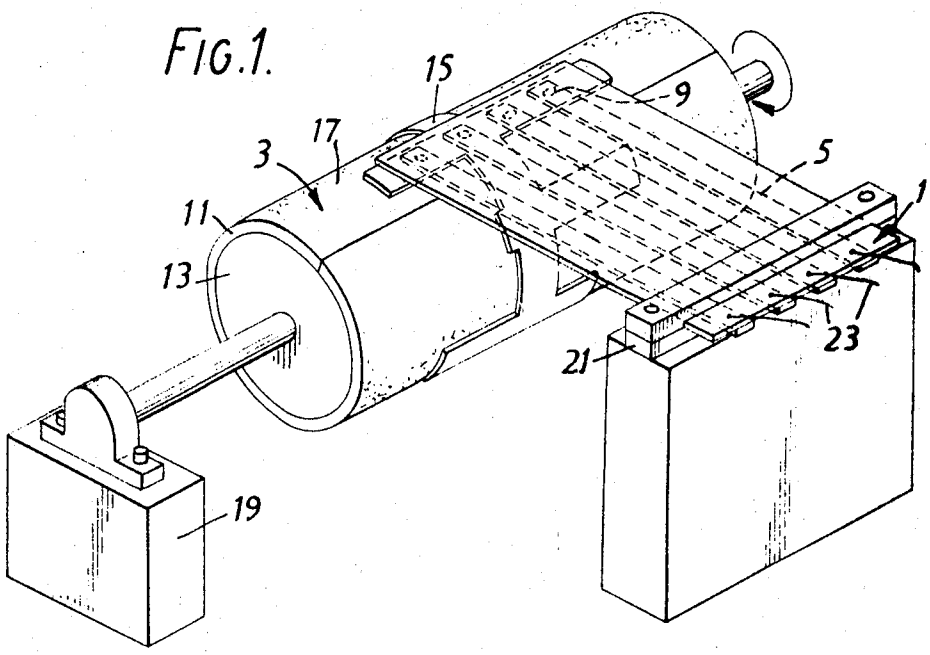


FIG. 2.

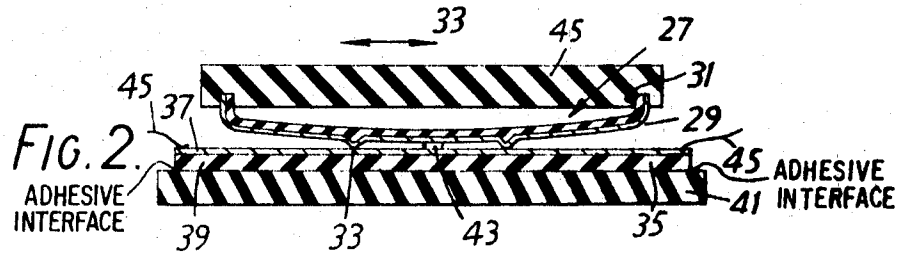
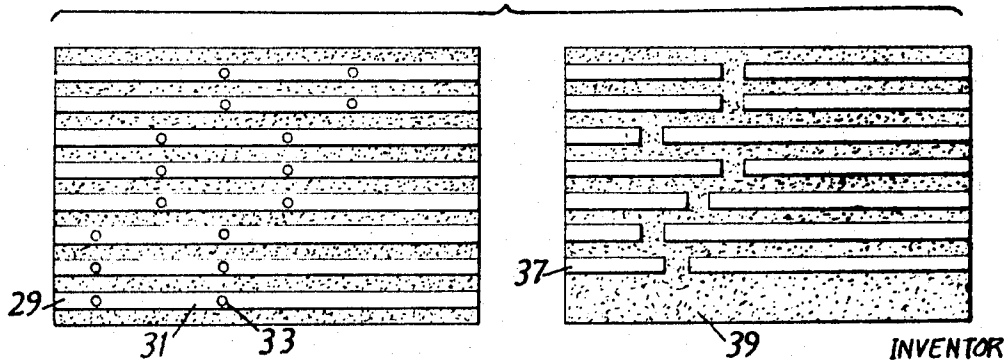


FIG. 2A.



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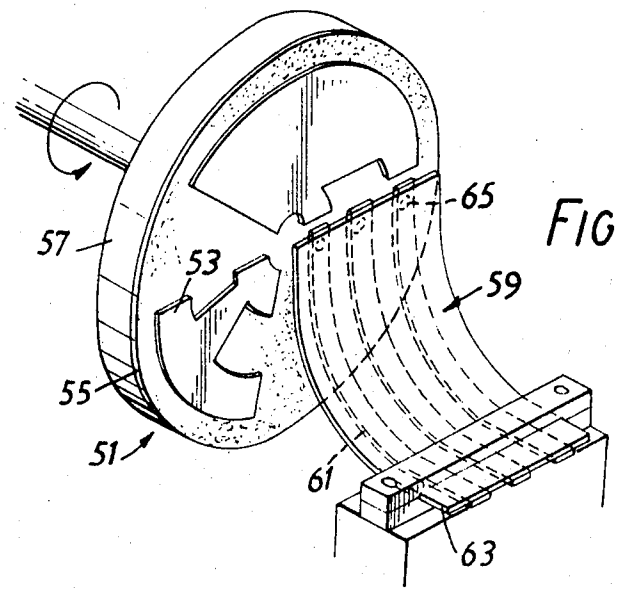


FIG. 3.

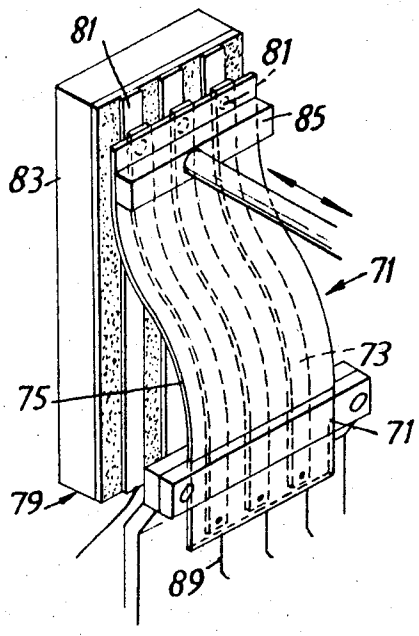


FIG. 4.

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ELECTRICAL SWITCH ASSEMBLY WITH IMPROVED PRINTED CIRCUIT CONTACT STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to electrical switches.

STATEMENTS OF THE INVENTION

The present invention includes an electrical switch wherein a pair of electrical contacts are respectively provided by relatively movable contact members, a first of the said contact members is resilient and comprises a layer of electrically conductive material on a base layer of insulating material, the said contact members are biassed into engagement with each other when the switch is in a closed condition, and the inherent resilience of the first contact member then serves to assist in maintaining the said contacts in engagement with each other.

Suitably, an area of electrically conductive material on the first contact member which engages the electrical contact on the second contact member when the switch is closed is raised relative to the remainder of the said conductive material.

The invention also includes, for use in making an electrical switch, a resilient sheet comprising a base layer of insulating material having on one side thereof a plurality of mutually spaced strips of electrically conductive material, each strip having at a predetermined location thereof a raised contact area of electrically conductive material, the sheet being readily cropped into a plurality of electrical contact members each containing one or more of the said strips.

The invention also includes, for use in making an electrical switch, a resilient sheet comprising a base layer of insulating material having on one side thereof a plurality of mutually spaced strips of electrically conductive material, there being a break in each strip, the sheet being readily cropped into a plurality of electrical contact members, each containing one or more of the said strips.

Suitably, the mutually spaced strips extend parallel with one another or are concentric arcs of a circle.

The invention also includes a method of making an electrical contact member for an electrical switch from a resilient laminate of electrically conductive material and insulating material, which method comprises the steps of applying a masking material to the layer of electrically conductive material, removing the masking material from mutually spaced, parallel arranged areas of the laminate to expose the electrically conductive material, removing the exposed electrically conductive material by etching, removing the masking material from the remaining, mutually spaced, parallel arranged strips of conductive material, and forming a raised contact area on each of the said strips.

The electrically conductive material is suitably copper and the insulating material is suitably mylar, fiber glass or polyester fiber.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a first electrical switch according to the invention;

FIG. 2 is a longitudinal section of a second switch according to the invention;

FIG. 2A are resilient sheets from which the switch of FIG. 2 is made; and

FIGS. 3 and 4 are perspective views of further switches according to the invention.

The electrical switch shown in FIG. 1 of the drawings is a rotary switch containing two relatively movable contact members 1 and 3, each providing a series of electrical contacts.

Contact member 1 is a resilient sheet comprising a series of parallel, mutually spaced strips 5 of copper on a base layer 7 of mylar.

The member 1 is formed from a laminate of copper and mylar by applying a resist or other masking material to the copper layer of the laminate and removing the masking material from selected areas by a photochemical etching technique. The exposed copper is then removed by the same technique to leave the above-mentioned strips 5 of copper.

A raised contact area 9 is formed on each copper strip 5 by embossing, these contact areas being aligned in a direction laterally of the copper strips 5.

The second contact member 3 of the present switch is a rotary switching member formed by securing an adhesive backing on one surface of a resilient sheet 11 to a cylindrical supporting member 13. The resilient sheet 11 comprises predetermined areas 15 of copper on a base layer 17 of mylar, and like the contact member 1 is formed from a laminate by a photochemical etching technique.

To form the switch the contact member 3 is mounted upon a suitable support 19 which allows rotation about the axis thereof. The resilient contact member 1 is mounted in a clamp 21 which engages an elongated section of the element which extends parallel with, and is spaced a short distance from, one edge thereof. Alternatively, the surface of the layer 7 of contact member 1 may be provided with a self-adhesive backing by means of which the member is secured to a fixed support.

The clamped section of the contact member 1 extends parallel with the axis of the member 3 and the raised areas 9 on the copper strips 5 engage the cylindrical surface of the member 3 along a line which extends parallel with the axis thereof. The arrangement of the resilient contact member 1 and the rotary member 3 is such that the former is biassed out of its natural, planar shape by engagement with the member 3. The inherent resilience of the member 1 tends to urge this member back towards its natural shape, thereby maintaining the member firmly in engagement with the rotary member 3.

The copper areas 15 on the rotary member 3 are so chosen that each metal strip 5 on the resilient member 1 is electrically connected to one or more of the remaining strips 5 when the member 3 assumes a predetermined angular position. Electrical connections to the strips 5 are made by soldering electrical leads 23 to parts of the strips which are disposed on the side of the clamp 21 remote from the raised areas 9.

Additional pressure to maintain the resilient member 1 in contact with the rotary member 3 may be applied by causing a further resilient member (not shown) to engage the member 1. To provide an even pressure a slit may be provided between each pair of adjacent strips 5 at the end of member 1 contacting the member 13.

In the present switch the resilient sheet 11 of the rotary member 3 forms a single turn round the cylindrical supporting member 13, opposed edges of the sheet 11 contacting each other to form a seam which extends parallel with the axis of the member 13. In an alternative construction the sheet 11 forms a spiral along the cylindrical supporting member 13.

It is convenient for a manufacturer or user of electrical switching apparatus to be able to construct a wide range of switches to suit his individual circuits from components supplied to him from component manufacturers. In the present instance this is achieved by supplying a resilient sheet comprising a series of mutually spaced, parallel arranged strips 5 of conductive material on a base layer 7 of insulating material. Each strip 5 is provided with a raised contact area 9, as described above.

From such a sheet the manufacturer or user can readily cut out a plurality of individual contact members 1 each containing a predetermined number of strips of predetermined length. Likewise, the manufacturer or user can be supplied with a further preformed resilient sheet from which he can crop one or more sheets 11 for mounting on a cylindrical supporting member 13.

FIG. 2 of the drawings shows a second switch according to the invention in which a first, resilient contact member 27 is again formed of a series of copper strips 29 on a base layer 31 of mylar. In this device, however, each strip 29 is formed with two raised contact areas 33 each of which is aligned with a corresponding contact area on each of the remaining strips.

There are therefore provided two lines of contact areas which extend laterally of the strips **29**.

A second contact member **35** of the present switch includes a resilient sheet containing a series of parallel, copper strips **37** on a base layer **39** of mylar, the thickness of each strip **37** and the spacing between adjacent strips respectively corresponding to the thickness and spacing of the strips **29** on the first member **27**. The base layer **39** of the resilient sheet is adhesively secured to a planar face of a supporting member **41** by means of a self-adhesive backing thereon.

Each metal strip **37** on the second contact member **35** is formed with a break **43** of predetermined length at a predetermined location thereon.

To form the present switch the contact members **27** and **35** are arranged with the two series of copper strips **29** and **37** parallel with one another and with each strip **29** on the member **27** facing a corresponding strip **37** on the member **35**. The resilient member **27** is then bent slightly about an axis perpendicular to the strips **29**, thereby moving the raised contact areas **33** out of the plane of the member towards the second contact member **35**, and is engaged in the holder **45**. The resilient member **27** is then arranged with the contact areas **33** engaging the member **35** and biassed thereby towards its natural planar shape. Holder **45** is engaged in grooved supports (not shown) which constrain movement thereof to the direction of the arrows in FIG. **2**.

Operation of the present switch involves sliding the resilient contact member **27** in a direction parallel with the strips on the members, as indicated by the arrows in FIG. **2**, whilst maintaining the members **27** and **35** in engagement with one another. The two sections of each broken strip **37** on the member **35** are electrically disconnected from one another or connected together by a strip **29** on the member **27**, according to the relative positions of the two members. Each end of each strip **37** on the member **35** has an external lead **45** soldered thereto.

To allow a manufacturer or user to construct any number of different switches according to his own circuit requirements it is convenient for a component manufacturer to supply him with composite resilient sheets, as shown in FIG. **2A**. One of these sheets contains a series of mutually spaced, parallel strips **29** of copper on a base layer **31** of mylar. Each strip **29** is provided with a pair of raised, contact areas **33**. The other sheet contains parallel strips **37** of copper on a base layer **39**, each strip **37** being formed with one or more breaks **43**. The manufacturer can then crop each composite member to form two or more individual contact members, each having a predetermined number of strips **29** or **37** of predetermined length, with the raised areas **33** or breaks **43** at predetermined positions lengthwise of the strips.

In the switch shown in FIG. **3** a second contact member **51** includes a resilient sheet comprising a series of copper areas **53** on a circular base layer **55** of mylar. This sheet is adhesively secured to a supporting disc **57**. A first resilient contact member **59** is formed of a series of metal strips **61** on a base layer **63** of mylar each strip **61** having a single raised contact area **65**.

The disc **57** is mounted for rotation about the axis thereof and the resilient contact member **59** is arranged with the contact areas **65** thereof extending radially of the disc **59** and biassed out of its natural shape by engagement with the second contact member **51**. Each strip **61** in the resilient member is electrically connected to one or more of the remaining strips **61** by one or more copper areas **53** on the second member **51**, or disconnected from all remaining strips, according to the angular position of the second member **51**.

FIG. **4** shows a switch wherein a first, resilient contact member **71** consists of a series of parallel copper strips **73** on a mylar base **75** and is supported by engagement of one end thereof in a clamp **77**. A second contact member **79** consists of a resilient sheet having metal strips **81** which is secured to a planar face of a supporting member **83**.

The two members **71** and **79** are arranged with the metal strips **73** parallel with and spaced from the strips **81** when the switch is in the off condition. An operating member **85** engages the first member **71**, intermediate the clamp **77** and raised contact areas **87** on this member, and upon operation to close the switch bends the first member **71** so that each contact area **87** engages a strip **81** on the member **79**. The distance through which the operating member **85** moves is slightly greater than the amount sufficient to cause each contact area **87** to contact the corresponding strip **81** on the second member **79**, and the contact area is then maintained in engagement with the strip by virtue of the inherent resilience of the first member **71**. An external lead **89** connected to one end of each strip on each member.

It will be appreciated that in the above switches it is not essential for the second contact member to be constructed from a resilient laminate.

The raised contact areas on the resilient contact member can be formed by electroplating copper on to the copper strip or by securing an additional element, suitably a rivet to the laminate rather than by embossing. Alternatively, the raised areas can be formed by etching away part of the remainder of the strips. To form a durable contact further metal may be electroplated on to the raised contact area. Suitably, the raised area is first plated with nickel and this in turn is plated with gold, to form "hard gold".

I claim:

1. A switching mechanism adapted to make and break a plurality of electrical connections, comprising a first member including a section of thin flexible insulating material, a plurality of resilient strips of electrical conductors carried on said insulating section in spaced apart substantially parallel relationship so that said section and conductors may be flexed and the inherent resiliency of said strips tends to bias said first member toward a relaxed condition, a second member having a predetermined pattern of conductive material thereon, said first and second members being disposed in operative relationship to make and break electrical connections upon relative movement therebetween, and the inherent resiliency of said strips acts to hold said first member in biased engagement with said second member.

2. The mechanism of claim **1** wherein spaced apart areas of said strips are raised with respect to the remainder thereof, the conductors of said second member are also a plurality of spaced apart and substantially parallel, and interrupted at portions along the length thereof, and said spaced apart raised portions of said first strips are arranged to selectively bridge the interruptions upon relative movement of said first and second members.

3. The mechanism of claim **1** wherein the second member is in the form of a rotatable disc having a conductive pattern on the face thereof, said first member is positioned with respect to said second member such that said strips are flexed and the inherent resiliency thereof biases said first member toward said disc.

4. The mechanism of claim **1** wherein the second contact member is formed with a generally planar surface upon which the associated electrical contact is provided and the mechanism is operated by relative movement between the contact members in a direction generally parallel with said strips.

5. The mechanism of claim **1** wherein the second member is a rotary element carrying contacts on a cylindrical surface thereof, and operation of the mechanism is effected by rotation of said rotary element.

6. The mechanism of claim **1** wherein the second contact member includes a rotary disc having the second contacts thereon on a planar face thereof and operation of the mechanism is effected by angular movement of the disc.

7. The mechanism of claim **1** wherein the second contact member is a resilient material having a layer of electrically conductive material on a base layer of insulating material secured to a supporting member of rigid construction.

8. A switching arrangement adapted to make and break a plurality of electrical connections, comprising a first member including a section of thin flexible insulating material, a plurality of resilient strips of electrical conductors carried on said insulating section in spaced apart substantially parallel relationship so that said section and conductors may be flexed and the inherent resiliency of said strips tends to bias said first member toward a relaxed condition, a second member having a predetermined pattern of conductive material thereon, said first and second members being disposed in operative relationship to make and break electrical connections upon relative movement therebetween, means for urging said first member into engagement with said second member and flex said first member, and the inherent resiliency of said strips acts to move said first member from engagement with said second member when the force of said means for urging is removed.

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