

[54] **PUSHBUTTON SWITCH ASSEMBLY FOR KEYBOARDS INCLUDING A BRIDGING CONDUCTIVE, ELASTOMERIC DIAPHRAGM TYPE CONTACT**

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[51] Int. Cl. .... **H01h 13/54**

[58] Field of Search ..... **200/1 R, 5 R, 5 A, 11 R, 200/11 DA, 11 K, 16 C, 159 R, 159 B, 166 C, DIG. 29**

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**FOREIGN PATENTS OR APPLICATIONS**

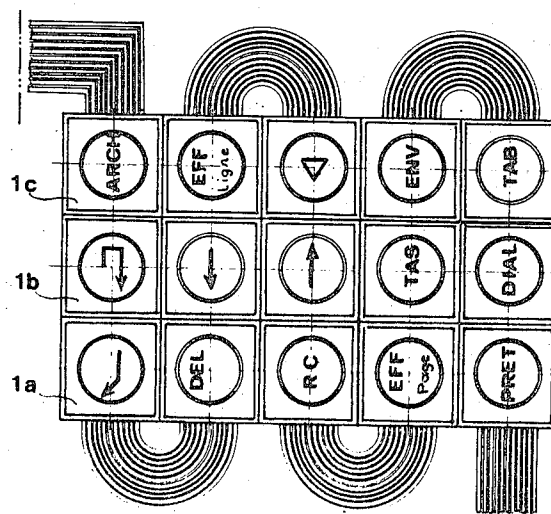
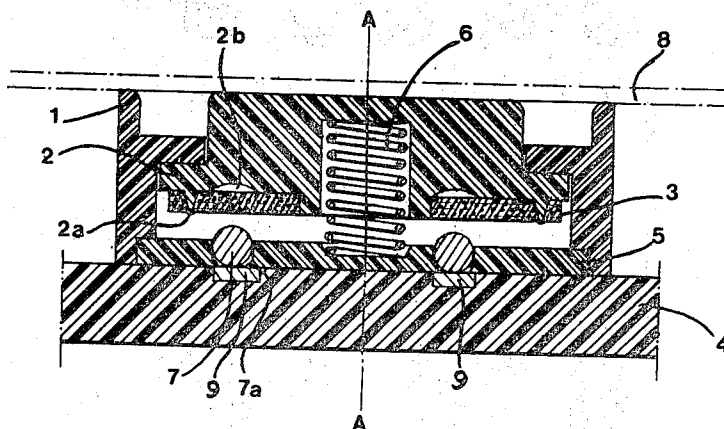
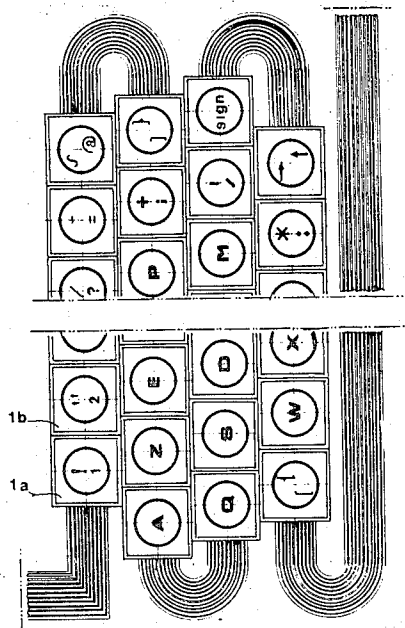
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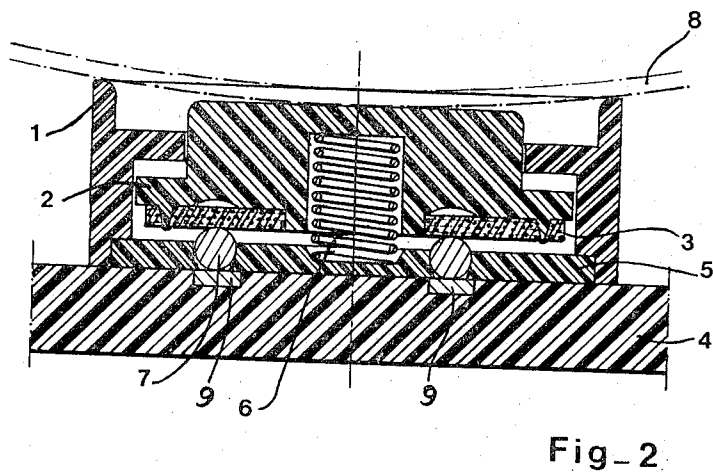
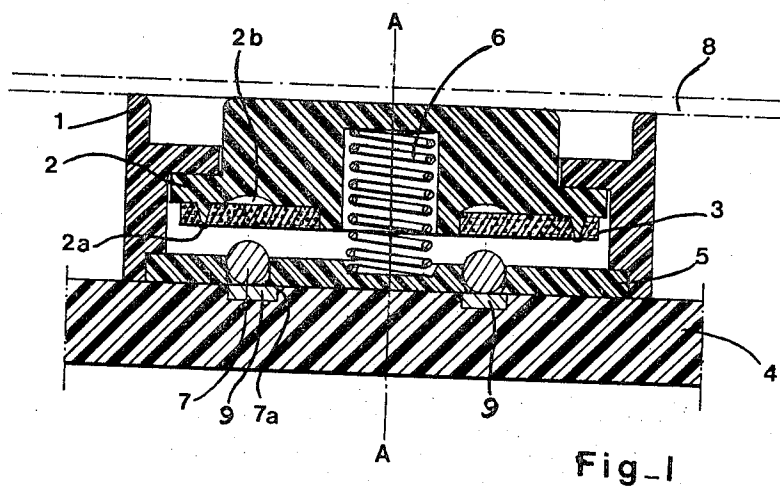
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[57] **ABSTRACT**

A pushbutton bears on its front face an elastomer conductive layer, conductive of electricity, of elastomer or elastic material and of limited area, which serves to close a circuit between two conductors of an array; moreover, between the latter and said layer there is arranged an insulating support exhibiting a pre-formed multiplicity of seats the positioning and arrangement of which are designed to be able to receive and hold each one ball or pellet or other equivalent intermediate member so that it can make contact on the one hand with the said conductors and on the other hand, when the pushbutton is depressed, with the said layer. Such an arrangement allows the use of coded combinations of contacts in a keyboard comprising a set of these pushbuttons.

**11 Claims, 5 Drawing Figures**





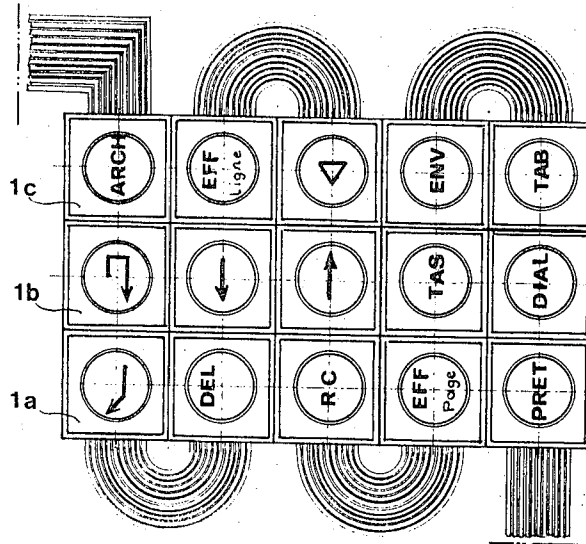


FIG-5

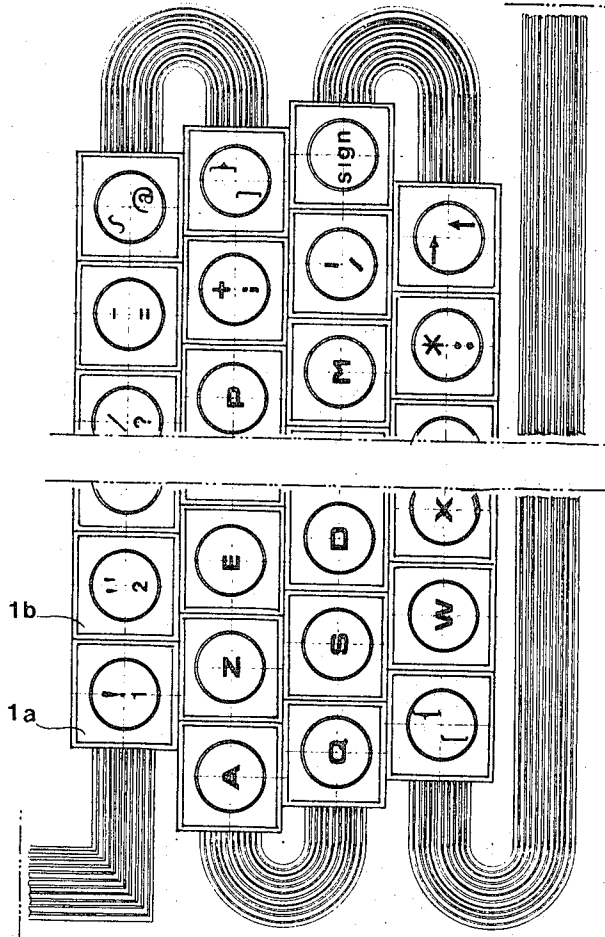


FIG-4

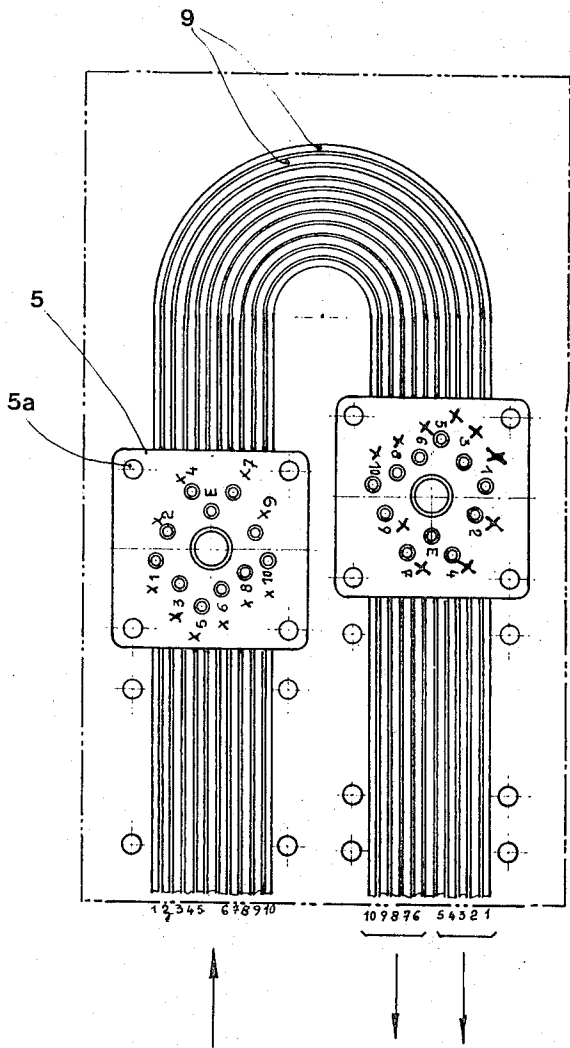


FIG-3

# **PUSHBUTTON SWITCH ASSEMBLY FOR KEYBOARDS INCLUDING A BRIDGING CONDUCTIVE, ELASTOMERIC DIAPHRAGM TYPE CONTACT**

The present invention concerning electrical switches or like members refers more particularly to devices with electrical contacts with pushbuttons capable of forming a keyboard and suitable for establishing electrical connections in a network or array of electrical conductors in accordance with combinations predetermined and preferably marked on top of the actuating buttons of the corresponding devices.

Combinations of devices are already known for the same purpose, with contacts arranged above an array of printed conductors, in which the plunger of the device, of pushbutton species, is provided with a small portion of conductive elastomer so that pressing the button which is integral with the plunger produces the application of the elastomer portion to the two conductors to be connected together which are situated underneath, and the establishment of a circuit. Such devices, capable of forming a keyboard, are convenient to handle and inexpensive to produce. At the same time, without completely exchanging an individual switch device it is very difficult to modify its function or its "coding," i.e., to make it connect two conductors different from those for which it was designed, because to do that it would be necessary to be able to modify the position of the elastomer portion on the active part of the plunger.

The principal object of the invention is to correct or improve upon the aforesaid by obtaining in individual contact devices in a keyboard a high flexibility of "coding" and at the same time a great facility for modifying this coding, while preserving in practice the advantages of the already mentioned known devices, namely, ease and economy in their construction. In this respect use will still be made in the invention, in the part establishing contact, of portions of conductive elastomer, in association with other means as will be explained.

Thus the invention relates to, as in the known previous art, to a device with electrical contacts actuated by push-button, in which the push-button bears on its front face a layer, conductive of electricity, of elastomer or elastic material and of limited area, which serves to close a circuit between at least two predetermined conductors of an array of electrical conductors, produced for example in printed circuits, arranged facing the push-button; but in addition the said device includes between the said elastic conductive layer and the array of conductors an insulating support exhibiting a pre-formed multiplicity of seats the positioning and arrangement of which are designed to be able to receive and hold each one ball (or pellet or other equivalent intermediate member) so that it can make contact on the one hand with one of the said conductors and on the other hand, when the push-button is depressed, with the said layer.

This device lends itself conveniently, for example, to the seating of two conductive balls in positions chosen to establish a connection, and also at least a third insulating ball to ensure stability. It is sufficient to change the positions of the conductive balls to modify the "coding" of the switch. It is easy to construct a keyboard of such switches.

The invention will be better explained and understood by referring by way of non-restrictive example to the following description and to the attached drawings in which:

FIG. 1 is an axial section through a contact device in accordance with the invention, in the up position (not making contact);

FIG. 2 is a similar section of the same device in the down position (making contact);

FIG. 3 shows how the ball seating plates can be arranged above the conductors, and

FIGS. 4 and 5 illustrate example of keyboards consisting of contact devices in accordance with the invention.

In FIG. 1 the body of the housing of the contact device is seen at 1, at 2 the push-button bearing at its end an elastomer layer 3 which here has an annular shape concentric with the axis A—A of the housing. The support 4 bears on its upper face the array 9 (FIG. 3) of printed circuits. A plate 5 fitted into the body 1 is applied against the slab 4 by means of screws 5a (see FIG. 3). An axial coil spring 6 is placed between the push-button and the plate.

The plate 5 exhibits a series of seats  $X_1, X_2 \dots X_{10}, E$ , in the form of holes open top and bottom, in which balls 7 can be placed without going right through, the hole being necked in at the bottom at 7a. The position of each of these seats is chosen to be directly on top of one of the conductors 9, the seats being distributed round the axis A—A as seen in FIG. 3.

In addition the annular ring 3 of conductive elastomer is fastened to the end of the push-button 2 by means of projections 2a borne by the latter, which simplifies putting it in position, ensures its retention but still enables it to be conveniently exchanged. Again, in the end face of the push-button facing each ball 7 slight hollows 2b have been formed.

For example, two balls 7 will be used, of a material conductive of electricity at least on the surface, such as metal (steel) silvered or gilded on the surface. It will be possible to have only two such balls; a third ball of insulating material, for example, glass, in a suitably placed seat, can ensure stability. The other seats can be unfilled or contain insulating balls as well.

When the push-button is pressed as by force 8 (FIG. 2), the conductive balls 7 which are each in contact with one of the conductors 9, are contacted by the ring 3. Good contact is obtained as a result of hollow 2b which when the push-button is pressed lets the elastic material of the ring deform freely and adopt the shape of the ball. In this way the two conductors of the array 9 are connected together through the two balls 7 and the ring 3.

The hole E is designed to come over the top of the voltage supply conductor (one pole of the voltage), the return circuit being made by any one (or a number) of the other conductors back to the other pole of the supply voltage. There can in fact be more than two conductive balls in action, namely a predetermined limited number of these balls, so as to connect together more than two conductors. Advantageously the ball 7 in the hole E can be a little smaller (for example, 0.1 mm smaller) than the others, so as to effect good contact simultaneously for a number of conductors with a delay.

It can also be seen that the assembly is designed so as to be easily dismantled and so that the combinations

of connections can be modified to choice in each contact device by moving the positions of the balls.

This system is thus very flexible. In addition, each of the contact devices can be placed at any point along the path of the array of these conductors. In FIG. 3 it is seen that the positions of the plate 5 (plate 5 has a standard form for all the contact devices) are reversed for the two devices shown; that is due to the path of the array of conductors, bent back on itself.

On this principle complete keyboards can be produced for all combinations to be effected. FIGS. 4 and 5 show examples of these executions. The tops of the contact devices (1a, 1b, etc...) are shown bearing symbols representing the combinations.

Over the top of the contact devices a flexible film or fabric can advantageously be provided which ensures air-tightness of the devices, the bodies of which exhibit on top an appropriate hollow shape not to obstruct operation, the fabric bending in as seen in FIG. 2. The film or fabric can be transparent and in this case the indication of the symbols are seen through it, engraved or otherwise marked on the faces of the push-buttons; or else the film or fabric itself, not necessarily transparent, bears the symbols printed on it, which are not essentially marked on the said faces of the buttons.

The embodiments described are only examples of the invention and that it would be possible to modify them, especially by substitution of technical equivalents, without thereby departing from the scope of the invention; for example, the balls can be replaced by pellets or other equivalent intermediate members.

I claim:

1. A contact device having a rest position and an operative position and comprising an elastic layer conductive of electricity and of elastic material, a push-button for actuating said contact device provided with spring means for repelling said push-button in said rest position and retention means for maintaining said layer on the inner operative face of said push-button, an insulating plate having a network of electrical conductors affixed on its surface facing the operative face of said push-button at a distance in the rest position, a plurality of tiny solid elements, some of which are conductive of electricity and each being in contact with a corresponding one of said conductors by their side opposed to said push-button, an insulating support which is distant from said layer in rest position, interposed between said layer and network of conductors and provided with a predetermined multiplicity of seats, each retaining therein one individual element, each of said elements

corresponding to an individual conductor so that said conductive element in contact with one conductor can also on its opposite face make contact with said layer when said push-button is depressed in operative position contrary to said spring means.

2. A device as in claim 1, in which said solid elements are balls of material conductive of electricity at least at the surface and in predetermined limited number are seated in seats of which the positions are predetermined in order to effect a coded combination of connections between conductors which can vary as a function of these positions.

3. A device as in claim 2, in which the said limit number is two.

4. A device as in claim 2, in which one of said balls comes into contact with one of said conductors connected to one pole of the supply voltage and other conductors are connected to the other pole, said one of the balls being slightly smaller than the other balls.

5. A device as in claim 1, in which in certain of the seats an insulating element is seated, for example of glass.

6. A device as in claim 1, in which said elastic or elastomeric layer has an annular shape encircling the axis of said push-button.

7. A device as in claim 1, in which said means of retention comprise at the end of said push-button roughnesses which can penetrate the material of said elastic layer.

8. A device as in claim 1, in which said face of the end of said push-button is provided opposite the positions of said seats with hollows enabling slight flexing of said elastic layer into them.

9. A device as in claim 1, in which said support has a plate shape and in which the different seats for said solid elements are distributed round the axis of said push-button.

10. A combination of contact devices as in claim 9, in which the said contact devices are at least partially joined side-by-side to form a keyboard with said array of conductors following a path passing underneath each of said devices, said support-plate being suitably orientated and the positions of said balls being selected to effect a distinct combination characteristic of each individual device.

11. A contact device as in claim 1, in which a flexible fabric covers the top of each body of said device, which has an appropriate hollow shape, ensuring its airtightness.

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