United States Patent [19]

Walker

[11] **3,745,287**

[45] **July 10, 1973**

[54] **KEY OPERATED SWITCH WITH DEPRESSIBLE BRIDGING CONTACT LAYER OF MATTED UNWOVEN ELECTRICALLY CONDUCTIVE FIBERS**

[75] Inventor: **Winston G. Walker,** Anaheim, Calif.

[73] Assignee: **Addmaster Corporation,** San Gabriel, Calif.

[22] Filed: **Oct. 1, 1971**

[21] Appl. No.: **185,677**

[52] **U.S. Cl.**..... **200/159 B,** 200/166 BH, 200/166 C

[51] **Int. Cl.**.... **H01h 13/52,** H01h 13/06, H01h 1/06

[58] **Field of Search** ..... 200/159 B, 166 C, 200/86 R, 166 BH, 159 R

[56] **References Cited**

UNITED STATES PATENTS

3,676,615	7/1972	Wiedmer	200/159 B X
3,617,666	11/1971	Braue	200/86 R
3,617,660	11/1971	Krakinowski	200/159 B X
3,437,973	4/1969	Mabbett	200/86 R X
3,227,840	1/1966	Reed et al.	200/166 C X
3,584,162	6/1971	Krakinowski	200/159 B X

FOREIGN PATENTS OR APPLICATIONS

1,216,717	4/1960	France	200/159 B

Primary Examiner—Herman J. Hohauser
Assistant Examiner—Robert A. Vanderhye
Attorney—Fred N. Schwend

[57] **ABSTRACT**

A key operated diaphragm type switch comprising a printed circuit board base having conductors thereon, a flexible sheet of non-conductive material supported in taut condition over the base and having an opening therein aligned with adjacent terminal portions of certain of the conductors, and a layer of unwoven matted metal fibers on the order of .10 in. thick overlying the sheet. Upon depression of the key, the underlying portion of the metal fiber layer and the flexible sheet are pressed toward the base. The portion of the metal fiber layer underlying the key is deformed through the opening in the flexible sheet and into bridging contact with the conductors to close the switch.

8 Claims, 2 Drawing Figures

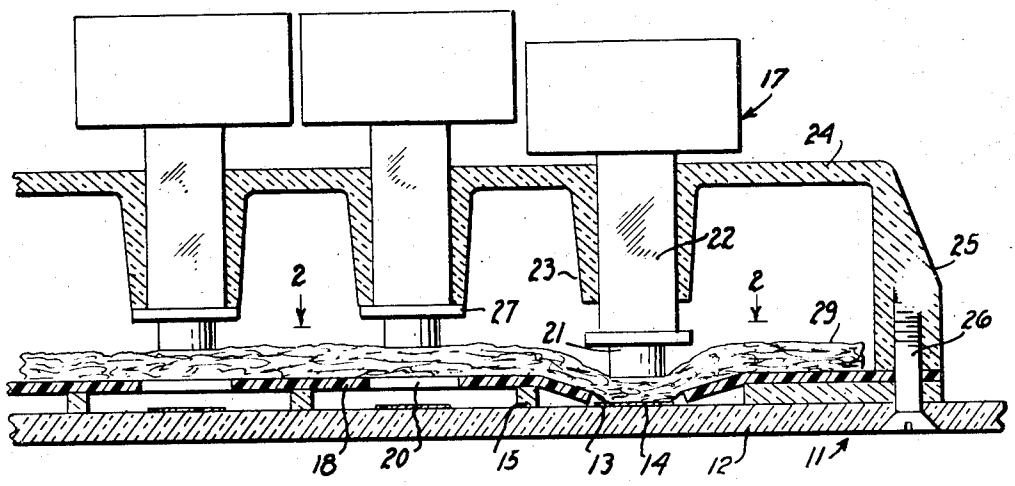
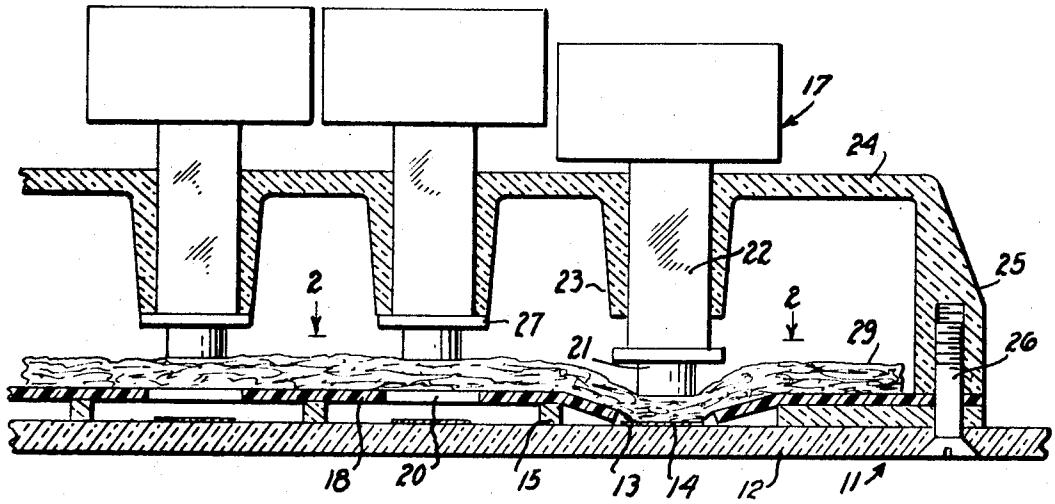


FIG. 1.


17
24
22
25
2
23
2
27
29
21
26
18
20
15
13
14
12
11

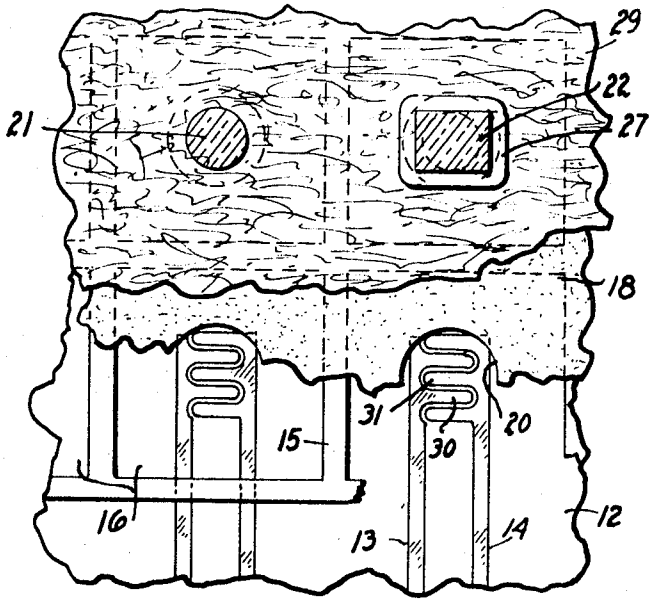

29
22
21
27
18
31
20
30
15
16
13
14
12

FIG. 2.

KEY OPERATED SWITCH WITH DEPRESSIBLE BRIDGING CONTACT LAYER OF MATTED UNWOVEN ELECTRICALLY CONDUCTIVE FIBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to key operated switches and has particular reference to switches of the diaphragm type which a reincorporated with printed circuit boards.

2. Description of the Prior Art

Key operated diaphragm type switches have been available heretofore in which a flexible diaphragm of elastomeric material or the like having conductive strips thereon is deflected by depression of a key to contact such strips with other conductive strips carried by a printed circuit board or the like.

Although such prior art diaphragm switches are generally satisfactory, the diaphragm generally lays closely adjacent the base and therefore the key is effective to close the contacts with very little key stroke. In fact, the operator may feel no apparent movement at all and since most operators are accustomed to an appreciable key stroke in operating keys of any kind, the lack of such apparent key stroke tends to become alarming and uncomfortable.

Further, in most keyboard operated switches, the switching contact area is relatively small and therefore may give a rise to appreciable contact resistance and heating.

Also, such prior switches generally comprise a single contact point or area and therefore any dirt or products of oxidation settling between the contact elements may prevent electrical contact from being made.

SUMMARY OF THE INVENTION

According to the present invention, I provide a simple and inexpensive key switch utilizing a flexible sheet of non-conducting material which is supported directly above a printed circuit board and which, in turn, supports a layer of compacted or matted conductive fibers, similar in some respects to the well known "steel wool." The flexible sheet has one or more openings therein aligned with adjacent terminal portions of certain conductors on the printed circuit board. Upon depression of a key located directly above such opening, the underlying portions of the layer of conductive fibers and the flexible sheet are pressed toward the printed circuit board and the aligned portion of the layer of conductive fibers is forced through the opening in the flexible sheet and into bridging contact with the terminal portions of the conductors. The conductive fibers, which are preferably plated with a thin coating of gold or other metal having little or no tendency to oxidize, presents a large number of contact points, thereby insuring adequate electrical contact even though only a light pressure may be applied to the overlying key. Such layer of fibers is resilient and, combined with the resiliency of the underlying flexible sheet, is effective to return the key to its undepressed condition through an appreciable stroke to thus give rise to a proper key stroke feel when the key is again depressed.

Because of the matted and flexible structure of the fibrous contact layer, any dirt particles or products of oxidation overlying the printed circuit board will have no effect since it is extremely unlikely that all of the many contact points presented by the fibers could be simultaneously blocked by such particles.

An additional feature of the invention is that because of the yieldable or cushioning character of the layer of conductive fibers, a substantially constant contact pressure, within reasonable limits, will be developed regardless of the pressure applied to the key during depression thereof.

A further feature of the invention resides in the fact that the flexible nature of the layer of conductive fibers enables the contact area presented by the adjacent or terminal portions of the printed circuit conductors to be enlarged as by forming spaced interdigitated projections.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional elevation view through a keyboard switching arrangement embodying a preferred form of the present invention.

FIG. 2 is a sectional plan view taken substantially along the line 2—2 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the switching arrangement forms part of a printed circuit board **11** which, according to general practice, comprises a base **12** on which a pattern of electrical conductors i.e., **13** and **14**, are formed. A grid like separater sheet **15** of plastic or other non-conductive material is mounted on the base **12** and has a group of square apertures **16** formed therein which are located below and in alignment with a series of depressible keys **17**.

A relatively thin sheet **18** of Mylar plastic or similar flexible non-conducting material is extended over the separater **15** and is provided with circular openings **20** centered over the apertures **16** in the separater **15** and arranged concentrically of cylindrical bottom portions **21** formed on key stems **22** of the keys **17**. Alternatively, the sheet **18** may be formed of a thicker resilient poly-foam or similar spongy material.

The key stems **22** are rectangular in cross section and are slidable vertically in mating bearings **23** formed in a plastic cover plate **24**. The latter has flanged sides **25** which are clamped to the printed circuit board **12** and sheet **18** by a series of clamp screws, one of which is shown at **26**.

During clamping of the cover plate **24** by the screws **26**, the sheet **18** is stretched taut, in at least one direction in its plane, so that it will normally be spaced above the surface of the various conductors, i.e., **13** and **14**.

A layer **29** of matted or interwoven metal fibers, similar to the commonly known "steel wool" is laid over the sheet **18**. Such layer is preferrably on the order .**10** inches thick, although this may be varied as desired. The layer **23** has a certain degree of resilience and is aided by the underlying portion of the sheet **18** to normally maintain the keys in their illustrated raised positions wherein flanges **27** formed on the key stems **22** limit against the bottom edges of the bearings **23**.

Although metal fibers of various conductive metals may be employed in forming the layer **29**, I have found that matted stainless steel fibers which have been plated with a coating of gold, on the order of 0.000050 inches thick, has proven satisfactory.

Upon depression of a key 17, as indicated at the right in FIG. 1, the lower key stem portion 21 deforms the immediately underlying portion of the layer 29 downwardly against the underlying portion of the sheet 18. A portion of the metal fiber is thus projected through the opening 20 and into bridging contact with underlying ones of the conductors i.e., 13 and 14 to close a circuit across such conductors.

In order to increase the area of bridging contact, the adjacent portions of the conductors 13 and 14 which are located under each key are formed with interdigitated projections or fingers 30 and 31 lying closely adjacent but out of electrical contact with each other.

The conductors 13 and 14 are also preferrably plated with an extremely thin coating of gold or other precious metal having little or no tendency to oxidize.

It will be noted that the layer 29 of metal fibers presents a multitude of contact points which insures adequate electrical bridging contact with the conductors regardless of the contact pressure applied by the key.

Because of its resilient nature and the multiple contact points presented by the layer 29, any products of oxidation, dirt or like foreign particles which might fall on the surface of the conductors and under the keys 17 will not be effective to prevent closing of the contacts upon depression of an overlying key. Also, because no wiping action occurs during closing of the contacts formed by the layer 29 and the printed circuit board conductors, no wear will occur and, therefore, the coating of gold or other precious metal may be made extremely thin without sacrificing its electrical contact qualities.

Due to the resilient nature of the layer 29 and the additional resiliency of the underlying portions of the sheet 18, the keys will have an appreciable key stroke, thereby presenting a proper "feel" and insuring return of the keys to their undepressed positions.

Although the layer 29 is merely laid loosely over the upper surface of the sheet 18, it may alternatively be either bonded thereto or clamped at its edges between the cover flanges 25 and the sheet 18 by the clamp screws 26.

I claim:

1. A key operated switching device comprising
a base plate of non-conductive material having a plurality of spaced electrical conductors thereon;
a flexible and compressible layer of matted unwoven electrically conductive fibers,
said layer being on the order of at least 0.10 in. thick, said fibers extending throughout said layer, means normally supporting said layer in spaced relation to said conductors, and
a plurality of depressible keys over said layer,
said keys each having a portion effective to flex an underlying portion of said layer into contact with underlying ones of said conductors upon depression of said key.

2. A key operated switching device comprising
a base plate of non-conductive material having a plurality of spaced electrical conductors thereon,
a sheet of flexible non-conductive material extending over said base plate,
means supporting said sheet in parallel spaced relation to said base plate,
said sheet having spaced openings therethrough aligned with underlying pairs of said conductors,
a flexible and compressible layer of unwoven matted electrically conductive fibers extending over said sheet and over said openings,
said layer being on the order of at least 0.10 in. thick, and depressible keys aligned with respective ones of said openings, each of said keys having a portion effective to flex underlying portions of said layer and said sheet and to deform a part of said layer through an aligned said opening and into contact with underlying ones of said conductors.

3. A key operated switch according to claim 2 wherein
means for supporting said sheet in spaced parallel relation to said base plate is provided.

4. A key operated switching device according to claim 2
wherein said layer is free on said sheet and supported solely by said sheet.

5. A key operated switching device according to claim 2
wherein each of said portions of said keys has an area smaller than the area of said aligned opening in said sheet.

6. A key operated switching device comprising
a base plate of non-conductive material having a plurality of spaced electrical conductors thereon,
a sheet of flexible non-conductive material extending over said base plate,
means supporting said sheet in parallel spaced relation to said base plate,
said sheet having spaced openings therethrough aligned with underlying pairs of said conductors,
a flexible layer of unwoven matted electrically conductive fibers extending over said sheet and over said openings,
depressible keys aligned with respective ones of said openings,
each of said keys having a portion effective to flex underlying portions of said layer and said sheet and to deform a part of said layer through an aligned said opening and into contact with underlying ones of said conductors,
said layer and said sheet forming the sole means for maintaining said key in undepressed condition.

7. A keyboard switching arrangement comprising
a base plate of non-conductive material having a plurality of spaced electrical conductors thereon;
a sheet of flexible non-conductive material having spaced openings therethrough aligned with adjacent portions with certain of said conductors,
means supporting said sheet in spaced relation to said base plate,
a deformable layer of unwoven matted metal fibers resting on said sheet and extending over said openings,
said layer being on the order of at least 0.10 in. thick, said fibers extending throughout said layer, and depressible keys resting on said layer,
said keys having actuating portions aligned with the respective ones of said openings,
each of said actuating portions being effective upon depression of its said key to flex underlying portions of said layer and said sheet and to project a part of said layer through a respective said opening and into contact with aligned ones of said conductors.

8. A key operated switch comprising

a base plate of non-conductive material having a pair of spaced electrical conductors thereon;
a sheet of flexible non-conductive material extending over said base plate,
means for supporting said sheet in spaced parallel relation to said base plate,
said sheet having an opening therethrough aligned with adjacent portions of said conductors,
a flexible layer of matted electrically conductive fibers extending over said sheet and over said opening, and
a depressible key,
said key having a portion effective to flex underlying portions of said layer and said sheet and to deform a part of said layer through said opening and into contact with said conductors,
said layer and said sheet forming the sole means for maintaining said key in undepressed condition.

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