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(54) **Membrane keyboard assembly.**

(57) The assembly includes a flexible insulating film (12) with indicia (21) visible on the upper surface and conductive contacts (14, 16, 18) on the lower surface. The top film may be comprised of two separate films (20, 12) for ease of applying the indicia and the contacts. The other contact of each SPST switch is a ground or reference contact formed by a chassis (10) or other relatively large and rigid conductive surface. A resilient spacer (22) is retained between the upper and lower switch contact surfaces and contains an aperture in registration with each upper switch contact.

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MEMBRANE KEYBOARD ASSEMBLY

Background of the Invention

This invention relates to the field of membrane keyboards and, more particularly, to a keyboard assembly having a simplified structure and providing superior protection against damage from static charges.

Membrane switches have generally been made in one of two general types, rigid and flexible. While flexible switches are generally cheaper to build, they also require a very firm and very flat mounting surface. Rigid switches have used printed circuit boards with one contact of each switch printed thereon. There are a number of known structures for membrane switch assemblies, most of which have problems and/or are expensive to construct. However, membrane switches can be made which are less expensive, installed, than other electronic switches or mechanical switches and, in all cases, a membrane switch assembly is thinner than any other known type. The flat surface of the membrane switch also lends itself to a wide variety of indicia arrangements, colors, etc.

A major problem in design heretofore has been to provide protection against damage to the associated circuitry from charges on the body of the user since a

person walking across a well waxed floor may generate a static voltage of from 4 to 15 kV, depending on humidity, etc. There are, of course, many varieties of circuitry which tend to protect from overload input voltages, but these complicate design and add to the cost thereof. In some applications, a protective overlay has been provided to prevent direct insulation breakdown, but if this overlay is very thick, the operation of the switches is affected. In some extreme cases, special plastic "operators" have been provided between the operator's finger and the switch. In some cases, a grounded border is used to interrupt surface currents due to contact charges, with a ground plane to reduce capacitance effects of the border. To date none of these solutions has been completely successful.

Summary of the Invention

It is an object, therefore, of the present invention to provide an inexpensive membrane switch which is easy to construct and easy to install.

It is a particular object to provide such a switch having the maximum amount of protection against damage from static charges.

These objects and others are provided in an assembly in accordance with the present invention wherein a flexible insulating film has conductive areas attached, as by printing, to one surface. Each area consists of at least one pad portion and a connecting link extending from the pad to the edge of the film. The film may also have graphics applied to indicate switch functions. A resiliant insulating foam spacer is adhesively attached to the one surface of the film, and has apertures therein corresponding to the pad portions of the conductive areas. A rigid conductive member, which may be a chassis, is adhesively attached to the other surface of

the foam spacer. The rigid member is connected to a circuit ground or reference point whereby, when a user's finger depresses the film in an area corresponding to one switch, the pad portion on the depressed area is moved through an aperture in the spacer and coupled to the ground. The circuit coupled to the corresponding connecting link is thus grounded, providing a desired function in the associated device.

Brief Description of the Drawing

The single drawing figure is an exploded view of the keyboard structure of the invention.

Detailed Description of a Preferred Embodiment

In the drawing figure, a rigid metal plate 10 forms a common contact for all switches of the keyboard, each switch thus providing a relatively low resistance ground for a corresponding electronic circuit when the switch is closed. In the preferred embodiment, the plate 10 is a terne-plated steel chassis, but it could be of any low resistance rigid material, preferably corrosion resistant so that the contact resistance of the switch does not change with time. A thin insulating flexible film 12 has a pattern of conducting areas affixed to a lower surface. These areas are the second contacts of the respective switches and are preferably screen printed on with a conductive ink such as Electrodag® manufactured by Acheson Colloids Co. Electrodaq 423SS is comprised of graphite in a vinyl binder, which has good adhesion to polyester films such as Mylar, and has a sheet resistance of from 30 to 50 Ω/sq. at a 10 mil thickness as is known in the art. Each conductive area will consist of

at least one pad portion 14 and a connecting link 16 extending from the pad portion to or near to the edge of the film 12. The connecting links may extend onto a tab portion 18 to a connector (not shown), or may be coupled to the corresponding circuits in any suitable fashion. A second film 20 may be superimposed on the film 12 to carry graphics 21 including indicia as to switch location and function. If desired, films 12 and 20 may comprise one layer of film bearing both graphics 21 and conducting areas 14, 16. The preferred material for the films is the material sold commercially as Mylar. Intermediate the film 12 and the plate 10, and adhesively attached to both, is a thin resilient, insulating foam spacer 22 with apertures 24, approximately corresponding in size and shape to the conductive pad portions 14. The material of the foam spacer will preferably be the type of material disclosed for this purpose in a co-pending application, attorney's docket No. AP-80266, assigned to the assignee of the present invention and incorporated herein by reference. In any case, the spacer 22 will have sufficient resilience to allow areas of the film 12 to be depressed to contact the plate 10, but to prevent contact otherwise. The material of the spacer should be such as to retain its resilience over a long span of time and much use.

In operation, a user desiring to close a particular switch in the circuit controlled by the keyboard assembly 10 will depress the insulating film 20 within the area designated by the indicia for that switch. Depression of the film in that area will bring the corresponding conductive pad 14 on the underside of that area of the film 12 into contact with the metal plate 10. Since only the resistance of the carbon ink is now in the switched circuit, a relatively low resistance "ground" is achieved. As is well-known, grounding a predetermined circuit point can enable a switching function

in the respective circuit. The present switch will, of course, be used with such circuits. In one application, the switches are designed to put from 6 to 20 kilohms across each respective circuit, and will even work with up to 75 kilohms. Such circuitry has been determined to be less expensive to produce than the circuitry required for capacitively coupled switches.

A major advantage of the above described structure is that any static charge developed on the body of the user is prevented from damaging the delicate electronic circuitry, since a substantial area (or volume) of "ground" is available to absorb the charge when a switch pad is depressed by the finger of the user. Naturally, any static charge transmitted to the switch assembly in any other fashion is likewise grounded harmlessly.

Thus there has been shown and described a simple and relatively inexpensive membrane keyboard assembly wherein damage to the associated electronic circuitry is prevented by using the chassis or other relatively large and rigid conductive surface as the common contact for each of the switches of the assembly. Thus, static charge, as on the body of the user, is prevented from damaging the circuitry coupled to the keyboard assembly.

What is claimed is:

Claims

1. A membrane keyboard assembly for a device including electronic circuitry and comprising:

a flexible insulating member (12);

conductive areas (14, 16, 18) on a first surface of the insulating member, each area including at least one pad portion and a connecting link extending at least near the edge of the member for connecting to respective portions of the electronic circuitry;

a rigid conductive member (10) adapted to be coupled to a reference terminal in the circuitry; and

a resilient insulating foam spacer (22) with one surface of the spacer being adhesively attached to the rigid member, the other surface of the spacer being adhesively attached to the first surface of the insulating member, and the spacer having one aperture in registration with each pad portion of the conductive areas.

2. A membrane keyboard assembly in accordance with claim 1 wherein the rigid conductive member forms at least a portion of the chassis of the device.

3. A membrane keyboard assembly in accordance with claim 1 wherein the flexible insulating member is comprised of a film of polyester.

4. A membrane keyboard assembly in accordance with claim 1 wherein the flexible insulating member is comprised of a first polyester film bearing the conductive surfaces and a second polyester film bearing indicia.

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