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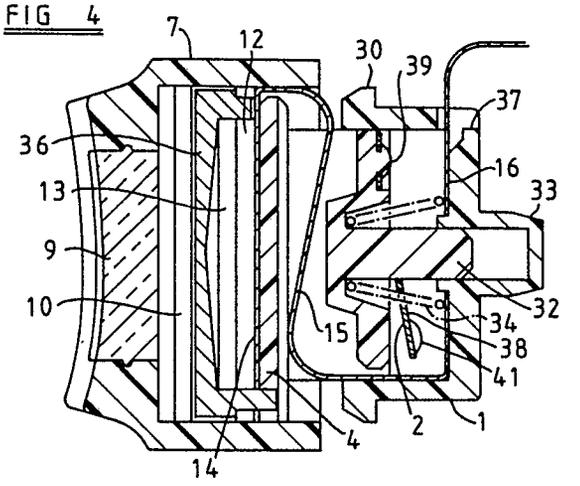
(54) Improvements in or relating to relegendable pushbutton switches.

(57) In order to accommodate relative movement between the movable button 7 and the fixed part 1 of the switch, a plurality of leads 14 connecting a display 10 mounted in the button 7 to the fixed part 1 follow an S-shaped path 15 with first ends extending into the button 7 and second ends extending into the fixed part 1. The leads 14 may be in the form of conductive tracks on a flexible printed circuit board. Such a switch may be used in a typewriter or computer keyboard, for example, and may be controlled to display different legends corresponding to different selectable functions of the switch.

FIG 4



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Description

"Improvements in or Relating to Relegendable Pushbutton Switches"

The present invention relates to relegendable pushbutton switches.

Pushbutton switches are used in a variety of applications and can be formed as individual switches, in groups, or arranged in arrays, for instance to provide a keyboard for a typewriter or computer terminal. Such switches can have an unmarked appearance or can be marked with a legend corresponding to or indicating the effect of actuation of the key. More recently, relegendable pushbutton switches have appeared in which a transparent panel in the cap or cover is located above an electro-optical display which is controlled to provide different legends corresponding to different selectable functions of the switch.

In order to provide a general purpose relegendable pushbutton switch which may be mounted in any suitable manner without requiring specially adapted printed circuit boards or the like, the electro-optical display has been mounted within the switch assembly. In order to allow the switch to use any suitable type of contact arrangement, it is preferable for the display to be mounted in the movable button or cap with the contact arrangement behind it. This gives rise to problems in providing electrical connections between the display and the fixed part of the switch, since such connections must allow movement of the display with the button or cap while providing reliable and robust electrical connection to the display.

According to the invention, there is provided a relegendable pushbutton switch, comprising a fixed part, a movable button, a display mounted in the button so as to be viewable, and a plurality of leads connected to the display and extending between the button and the fixed part, the leads following an S-shaped path with first ends extending into the button and second ends extending into the fixed part.

This arrangement allows the leads to accommodate the relative movement between the button and the fixed part without being subjected to substantial stress. The connections to the display are made in a reliable manner, thus ensuring reliability and a long working life of the switch. The leads can also be contained within the switch, or at least within the base profile of the switch, allowing such switches to be arranged in arrays with little or no spacing between adjacent switches. Such switches are therefore suitable for use in keyboards, for instance for computers, where the keys are required to be relegendable, closely spaced, and reliable despite heavy usage.

Preferably the leads comprise conductive tracks on a flexible printed circuit board. Preferably the flexible printed circuit board provides at least one switch contact of the switch. Such arrangements make manufacture easier and thus reduce cost.

Preferably the display comprises electro-optical display means and decoding means for driving the display. This allows the number of leads to be reduced when the display means incorporates multiple segment (e.g. seven segment) or dot matrix display devices. The display means may comprises light emitting diodes or a liquid crystal display. Preferably the decoding means is located behind the display means and, in the case of a liquid crystal display, may include light emitting means, such as light emitting diodes, for backlighting the display. The liquid crystal and the light emitting means may be covered by transparent or translucent material, such as epoxy resin.

Conveniently at least one movable switch contact is mounted on an actuator movable with the button. In a preferred embodiment the or each movable switch contact is provided on a cantilever spring plate fixed to the actuator.

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

Figure 1 is a front view of a relegendable pushbutton switch constituting a preferred embodiment of the invention;

Figure 2 is a side view of the switch of Figure 1;

Figure 3 is a sectional view on the line III-III of Figure 1;

Figure 4 is a sectional view on the line IV-IV of Figure 1;

Figure 5 is a rear view of the switch with the housing removed;

Figure 6 is a view similar to that of Figure 4 showing a modification;

Figure 7 is a view similar to that of Figure 3 showing another modification;

Figure 8 is a view similar to that of Figure 4 showing a further modification;

Figure 9 is a side view similar to that of Figure 3 showing yet another modification; and

Figure 10 is a block circuit diagram of an array of switches of the type shown in the other figures and associated circuitry.

In the accompanying drawings, like parts are referred to by the same reference numerals.

Referring to Figures 1 to 5 a preferred embodiment of relegendable pushbutton switch according to the invention comprises a housing 1 which is generally square in cross-section and which is intended to be mounted within a correspondingly shaped aperture in a mounting plate (not shown) so that a flange 30 thereon bears against the plate. Deformable tangs 31 are provided on opposite sides of the housing 1 and provide for a snap fit of the housing within the aperture. An actuator 4 bearing a switch element 2 is held within the housing 1 by barbed portions 5 which are snapped into rectangular openings 6 in opposite sides of the housing 1. The form of the opening 6 is such as to enable limited sliding movement of the actuator 4 within the housing 1, such movement being guided by an extension 32 of the actuator 4 which is guided within a recessed portion 33 of the housing 1 and the

actuator 4 being biased outwardly by a conical compression spring 34.

A button 7 has apertures 35 on opposite sides thereof which are a snap fit over second barbed portions 8 of the actuator 4 so as to fix the button 7 to the actuator 4. The front face of the button 7 comprises a clear lens 9 behind which is located a liquid crystal display 10. The liquid crystal display 10 provides an 8 x 16 dot matrix display element which is shown in Figure 1 indicating "F2". The dot matrix display is capable of displaying any alpha numeric character and a variety of other symbols.

The display 10 is provided with elastomeric connectors 11 which provide electrical connections to a printed circuit board 12. The printed circuit board 12 carries a display decoder/driver integrated circuit 13 for providing drive signals to the display 10. Furthermore a plurality of light emitting diodes 17 are mounted on the circuit board 12 to provide back illumination for the liquid crystal display 10, and a moulded cover 36 extends over the integrated circuit 13 to provide a desired visual effect. The cover 36 can be moulded in transparent clear or translucent coloured thermoplastic material to match the colour of the illumination provided by the light emitting diodes 17.

A flexible printed circuit board 14 is connected to the printed circuit board 12 and has a portion thereof located between the circuit board 12 and the actuator 4. This portion extends by way of an eased right angled bend smoothly into an S-shaped portion 15 located within the actuator 4, and the S-shaped portion 15 in turn extends into the housing 1 and, by way of an eased right angled bend,along the inside of a base portion of the housing where it constitutes a contact portion 16, prior to extending out of the housing 1 by way of an outlet 37 for connection to an external circuit.

The flexible printed circuit board 14 carries a plurality of printed tracks which are connected to the circuit board 12 and supply it with the signals for energising and controlling the display 10. In addition, the portion 16 of the flexible printed circuit board 14 carries tracks which cooperate with the switch element 2 to provide a set of switch contacts which are actuated when the button 7 is pressed.

The switch element 2 comprises a cantilever spring plate 38 fixed to the actuator 4 by a stud 39 and having two arms 40 provided with gold-plated contact dimples 41. The contact dimples 41 are arranged to contact gold-plated contact pads exposed on the surface of the portion 16 of the flexible circuit board 14 when the button 7 is pressed, so as to close the switch.

The S-shaped profile of the portion 15 of the flexible printed circuit board 14 accommodates the relative movement of the button 7 and the housing 1 when the button 7 is pressed. This profile allows such movement without the conductive tracks forming the leads to the circuit board 12 suffering any substantial stress. Also, the portion 15 remains fully within the base profile of the switch both during and after actuation, so that switches of this type may be located immediately adjacent each other without any danger of fouling or short circuits.

The switch is designed so that a plurality of such switches may be snapped into a mounting plate spaced 5 mm above a printed circuit board, to form a keyboard, the overall height of the switches above the printed circuit board being 18 mm. The switch is thus compatible with standard conventional keyboard switches, and can be used in combination with these, for example as function buttons on a microcomputer keyboard.

Various modifications of such a switch are shown diagrammatically in Figures 6 to 9, and these will now be described in so far as they differ from the preferred embodiment.

The switch shown in Figure 6 comprises an elastomeric switch element 2 carrying a conductive rubber contact element 3. The switch element 2 bears on the actuator 4 and biases it outwardly of the housing 1. When the button 7 is pressed the actuator 4 deforms the switch element 2 so that the contact element 3 bridges contact tracks on the portion 16 of the flexible printed circuit board 14. The integrated circuit 13 is not provided with a cover in this arrangement.

Figure 7 illustrates a modification of the switch of Figure 6 in which a plurality of light emitting diodes 17 are mounted on the circuit board 12 to provide back illumination for the liquid crystal display 10. Optionally, the space between the circuit board 12 and the display 10 may be filled with a transparent or translucent epoxy resin to provide a desired visual effect. The epoxy resin is preferably the same type as is used in the manufacture of light emitting diodes and may be in any of the colours normally used, for instance water clear (colourless), transparent red, green or yellow, or translucent red, green or yellow, depending upon the colour of the illumination provided by the light emitting diodes 17.

The switch element 2 is arranged to provide four millimeters of button travel and may be constructed so as to provide tactile feedback of when the switch has been actuated. Instead of the arrangement shown in Figures 6 and 7, the switch element 2 may be made of conductive silicone rubber so that the contact element 3 is unnecessary. In this case, the switch element acts directly to short together two tracks on the portion 16 of the flexible printed circuit board 14 when the switch is actuated.

Instead of cooperating directly with contacts on the portion 16, the switch element 2 may be made of non-conductive silicone rubber to provide four millimeters of button travel and may cooperate with a membrane switch formed by laminating the flexible printed circuit board at the portion 16 with a spacer and top contact layer.

Figure 8 illustrates another type of switch assembly in which the element 2 is replaced by a metal click-dome 18 operated directly by the actuator 4 to provide between 0.3 and 0.5 millimeters of button travel with tactile feedback. The click-dome 18 is mounted directly on the portion 16 of the flexible printed circuit board 14 and, when actuated, shorts out adjacent tracks. This type of construction permits a low-profile switch assembly to be provided.

In a modification of the switch shown in Figure 8, a

metal click-dome is provided but operates a membrane switch of the type described hereinbefore instead of acting as a switch contact itself.

Figure 9 shows another switching arrangement employing a snap-action contact mechanism in the form of a microswitch 19 whose actuating element 20 rests directly against the actuator 4.

Any other suitable switching arrangements may be provided. For instance, a reed switch could be located in the housing 1 connected to the portion 16 of the flexible printed circuit board and a magnet fixed to the adjacent side of the actuator 4. Also, solid state switching devices such as Hall-effect and capacitance switches may be used.

The switching arrangement may also be provided separately from the pushbutton switch assembly and mounted directly on an equipment motherboard with the pushbutton switch mounted directly over it. The flexible printed circuit board, which in this case does not carry the switching connections, may then be connected to the motherboard, for instance at some distance from the switch contacts by means of a suitable plug and socket arrangement. Thus, the pushbutton switch does not necessarily include the specific switch contact arrangement, which may be provided as a separate assembly.

Switches of the type described hereinbefore are eminently suitable for use in an array or matrix and are well suited for inclusion in a standard keyboard array. Grouped switches may be assembled onto a common flexible printed circuit board to reduce the number of interconnections required, thus increasing the reliability and reducing cost. Such common printed circuit boards may also include address decoding to provide interfacing with an equipment motherboard. This is illustrated in Figure 10 of the accompanying drawings.

Sixteen switches 21 (only two shown) are connected by a bus 22 to an address decoder 23 which had a data input for receiving data to define the legends displayed by the switches, and a parallel four bit binary address input for selecting the switches. The bus 22 is also connected to circuitry (not shown) for providing a clock signal, power supplies V_{SS} and V_{DD}, and a voltage V_{LCD} for powering the liquid crystal displays in the switches 21. Back light illumination signals may also be supplied to the switches 21. Preferably, the decoder/driver integrated circuit 13 has on-board memory suitable for storing data defining the last legend or legends which were selected for display. Thus, new data need only be supplied when a new or modified legend is to be displayed. The switch contacts 24 may be polled in the usual way, for instance by a computer.

Claims

1. A relegendable pushbutton switch comprising a fixed part (1), a movable button (7), a display (10, 12) mounted in the button (7) so as to be viewable, and a plurality of leads (14) connected to the display (10, 12) and extending between the button (7) and the fixed part (1), the leads (14) following an S-shaped path (15) with first ends extending into the button (7) and second ends extending into the fixed part (1).

2. A switch according to claim 1, wherein the leads (14) comprise conductive tracks on a flexible printed circuit board.

3. A switch according to claim 2, wherein the flexible printed circuit board provided at least one switch contact of the switch.

4. A switch according to claim 1, 2 or 3, wherein the display (10, 12) comprises electro-optical display means (10) and decoding means (12) for driving the display.

5. A switch according to claim 4, wherein the display means (10) comprises light emitting diodes.

6. A switch according to claim 4 or 5, wherein the display means (10) comprises a liquid crystal display.

7. A switch according to claim 6, wherein the decoding means (12) is located behind the display means (10) and includes light emitting means (17) for back-lighting the display.

8. A switch according to claim 7, wherein the liquid crystal display (10) and the light emitting means (17) are covered by transparent or translucent material (36).

9. A switch according to any preceding claim, wherein at least one movable switch contact (41) is mounted on an actuator (4) movable with the button (7).

10. A switch according to claim 9, wherein the or each movable switch contact (41) is provided on a cantilever spring plate (38) fixed to the actuator (4).

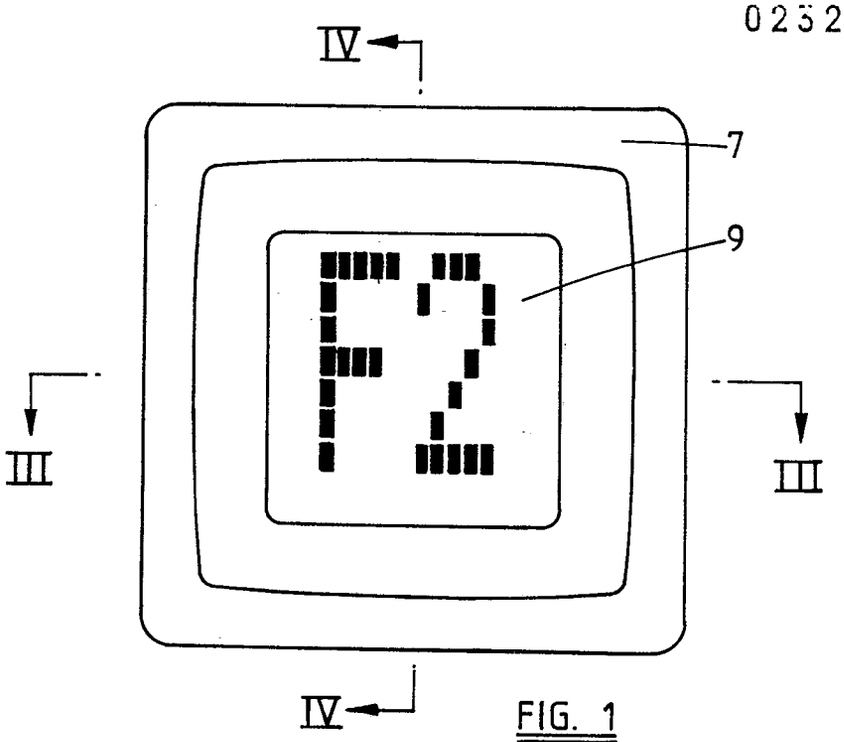


FIG. 1

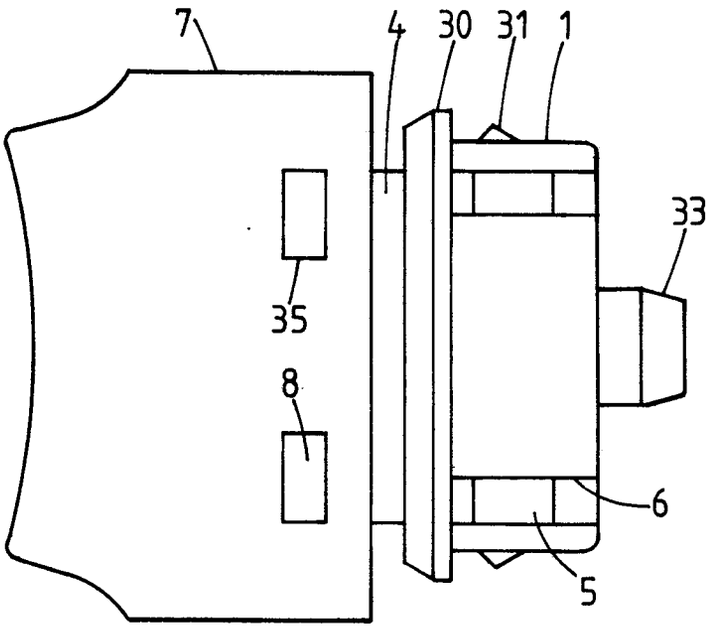
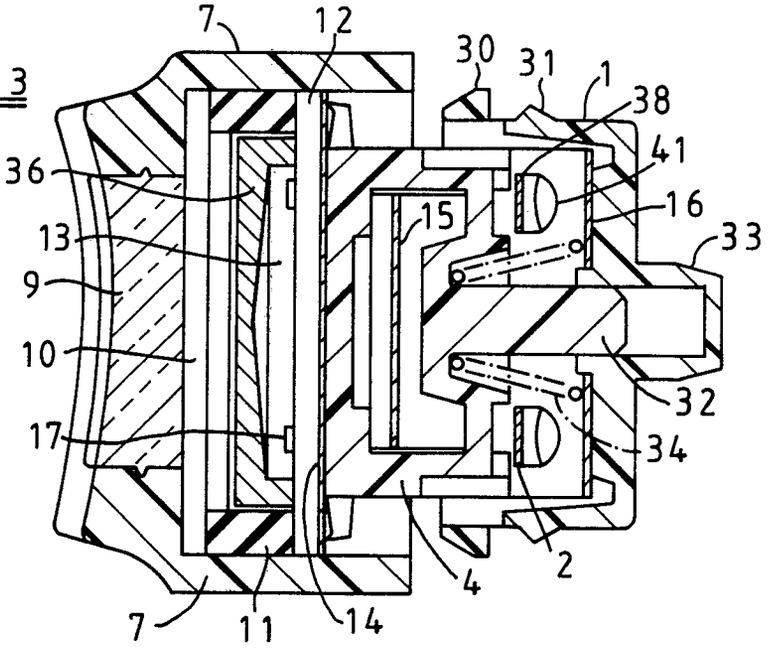


FIG 2

FIG 3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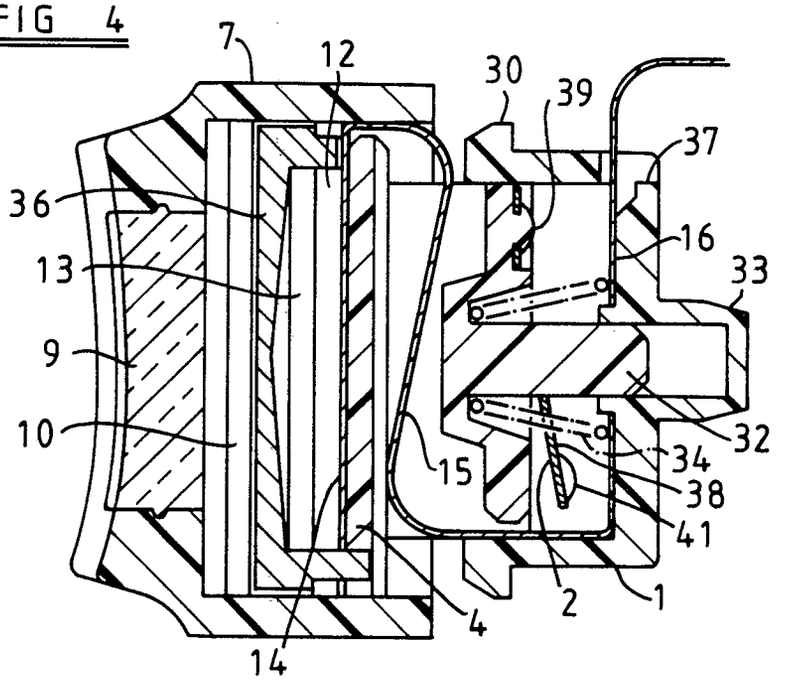
11
14

FIG 4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14

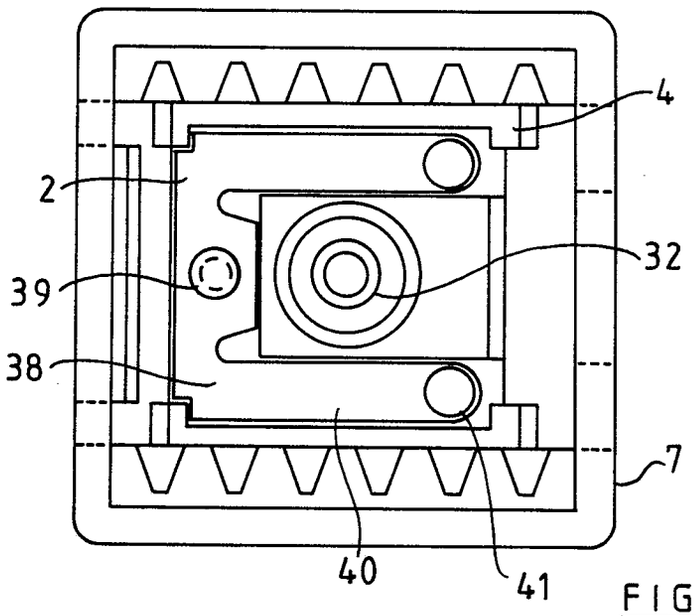

FIG 5

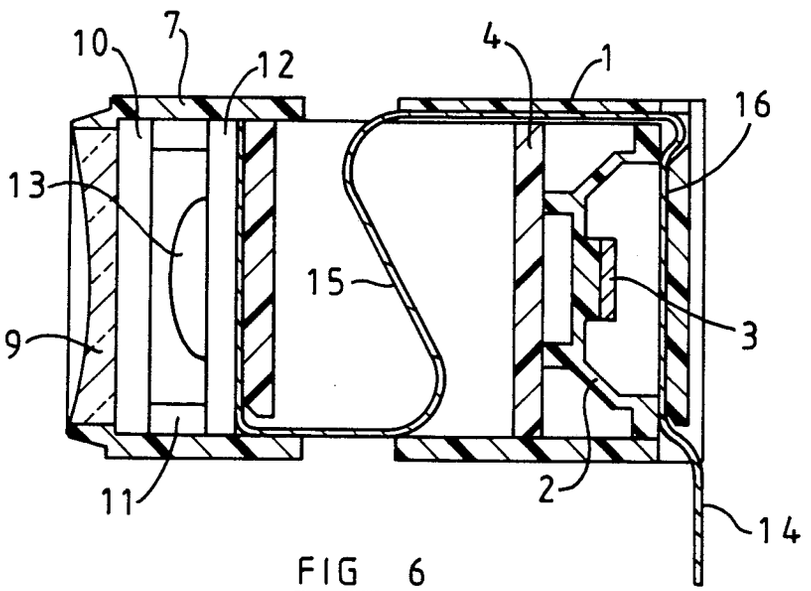

FIG 6

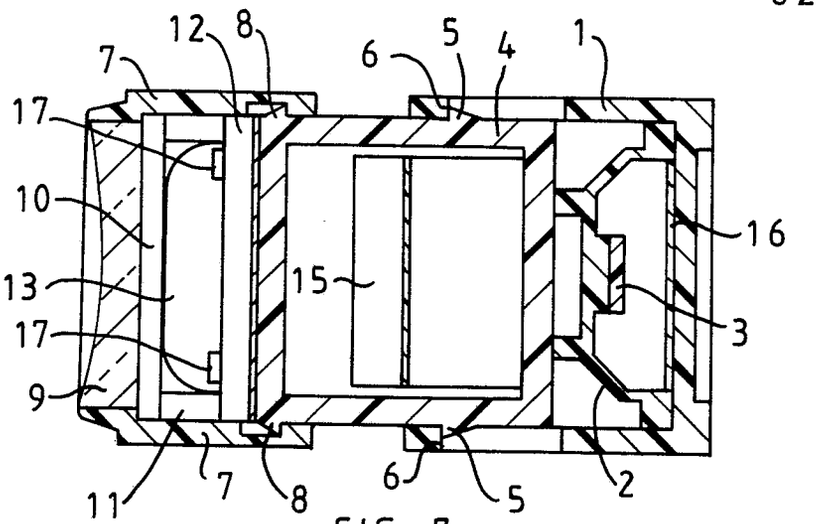

FIG 7

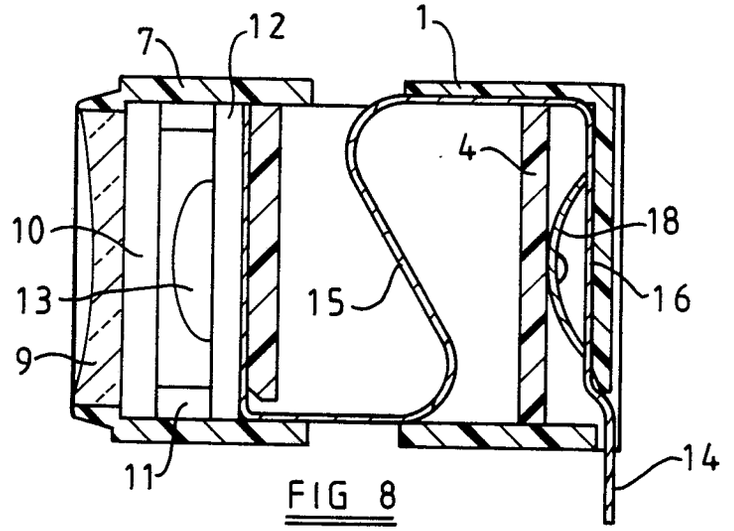

FIG 8

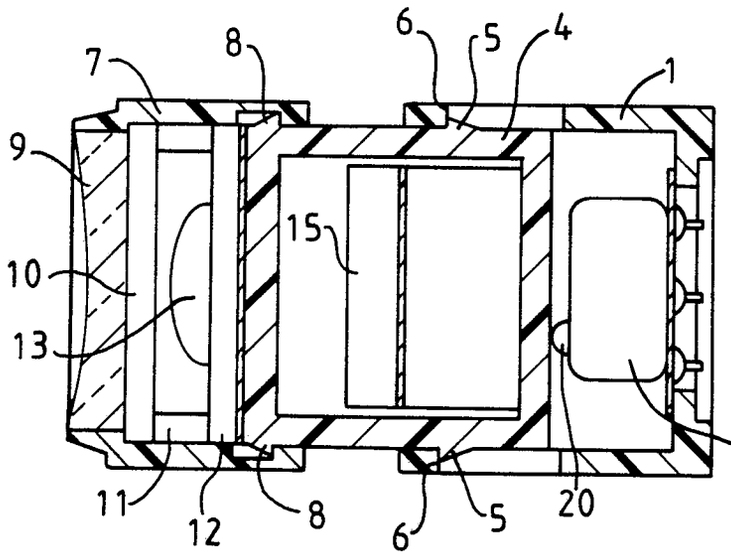

FIG 9

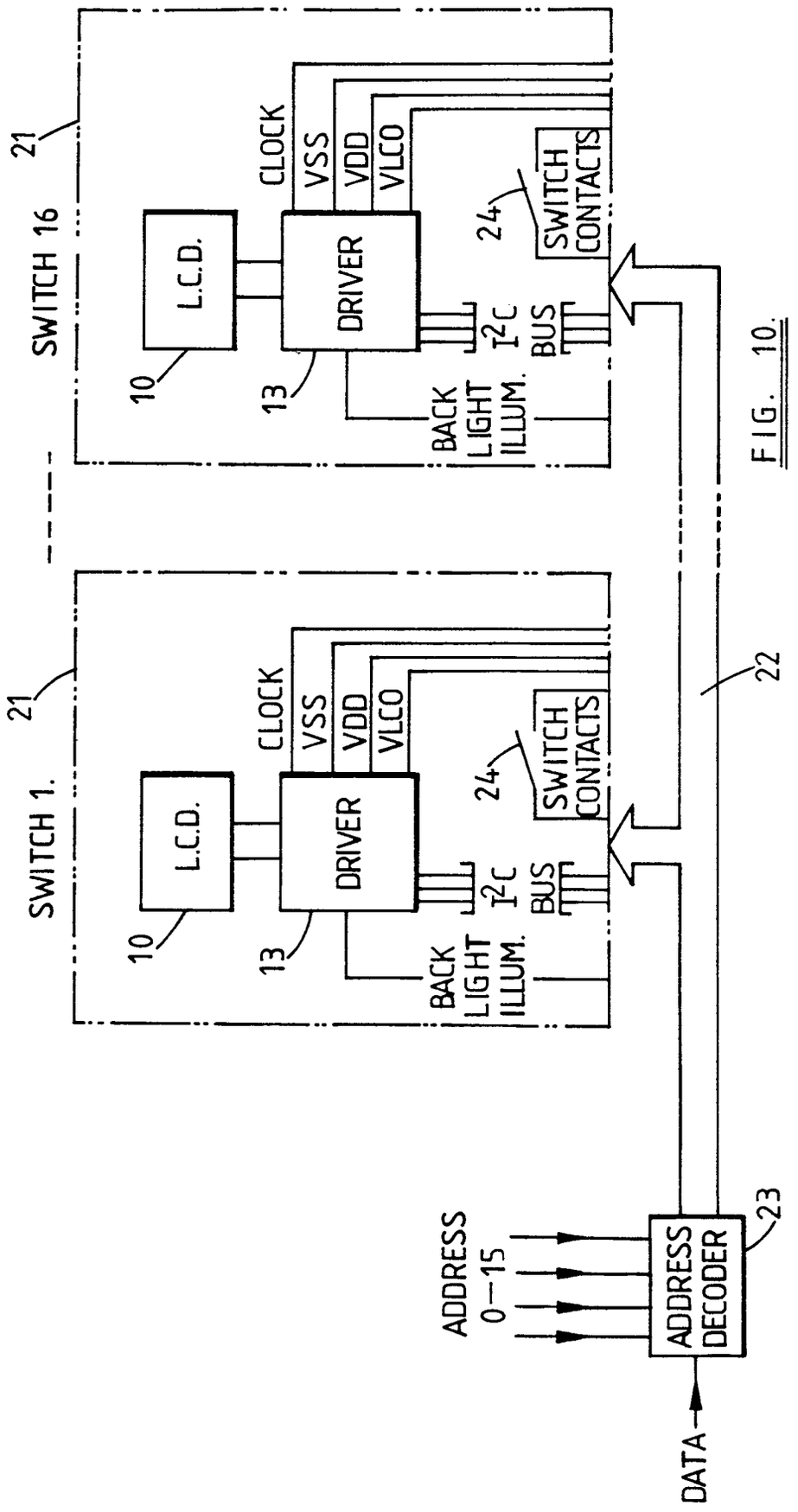
SWITCH 1.
SWITCH 16
21
L.C.D.
10
DRIVER
13
CLOCK
VSS
VDD
VLCO
I²C BUS
BACK LIGHT ILLUM.
24
SWITCH CONTACTS
22
ADDRESS 0–15
ADDRESS DECODER
23
DATA

FIG. 10.