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(54) Membrane switch.

(57) A membrane switch is provided which comprises a base layer (10) of non-conductive material, a static circuit in the form of a first electrical conductor or conductors (11) mounted on said base layer, a spacer layer (14) having at least one aperture (15) therein which is coincident with said first conductor or conductors (11), a dynamic circuit in the form of a second electrical conductor or conductors (13) coincident with said aperture facing said first electrical conductor or conductors (11), and a resilient membrane (12) covering said second conductor or conductors (13).

Within the area bounded by the aperture a discontinuous layer of non-conductive material (16) is provided between said first conductor or conductors and said second conductor or conductors, whereby the first conductor or conductors is/are spaced from the second conductor or conductors until the resilient membrane is depressed by the user's finger and contact is made between the opposed first and second conductors in zones free of the non-conductive material.

In this manner advantage can be made of the deformable texture of the fleshy pad of the finger in that the latter will press one conductor (13) on both sides of a line of non-conductive material (16) into contact with its opposite conductor the pad temporarily deforming to accommodate the non-conductive line.

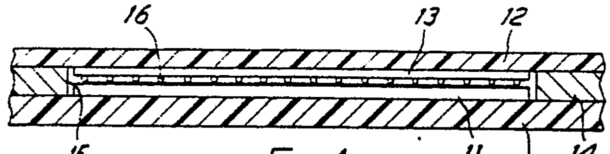

FIG.1

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MEMBRANE SWITCH

This invention relates to a membrane switch of the kind having a static circuit surmounted by a dynamic circuit of which discrete portions of one circuit may be electrically connected to discrete portions of the other by means of deformation of a membrane covering the dynamic circuit.

An example of a known form of membrane switch comprises a base layer of non-conductive material, a static circuit in the form of a first electrical conductor or conductors mounted on said base layer, a spacer layer having at least one aperture therein which is coincident with said first conductor or conductors, a dynamic circuit in the form of a second electrical conductor or conductors, coincident with said aperture facing said first electrical conductor or conductors, and a resilient membrane covering said second conductor or conductors by means of which membrane the second conductor or conductors may be moved into contact with the first conductor or conductors by finger pressure and moved out of contact by the resilience of the membrane and the air pressure contained between the two conductive layers. The first or second conductor or conductors may be applied to the base layer and membrane by printing.

Such an arrangement is satisfactory in switches where the aperture i.e. the area over which pressure is applied by the finger, is no larger than say from 8mm x 8mm to 30mm x 30mm. Where the touch area is required to be larger the problem arises that the membrane may sag so that undesired electrical contact may occur between the opposed conductors. The membrane is particularly vulnerable to sagging where ambient temperature can exceed 30°C e.g. in a motor vehicle.

In order to meet this problem attention was turned to scaling up the thickness of the membrane. However, this resulted in unsatisfactory operation since the finger pressure required for actuation of the switch varied over the touch area; less pressure being required at the central zone than at the marginal regions.

An object of the present invention is to provide a membrane switch having a relatively large touch area e.g. greater than 15mm x 15mm, which does not give rise to unwanted contact between the opposed conductors. Such a membrane switch would be desirable for use in operating a motor vehicle horn or as an emergency press button in a hospital.

According to the invention there is provided a membrane switch comprising a base layer of non-conductive material, a static circuit in the form of a first electrical conductor or conductors mounted on said base layer, a spacer layer having at least one aperture therein which is coincident with said first conductor or conductors, a dynamic circuit in the form of a second electrical conductor or conductors coincident with said aperture facing said first electrical conductor or conductors, and a resilient membrane covering said second conductor or conductors, characterized within the area in that bounded by the aperture a dis-continuous layer of non-conductive material is provided between said first conductor or conductors and said second conductor or conductors, whereby the first conductor or conductors is/are spaced from the second conductor or conductors until the resilient membrane is depressed by the user and contact is made between the opposed first and second conductors in zones free of the non-conductive material.

Preferably the first and second electrical conductors are printed on the base layer and membrane respectively and the non-conductive material is printed in a uniform pattern on the second conductor or conductors or on the membrane.

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

FIGURE 1 shows in section a membrane switch in which the electrical conductors are supported on the surfaces of the base layer and the membrane, a non-continuous layer of non-conductive material being provided on the surface of said membrane,

FIGURE 2 shows an underplan view of the membrane and the non-conductive material applied in grid pattern,

FIGURE 3 shows another pattern of said non-conductive material in "brick-wall" pattern,

FIGURE 4 shows a further pattern in dot matrix,

FIGURE 5 shows another embodiment having an array of electrical conductors and connection with a dot pattern of non-conductive material, and

FIGURE 6 is a schematic section of the embodiment of Figure 5.

The membrane switch shown in Figure 1 comprises a base layer 10 of non-conductive material supporting a static circuit in the form of a first continuous conductor 11 which is printed onto the surface of layer 10. A deformable membrane 12 carrying a dynamic circuit in the form of a second continuous conductor 13 printed thereon is spaced from said base layer 10 by a spacer layer 14 provided with an aperture 15. The two conductors 11, 13 are disposed just within the periphery of the aperture.

The conductor 13 has a discontinuous layer of a non-conductive material 16 printed thereon in intersecting lines over substantially the whole area bounded by the aperture. In this manner the two conductors 11,13 are held apart by contact of the material 16 with the layer 11 expecially in examples in which the aperture is more than 15mm x 15mm e.g. 100 mm x 65 mm, where otherwise the membrane may tend to sag over its relatively wide span.

By careful selection of the width and spacing of the lines advantage can be made of the deformable texture of the fleshy pad of the finger in that the latter will press the conductor 13 on both sides of a line of non-conductive material into contact with its opposite conductor, the pad temporarily deforming to accommodate the non-conductive line.

The discontinuous layer shown in Figure 2 is in the form of a squared grid having a thickness of from 10 -20 μ, preferably 15 μ, a line spacing of from 3.5 -15mm, preferably 5mm, between centres and a line width of from 0.25 - 1mm, preferably 0.5mm.

The pattern shown in Figure 3 is similarly dimensioned to the square pattern of Figure 2 with the exception that alternate vertical lines have been omitted from alternate horizontal rows, so as to form a "brick-wall" pattern. The dimensions and spacing may be as in the example of Figure 2. This facilitates depression by the user's finger in that at each junction of a vertical and horizontal line three lines meet, as shown encircled at 17 in Figure 3, and thus offer less resistance than in the Figure 2 example where four lines meet at each juncture.

In a further example shown in Figure 4 the discontinuous non-conductive layer is formed as a matrix of dots spaced apart by 3.5 - 15 mm, preferably 5mm, each dot having a diameter of from 0.25 to 1mm, preferably 0.5mm.

The base layer, spacer and membrane may all be made of polyester or polycarbonate resin. The base layer may be from 0.5 to 1.0mm in thickness and the membrane from 0.125 to 0.25mm. The conductive layers are each about 15 μ thick and by providing a spacer having a thickness of about 0.125 to 0.5mm, the clearance in the normal unoperated condition the clearance between the non-conductive layer 16 and the conductive layer 11 is much greater than 15 μ.

Contrary to the examples of Figures 1-4, in the example of Figure 5 the non-conductive discontinuous layer 16 may be printed onto the membrane 12 so that it appears as a pattern of dots disposed within the spaces of a dis-continuous conductive layer 13 also printed on the membrane 12. The non-conductive layer 16 has a greater thickness than the conductive layer.

In this example the switch comprises a base layer 10 on which is printed a static circuit 11 within the area of an aperture 15 in a spacer 14. The membrane 12 is arranged over the space so that the conductive and non-conductive layers 13, 16 of the pattern shown in Figure 5 are located within the boundary of the aperture 15.

The pattern may be varied in dependance upon the pressure required to operate the switch. In all the examples a single pressure level is required to operate the switch at any selected point over the touch area.

The non-conductive layer may be formed by screen printing a two-part epoxy resin ink (e.g. 10 parts printing colour (other than black) mixed with 1 to 2.75 parts catalyst as supplied by MarlerPak).

If desired a non-conductive layer may be printed on both opposing conductive layers.

Claims

1. A membrane switch comprising a base layer (10) of non-conductive material, a static circuit in the form of a first electrical conductor or conductors (11) mounted on said base layer, a spacer layer (14) having at least one aperture (15) therein which is coincident with said first conductor or conductors (11), a dynamic circuit in the form of a second electrical conductor or conductors (13) coincident with said aperture facing said first electrical conductor or conductors (11), and a resilient membrane (12) covering said second conductor or conductors (13), characterized in that within the area bounded by the aperture a discontinuous layer of non-conductive material (16) is provided between said first conductor or conductors and said second conductor or conductors, whereby the first conductor or conductors is/are spaced from the second conductor or conductors until the resilient membrane is depressed by the user and contact is made between the opposed first and second conductors in zones free of the non-conductive material.

2. A membrane switch as claimed in Claim 1, characterized in that said non-continuous layer of non-conductive material (16) is printed over said first conductor or conductors (11) or over said second conductor or conductors (13).

3. A membrane switch as claimed in Claim 1 or 2, characterized in that said second conductor or conductors (13) is/are printed on said resilient membrane (12) and said non-conductive material (16) is printed on said second conductor or conductors (13).

4. A membrane switch as claimed in Claim 1 or 2, characterized in that said first electrical conductor or conductors is/are printed on said base layer

(10) and the non-conductive material (16) is printed in a uniform pattern on the second conductor or conductors.

5. A membrane switch as claimed in Claim 4, characterized in that the first and second conductors each comprises in continuous layer, and in that said discontinuous layer of non-conductive material (16) is printed on said second conductor (13) in the form of intersecting lines over substantially the whole area bounded by the aperture.

6. A membrane switch as claimed in any one of Claims 1-5, characterized in that said discontinuous layer of non-conductive material (16) is in the form of a squared grid pattern.

7. A membrane switch as claimed in any one of Claims 1-5, characterized in that said discontinuous layer of non-conductive material (16) has a "brick-wall" pattern.

8. A membrane switch as claimed in Claim 5,6 or 7, characterized in that the lines of the pattern have a thickness of from 10-20μ, preferably 15μ, a line spacing of from 3.5-15mm, preferably 5mm, between centres and a line width of from 0.25-1mm, preferably 0.5mm.

9. A membrane switch as claimed in any one of Claims 1-4, characterized in that said non-conductive material (16) if formed on a matrix of dots.

10. A membrane switch as claimed in Claim 9, wherein said dots are spaced apart by 3.5-15mm, preferably 5mm, each dot having a diameter of from 0.25 to 1mm, preferably 0.5mm.

11. A membrane switch as claimed in Claim 1 or 2, characterized in that the non-conductive material (16) is printed onto the membrane as a pattern of discrete areas e.g. dots, disposed within the spaces of a discontinuous conductive layer (13) also printed on the membrane (12), the non-conductive layer being thicker than the conductive layer (13).

12. A membrane switch as claimed in any one of Claims 1-11, characterized in that a non-conductive layer may be printed on both opposing conductive layers (11,13).

13. A membrane switch as claimed in any one of Claims 1-12, wherein the non-conductive layer or layers maybe formed by screen printing a two-part epoxy resin ink.

14. A membrane switch as claimed in any one of Claims 1-13, characterized in that the base layer, spacer and membrane are all made of polyester or polycarbonate resin.

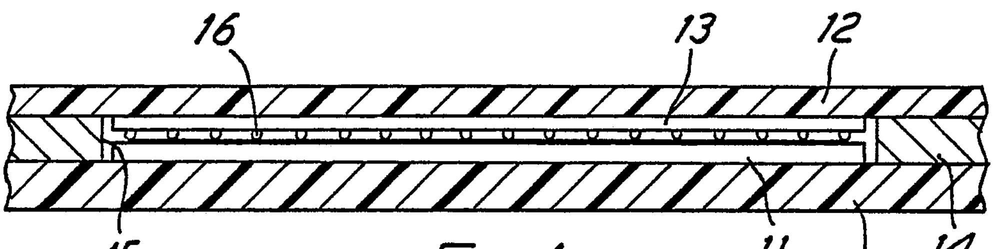

FIG.1

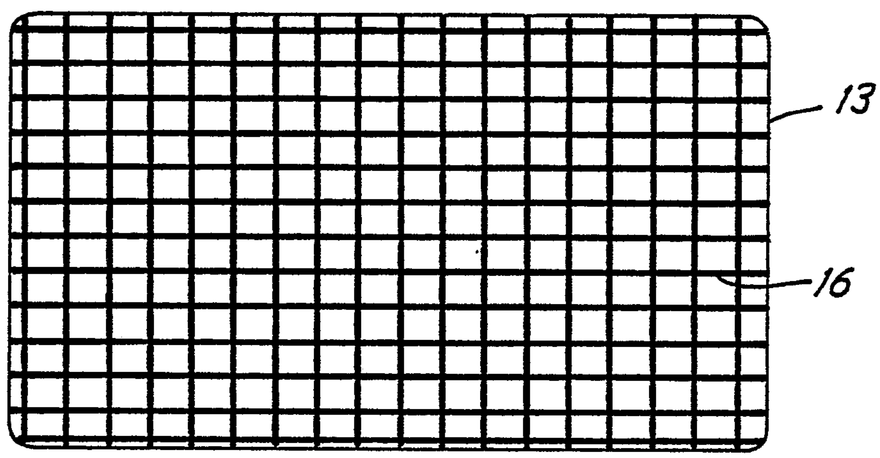

FIG.2

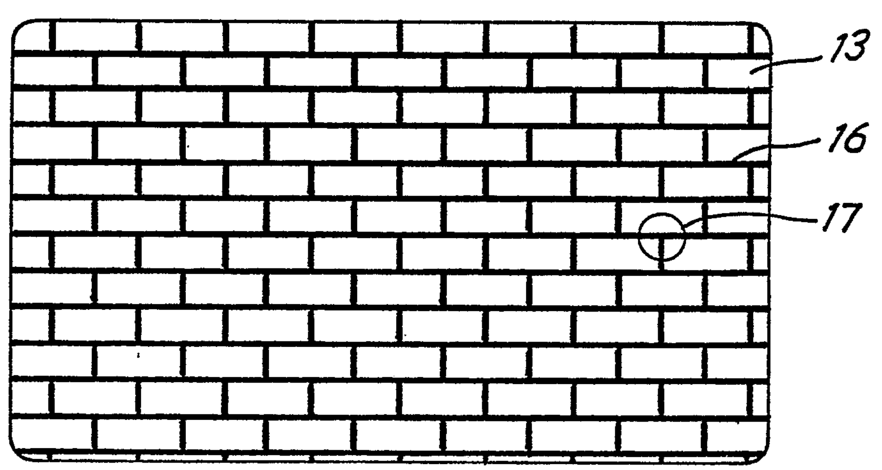

FIG.3

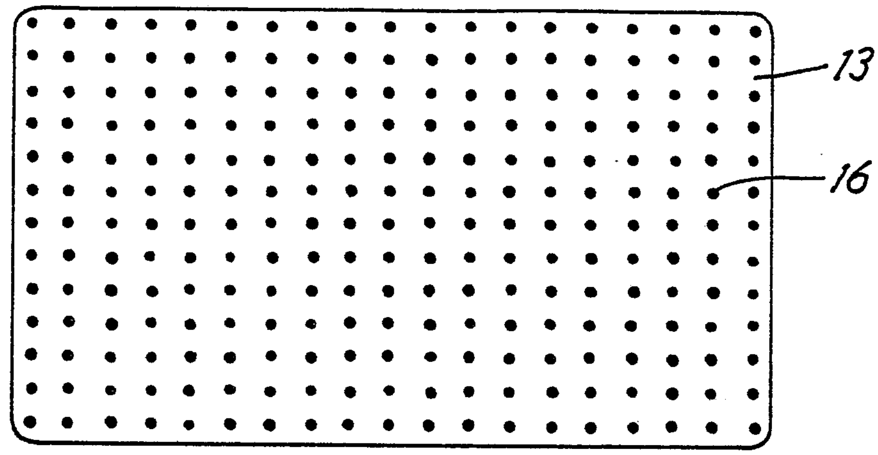

FIG. 4

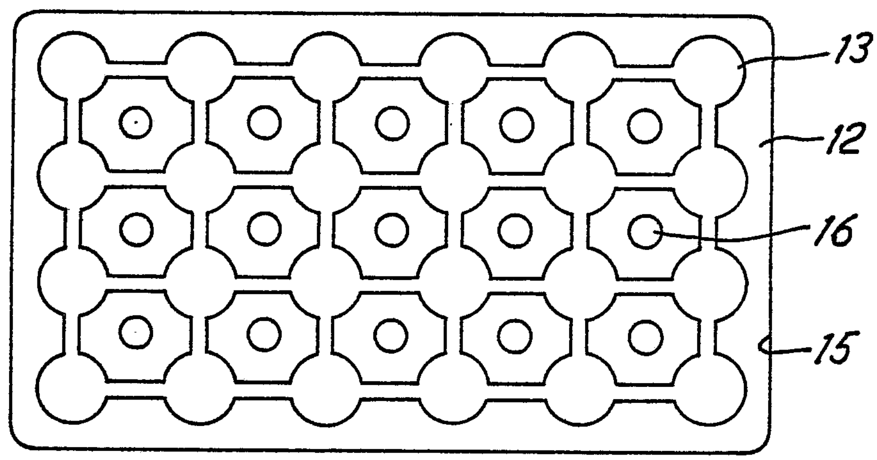

FIG. 5

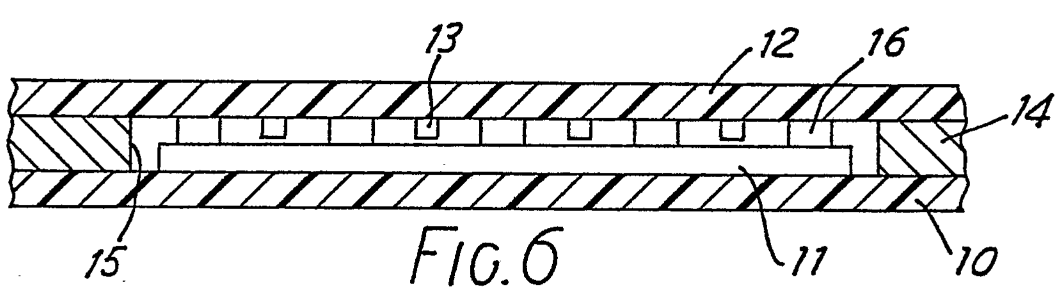

FIG. 6