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(54) **Rotary switching element**

(57) A rotary switching element, comprises
a membrane switch having a generally annular active area, said membrane switch comprising a plurality of dead regions along said active area where activation of the membrane switch is prevented,
an actuating element mounted for rotation on said membrane switch, said actuating element for locally activating said membrane switch, and
a mechanical step limiter associated to said actuating element, said step limiter for defining two alternating sets of activation and stand-by positions for said actuating element along a rotational travel path of said actuating element and for biasing said actuating element into one of said stand-by positions where said actuating element is associated to one of the dead regions of said membrane switch.

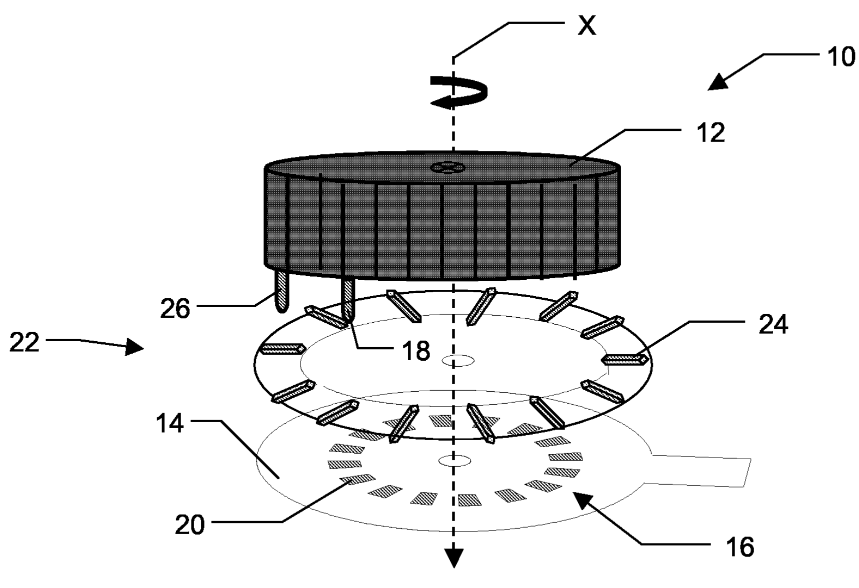

Fig. 1

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Description

Introduction

[0001] The present invention relates to a rotary switching element and more specifically to a pulse generating rotary switch having a reduced integration height.

[0002] Rotary switching devices or pulse generating rotary switches are used in cursor control devices for interactive, display oriented electronic systems wherein a display cursor is movable about the screen of the device by means of the cursor control device. These switches generate electrical signals corresponding to the position or the movement of a movable body and the so generated electrical signals or pulses are used to move the cursor on the display screen.

[0003] Various types of rotary switches are known in the art. Such rotary switches are based e.g. on the output signal of rotary potentiometers or on the output of optical encoders. These switches mostly suffer from a bulky construction and are accordingly not suitable for the integration into flat switch panels.

[0004] Today automotive vehicles are more and more equipped with menu controlled interfaces for controlling e.g. the air-conditioning system, the car hi-fi components, the navigation system, the car phone, etc. The control of these menu-controlled interfaces is performed by rotary switching elements, which are commonly mounted on the vehicle dashboard or on the console between the front seats. The space available for integration of such electrical components is however extremely reduced so that the above-mentioned classical rotary switching devices are very difficult to integrate.

Object of the invention

[0005] It is accordingly an object of the present invention to provide an improved rotary switching element.

General description **of** *the invention*

[0006] In order to overcome the abovementioned problems, the present invention proposes a rotary switching element, comprising
a membrane switch having a generally annular active area, said membrane switch comprising a plurality of dead regions along said active area where activation of the membrane switch is prevented,
an actuating element mounted for rotation on said membrane switch, said actuating element for locally activating said membrane switch, and
a mechanical step limiter associated to said actuating element, said step limiter for defining two alternating sets of activation and stand-by positions for said actuating element along a rotational travel path of said actuating element and for biasing said actuating element into one of said stand-by positions where said actuating element is associated to one of the dead regions of said membrane switch.

[0007] Membrane switches are known for providing electrical switching functions in a reliable, compact package. Membrane switches typically have a flexible plastic membrane layer normally separated from a substrate by a nonconductive spacer. Openings in the spacer permit a user to push the membrane through the spacer, bringing facing electrical contacts on the internal surfaces of the membrane and substrate into contact with one another, thereby closing a switch. The natural resilience of the membrane returns the membrane to its spaced position upon removal of the actuating force.

[0008] Membrane switches offer a very slim profile, low weight and economical assembly. With these properties, the membrane switches are of course just right for the construction of rotary switching elements having a very small constructional bulkiness. In fact, the very slim form of the membrane switches enables the construction of compact rotary switches having a reduced fitting height, i.e. compact rotary switches having a small thickness and accordingly requiring very small fitting depth. The rotary switching element of the present invention is accordingly very well suited for the integration into flat switch panels and in particular into the operation panel of an automotive vehicle.

[0009] It should be noted, that the membrane switches are very flexible, which enables an integration of the membrane switches into curved surfaces. With this property, the rotary switching element of the present invention offers an increased flexibility regarding the choice of the fitting space, especially for the integration into a curved surface of the console between the front seats of an automotive vehicle.

[0010] An ongoing problem in membrane switches has been providing feedback to a user of switch actuation. Since the membrane travel to closure is very small users usually cannot tell when they have actuated a switch unless there is something to indicate to them that closure has occurred. The present invention addresses this problem by providing the mechanical step limiter, which provides tactile feedback as the actuating element is rotated between activation and stand-by positions.

[0011] The step limiter of the present invention ensures a supplemental function of biasing the actuating element into one of the stand-by positions where the actuating element is associated to one of the dead regions of said membrane switch. It follows that, when the rotary switching element of the present invention is not operated, the actuating element is always located in a dead region of the membrane switch and accordingly the rotary switching element is "open". This means that electrode structures of the membrane switch are not electrically contacted and no current flows through the rotary switching element. Hence the rotary switching element of the present invention is usually idle and problems due to constant current flow, such as drift phenomena over time, may not occur.

[0012] As a further advantage of the rotary switching element being normally "open", the rotary switching element of the present invention may be connected in parallel with other keys or switching elements of a common operating panel, so as to reduce the total number of wires necessary to connect the operating panel to a control unit for processing the signals from the different devices. The rotary switching element may e.g. be connected in parallel with a keyboard having a number of individual keys.

[0013] In a first preferred embodiment of the rotary switching element of the present invention, the membrane switch comprises a first carrier foil and a second carrier foil arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element. The membrane switch further comprises a set of electrode structures being arranged in the active area of the membrane switch between the first and second carrier foils so as to define at least one pair of spaced switch contacts. In this case, at least one of said dead regions of said membrane switch is defined by a patch of dielectric material applied onto at least one of said electrode structures. The patch of dielectric or insulating material prevents the electrode structures from being brought into electrically conductive relationship in the region of the dielectric patch. It follows that no contact signal is generated at the output terminals of the membrane switch when said actuating element is located in the region of the dielectric patch.

[0014] In a second preferred embodiment, the membrane switch comprises a first carrier foil and a second carrier foil arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element. A set of electrode structures is arranged in said active area of said membrane switch in a spaced relationship on said first carrier foil. The membrane switch further comprises a shunt element comprising a number of shunt patches made of electrically conductive material, said shunt patches being arranged in said active area of said membrane switch on said second carrier foil, said shunt patches for establishing an electrical contact between said eletrode structures when said carrier foils are pressed together. In this embodiment, the dead regions may be defined if at least two of said shunt patches are arranged at a certain distance from each other so as to define at least one of said dead regions there between.

[0015] In this embodiment, activation of the membrane switch is only possible on those regions, where a shunt patch is arranged on the second carrier foil for establishing an electrical contact between the electrode structures on the first carrier foil. It follows that a pressure acting on the membrane switch in a region where no shunt patch is located, i.e. between two patches, does not result in an established electrical contact between the two electrode structures and accordingly no contact signal is generated at the output terminals of the membrane switch.

[0016] It should be noted that in this embodiment of the invention, the rotary switching element may further comprise a patch of dielelectric material arranged between said at least two spaced shunt patches. Such a patch of dielectric material may prevent the carrier foils from being bent at these locations, thus preventing an undesired contacting of the electrode structures in the immediate vicinity of the dead zone.

[0017] In a further preferred embodiment of the rotary switching element, said membrane switch comprises a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element. A first electrode structure comprises a plurality of first conductors, which arranged side by side on the first carrier foil so as to extend at least partially through said active area, said first connectors being interconnected by a first connection line. A second electrode structure comprises a plurality of second conductors, which are arranged side by side in alternation with said first conductors on said first carrier foil so as to extend at least partially through said active area, said second conductors being interconnected by a bleeder resistor. A shunt element is arranged in the active area of the membrane switch in facing relationship with said first and second conductors on said second carrier foil.

[0018] The second conductors in this embodiment are interconnected by means of a bleeder resistor, which may comprise a series of discrete resistors or an extended film resistor or the like. The second conductors are connected to the bleeder resistor in a voltage divider arrangement at different locations thereof, such that when a voltage difference is applied on the terminals of the bleeder resistor, each second conductor is supplied with a specific voltage depending on its position on the bleeder resistor. If the membrane switch is activated in one of the activation zones, the respective second conductor arranged in this activation zone are brought into conducting relationship with the first conductors arranged in the activation zone.

[0019] As a result, a voltage depending on the position of the second conductor may be measured on the terminal of the fist connection line. The voltage on the terminal of the first connection line is thus an indicator for the position of the respective second conductor on the bleeder resistance and accordingly an indicator for the location of the respective activation zone with respect to the active area of the membrane switch.

[0020] Furthermore, as the actuating element is moved along the active area, the actuating element activates the membrane switch subsequently in different activation regions of the switch. Since each of these subsequently activated activation regions produces a specific response voltage on the terminal of the first connection line, the direction of rotation of the actuating element can be unambiguously determined from the voltage signal on the terminal of the first connection line.

[0021] In an alternative embodiment of the rotary switching element, said membrane switch comprises a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element. A electrode structure comprises a plurality of first conductors, which are arranged side by side on said first carrier foil so as to extend at least partially through said active area, said first connectors being interconnected by a first connection line. A second electrode structure comprises a plurality of second conductors, which are arranged side by side in alternation with said first conductors on said first carrier foil so as to extend at least partially through said active area, said second conductors being interconnected by a second connection line. A third electrode structure comprises a third connection line which extends between said first and second conductors along said active area, whereby said third connection line alternately passes in the vicinity of one of said first and second conductors. A shunt element is arranged in said active area of said membrane switch in facing relationship with said first and second conductors on said second carrier foil.

[0022] In this embodiment, a rotation of the actuation element along the active area of the membrane switch results in the first and second conductors being alternately brought into contact with said third connection line. The succession of the alternate connection events may be used in this embodiment in order to determine the direction of rotation of the actuating element.

[0023] It should be noted that in the two previously describes embodiments of the invention, the different first and second conductors are preferably uniformly distributed along the active area of the membrane switch and most preferably extend substantially radially across the active area.

[0024] In the two previously described embodiments of the rotary switching element, at least one of said dead regions of said membrane switch may be defined by a patch of dielectric material applied onto at least one of said electrode structures. Alternatively or additionally, the shunt element in these embodiments may comprise a number of shunt patches, wherein at least two of said shunt patches are arranged at a certain distance from each other so as to define at least one of said dead regions there between.

[0025] In those embodiments of the membrane switch, which comprise patches of dielectric material, a thickness of said patch or dielectric material substantially preferably equals the distance between said and second carrier foil. In this case, the dielectric patches completely prevent the carrier foils or membranes of the membrane switch from being deflected in these regions so that at stand-by of the rotary switching element no deflection or deformation of the carrier foils occurs. This may effectively prevent that the carrier foils are irreversibly deformed over time under the continuous action of actuating element, which would result in premature material fatigue and a drift of the switching properties of the switching element.

[0026] It will be noted, that in these embodiments the patch of dielectric material is preferably an integral part of said spacer. The patches of isolating material may e. g. be simply stamped out together with the rest of the spacer from a suitable material. This reduces the number of manufacturing steps, as the dielectric patches do not need to be provided separately. Furthermore, as the dielectric patches are an integral part of the spacer, the number of assembly steps for the membrane switch and additionally the possibility of wrong assembly are reduced.

[0027] The mechanical step limiter of the present rotary switching element preferably comprises a generally annular toothed structure with a plurality of teeth and an indexing pin associated with said toothed structure, wherein said teeth and said indexing pin extend in a plane parallel to said membrane switch. The toothed structure may e.g. comprise a flat toothed wheel with the teeth lying in a plane parallel to the sensor plane. The indexing pin may comprise a spring biased pin mounted to the actuating element of the rotary switching element in a direction parallel to the sensor plane so as to be in contact with the teeth of said toothed wheel.

[0028] In an alternative embodiment, the mechanical step limiter comprises a generally annular toothed structure with a plurality of teeth and an indexing pin associated to said toothed structure, wherein said teeth and said indexing pin extend in a transverse direction to said membrane switch. In this embodiment, the toothed structure may be provided by a number of humps or grooves arranged on the outer membrane switch surface. The indexing means then may comprise a spring biased pin mounted to the actuating element of the rotary switching element in a direction normal to the sensor plane so as to be in contact with the outer membrane switch surface and the humps or grooves thereon.

[0029] The actuating element advantageously comprises at least one indexing means for exerting a local pressure on said active area of said membrane switch. In a preferred embodiment, the actuating element comprises a rotary Knob and a spring biased pin, which is arranged in a corresponding bore in said rotary knob so as to be biased towards the active area of said membrane switch.

Detailed description with respect to the figures

[0030] The present invention will be more apparent from the following description of several not limiting embodiments with reference to the attached drawings, wherein

Fig.1: shows a schematic exploded view of an embodiment of a rotary switching element in accordance with the present invention;

Fig.2: shows a sectional view of an embodiment of a rotary switching element;

Fig.3: an exploded view an embodiment of a membrane switch to be used in a rotary switch;

Fig.4: an embodiment of a shunt element of a membrane switch to be used in a rotary switching element according to the present invention;

Fig.5: an embodiment of a spacer with integral patches of insulating material to be used in a rotary switching element according to the present invention;

Fig.6: two embodiments of the electrode structures of a membrane switch to be used in a rotary switching element according to the present invention;

Fig.7: an illustration of a rotary switching element with a second embodiment of a step limiter.

[0031] Fig. 1 schematically shows an exploded view of an embodiment of a rotary switching element in accordance with the present invention. The rotary switching element 10 generally comprises a turning knob 12 rotatably arranged above a membrane switch 14 having a generally annular active area 16. A spring loaded activator 18 is arranged in the turning knob 12 so as to exert a local pressure on the active area 16 of the membrane switch 14.

[0032] The active area 16 of membrane switch 14 comprises a plurality of dead regions (illustrated schematically in fig. 1 by the dark patches 20), which are preferably regularly spaced along the active area 16. In these dead regions 20, the membrane switch is configured so that activation of the membrane switch is prevented.

[0033] A mechanical step limiter 22 is associated with the turning knob 12. The mechanical step limiter 22 defines two alternating sets of activation and stand-by positions for the spring loaded activator 18 along its rotational travel path.

[0034] The stand-by and the activation positions are defined in such a way that the activator 18 is associated to one of the dead regions 20 of said membrane switch 14 when the activator 18 is in one of the stand-by positions.

[0035] According to an aspect of the present invention, the step limiter 22 is configured so as to bias the spring loaded activator 18 into one of said stand-by positions. This means that the activator 18 is always urged into one of the stand-by positions so that, when the rotary switching element 10 is not operated, the activator 18 acts on a dead region 20 of the membrane switch 14. As a result, the rotary switching element 10 is normally "open", i.e. electrode structures of the membrane switch 14 are not electrically contacted and no current flows through the rotary switching element 10, when the switching element is nor operated.

[0036] Further to this biasing function, the mechanical step limiter 22 also should ensure a tactile feedback of the rotary switching element 10. In the embodiment of fig. 1, the mechanical step limiter 22 therefore comprises a toothed structure including a number of humps 24, which are arranged in an annular configuration on an outer surface of the membrane switch 14, and an indexing pin 26 associated with the humps 24 of the toothed structure. The indexing pin is preferably a spring biased pin mounted into the turning knob 12 of the rotary switching element 10 in a direction normal to the membrane switch plane so as to be in contact with the outer membrane switch surface and the humps 24 thereon. The humps 24 may be provided on a respective annular carrier foil and assembled onto the outer membrane switch surface. In a preferred embodiment however, the humps 24 may be directly formed onto the outer membrane switch carrier foil, e.g. by a thermoforming process or by an embossing process. In a variant of this step limiter embodiment with transversal toothed structure, the toothed structure may comprise a number of grooves instead of humps.

[0037] In operation, when the turning knob 12 is rotated about its axis X, the spring pressure acting on the indexing pin 26 urges the indexing pin 26 against the outer membrane switch surface and produces an audible "click" and an haptic feedback when passing over one of the humps 24 or grooves. It should be noted that the humps 24 or grooves of the toothed structure are arranged in such a way, that when the turning knob 12 is not rotated, the turning knob automatically is urged into a neutral position, in which the activator 18 is associated with a dead region 20 of the membrane switch 14.

[0038] Different embodiments of the membrane switch will be further described with respect to fig. 2 to 6. Membrane switches typically have a flexible plastic membrane layer 28 normally separated from a substrate layer 30 by a nonconductive spacer 32. The spacer 32 comprises at least one cut-out 34 defining the active area 16 of the membrane switch 14, where the membrane layer 28 and the substrate layer 30 face each other.

[0039] The membrane switch 10 represented in fig. 3 comprises two electrode structures 36 and 38 arranged in spaced relationship inside the active area 16 on the substrate layer 30 and a shunt element 40, which is arrange in the active area of the membrane switch 12 in facing relationship with said two electrode structures 36 and 38 on the membrane layer 28. This membrane switch operates in the so-called "shunt mode", wherein an electrical contact is established between the two electrode structures by means of the shunt element when the membrane switch is locally activated.

[0040] The shunt element 40 in the shown embodiment comprises a number of shunt patches 42, which are arranged in spaced relationship along the annular active area. In the region between two shunt patches, the electrode structures 36 and 38 may not be contacted when the membrane switch is activated. It follows that the regions between two adjacent shunt patches 42 define the dead regions of the membrane switch.

[0041] The different shunt patches 42 may be individually applied to the inner surface of the membrane layer by any suitable manufacturing method. Typically the shunt element is formed by printing a suitable conducting material such as e.g. graphite onto the inner surface of the membrane layer. It will be noted, that the shunt patches only need to be separated in the active area of the me mbrane switch, i.e. in the area in which activation of the membrane switch may occur. Outside of this area, the different patches may be interconnected, which may facilitate the manufacturing of the shunt element. Fig. 4 illustrates such an embodiment of the shunt element 40.

[0042] The skilled person will appreciate, that the use of a shunt element being formed of several spaced shunt patches provides an easy to manufacture subdivision of the membrane switch in activation and dead regions. In this embodiment, no patches of dielectric or insulating material are needed in order to prevent an electrical contact between the electrode structures in the dead zones of the membrane switch. The spacer 32 may accordingly have a very simple config u-ration of two coaxially arranged annular elements as shown e.g. in fig. 3.

[0043] In addition or as an alternative to the spaced shunt patches 42, patches 44 of dielectric or insulating material may be applied in the dead regions on at least one of the electrode structures so as to prevent an electrical contact via the shunt element 40. These patches preferably have a thickness, which is substantially equal the distance between said first and second carrier foil. The patches 44 then prevent the membrane layer 28 and substrate layer 30 of the membrane switch 14 from being deflected in the vicinity of the patches44 so that at stand-by of the rotary switching element no deflection or deformation of the carrier foils occurs. This embodiment prevents the layers 28 and 30 from being irreversibly deformed over time under the continuous action of the activator 18, which would result in premature material fatigue and a drift of the switching properties of the switching element.

[0044] It will be noted, that the patches 44 of dielectric material may be provided as individual parts to be assembled in the predefined locations in the active area of the membrane switch. In a preferred embodiment, the patches 44 of dielectric material are however formed as an integral part of the spacer 32. This embodiment is schematically illustrated in fig. 5. The patches 44 of isolating material may e.g. be simply stamped out together with the rest of the spacer from a suitable material. This reduces the number of manufacturing steps, as the dielectric patches do not need to be provided separately. Furthermore, as the dielectric patches 44 are an integral part of the spacer 32, the number of assembly steps for the membrane switch and additionally the possibility of wrong assembly are reduced.

[0045] Figures 6a and 6b show different embodiments for the electrode structures of a membrane switch 14 to be used in a rotary switching element. In the embodiment of fig. 6a, a first electrode structure 36 comprises a plurality of first conductors 46, which are arranged side by side on the substrate layer 30 so as to extend radially through said active area. Inside of the active area, the different first conductors 46 are interconnected by means of a first connection line 48, which is itself connected to a first terminal 50 of the membrane switch 14. A second electrode structure 38 comprises a plurality of second conductors 52, which are arranged side by side in alternation with said first conductors 46 on the substrate layer 30. The second conductors 52 are arranged so as to extend radially at least partially through the active area. On the outside, the second conductors 52 are interconnected by a bleeder resistor 54 in a voltage divider arrangement. This means, that the second conductors 52 are connected to the bleeder resistor 54 at different locations thereof, such that when a voltage difference is applied on the terminals 56 and 58 of the bleeder resistor 54, each second conductor 52 is supplied with a specific voltage depending on its position on the bleeder resistor 54.

[0046] If the membrane switch 14 is activated in one of the activation zones, the respective second conductors 52 arranged in this activation zone are brought into conducting relationship with the first conductors 46 arranged in the activation zone. As a result, a voltage depending on the position of the second conductor may be measured on the terminal 50 of the fist connection line 48. The voltage on the terminal of the first connection line is thus an indicator for the position of the respective second conductor on the bleeder resistance and accordingly an indicator for the location of the respective activation zone with respect to the active area of the membrane switch.

[0047] Furthermore, as the actuating element is moved along the active area, the actuating element activates the membrane switch subsequently in different activation regions of the switch. Since each of these subsequently activated activation regions produces a specific response voltage on the terminal of the first connection line, the direction of rotation of the actuating element can be unambiguously determined from the voltage signal on the terminal of the first connection line.

[0048] Although the bleeder resistor is represented in the current figures as comprising an extended film resistor, it will be appreciated, that the bleeder resistor 54 may alternatively comprise a series of discrete resistors or the like.

[0049] In an alternative embodiment (shown in fig. 6b) of the membrane switch a first electrode structure 136 comprises a plurality of first conductors 146, which are arranged side by side on the substrate layer 30 so as to extend radially atleast partially through the active area. Inside of the active area, the different first conductors 146 are interconnected by means of a first connection line 148, which is itself connected to a first terminal 150 of the membrane switch 14. A second electrode structure 138 comprises a plurality of second conductors 152, which are arranged side by side in alternation with said first conductors 146 on the substrate layer 30. The second conductors 152 are arranged so as to extend radially at least partially through the active area. On the outside, the second conductors 152 are interconnected by means of a second connection line 154, which is itself connected to a second terminal 156 of the membrane switch 14. A third electrode structure 160 comprises a third connection line 162 which extends between said first and second conductors 146 and 152 along said active area, whereby said third connection line 162 alternately passes in the vicinity of one of said first and second conductors. The third connection line is connected to a third terminal 158 of the membrane switch.

[0050] In this embodiment, a rotation of the activator 18 along the active area of the membrane switch 14 results in the first and second conductors 146 and 152 being alternately brought into contact via the shunt element 40 with said third connection line 158. The succession of the alternate connection events, which are measured on the three terminals 150, 156 and 158 of the membrane switch, may be used by a connected processing unit in order to determine the direction of rotation of the activator 18.

[0051] It should be noted that in the two previously describes embodiments of the invention, the dead zones of the membrane switch may be defined by either the shunt element comprising several spaced shunt patches of by insulating patches covering at least one of the electrode structures or even a combination of these two elements.

[0052] Fig. 7 schematically illustrates a rotary switching element with a different embodiment of mechanical step limiter 122. In this embodiment, the mechanical step limiter 122 comprises a flat toothed wheel 164 with a plurality of teeth 166 lying in a plane parallel to the membrane switch plane. The indexing pin 168 may comprise a spring biased pin mounted to the turning knob 12 of the rotary switching element 10 in a direction parallel to the membrane switch so as to be in contact with the teeth 166 of said toothed wheel 164. It will be appreciated, that the tips of the teeth may be sharp as shown in fig. 7 or slightly rounded in order to facilitate the toggle of the spring biased pin 168 between two adjacent stand-by positions.

List of reference signs

[0053]

10	rotary switching element
12	turning knob
14	membrane switch
16	active area
18	activator
20	dead regions
22	mechanical step limiter
24	humps
26	indexing pin
28	membrane layer
30	substrate layer
32	spacer
34	cut-out
36, 38	electrode structures
40	shunt element
42	shunt patches
44	patches of dielectric material
46	first conductors
48	first connection line
50	first terminal
52	second conductors
54	bleeder resistor
56, 58	terminals
122	mechanical step limiter
136	first electrode structure
138	second electrode structure
146	first conductors
148	first connection line
150	first terminal
152	second conductors
154	second connection line
156	second terminal
158	third terminal
160	third electrode structure
162	third connection line
164	flat toothed wheel
166	teeth
168	indexing pin

Claims

1. Rotary switching element, comprising
a membrane switch having a generally annular active area, said membrane switch comprising a plurality of dead regions along said active area where activation of the membrane switch is prevented,
an actuating element mounted for rotation on said membrane switch, said actuating element for locally activating said membrane switch, and
a mechanical step limiter associated to said actuating element, said step limiter for defining two alternating sets of activation and stand-by positions for said actuating element along a rotational travel path of said actuating element and for biasing said actuating element into one of said stand-by positions where said actuating element is associated to one of the dead regions of said membrane switch.

2. Rotary switching element according to claim 1, wherein said membrane switch comprises
a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain

distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element,
a set of electrode structures, said electrode structures being arranged in said active area of said membrane switch between said first and second carrier foils so as to define at least one pair of spaced switch contacts, and wherein at least one of said dead regions of said membrane switch is defined by a patch of dielectric material applied onto at least one of said electrode structures.

3. Rotary switching element according to claim 1, wherein said membrane switch comprises
a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element,
a set of electrode structures arranged in said active area of said membrane switch in a spaced relationship on said first carrier foil, and
a shunt element comprising a number of shunt patches made of electrically conductive material, said shunt patches being arranged in said active area of said membrane switch on said second carrier foil, said shunt patches for establishing an electrical contact between said electrode structures when said carrier foils are pressed together, wherein at least two of said shunt patches are arranged at a certain distance from each other so as to define at least one of said dead regions there between.

4. Rotary switching element according to claim 3, further comprising a patch of dielectric material arranged between said at least two spaced shunt patches.

5. Rotary switching element according to claim 1, wherein said membrane switch comprises
a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element,
a first electrode structure comprising a plurality of first conductors, said first conductors being arranged side by side on said first carrier foil so as to extend at least partially through said active area, said first connectors being interconnected by a first connection line,
a second electrode structure comprising a plurality of second conductors, said second conductors being arranged side by side in alternation with said first conductors on said first carrier foil so as to extend at least partially through said active area, said second conductors being interconnected by a bleeder resistor; and
a shunt element arranged in said active area of said membrane switch in facing relationship with said first and second conductors on said second carrier foil.

6. Rotary switching element according to claim 1, wherein said membrane switch comprises
a first carrier foil and a second carrier foil, said first and second carrier foil being arranged at a certain distance from each other by means of a spacer, wherein said spacer comprises at least one cut-out which defines said active area of the switching element,
a first electrode structure comprising a plurality of first conductors, said first conductors being arranged side by side on said first carrier foil so as to extend at least partially through said active area, said first connectors being interconnected by a first connection line,
a second electrode structure comprising a plurality of second conductors, said second conductors being arranged side by side in alternation with said first conductors on said first carrier foil so as to extend at least partially through said active area, said second conductors being interconnected by a second connection line,
a third electrode structure comprising a third connection line, said third connection line extending between said first and second conductors along said active area, whereby said third connection line alternately passes in the vicinity of one of said first and second conductors, and
a shunt element arranged in said active area of said membrane switch in facing relationship with said first and second conductors on said second carrier foil.

7. Rotary switching element according to any one of claims 5 or 6, wherein at least one of said dead regions of said membrane switch is defined by a patch of dielectric material applied onto at least one of said electrode structures.

8. Rotary switching element according to any one of claims 5 to 7, wherein said shunt element comprises a number of shunt patches and wherein at least two of said shunt patches are arranged at a certain distance from each other so as to define at least one of said dead regions there between.

9. Rotary switching element according to any one of claims 2, 4 or 7, wherein a thickness of said patch of dielectric material substantially equals the distance between said first and second carrier foil.

10. Rotary switching element according to any one of claims 2, 4 or 7, wherein said patch of dielectric material is an integral part of said spacer.

11. Rotary switching element according to any one of claims 1 to 10, wherein said mechanical step limiter comprises a generally annular toothed structure with a plurality of teeth and an indexing pin associated to said toothed structure, wherein said teeth and said indexing pin extend in a plane parallel to said membrane switch.

12. Rotary switching element according to any one of claims 1 to 10, wherein said mechanical step limiter comprises a generally annular toothed structure with a plurality of teeth and an indexing pin associated to said toothed structure, wherein said teeth and said indexing pin extend in a transverse direction to said membrane switch.

13. Rotary switching element according to any one of claims 1 to 12, wherein said actuating element comprises at least one indexing means for exerting a local pressure on said active area of said membrane switch.

14. Rotary switching element according to any one of claims 1 to 13, wherein said actuating element comprises a rotary knob and a spring biased pin, which is arranged in a corresponding bore in said rotary knob so as to be biased towards the active area of said membrane switch.

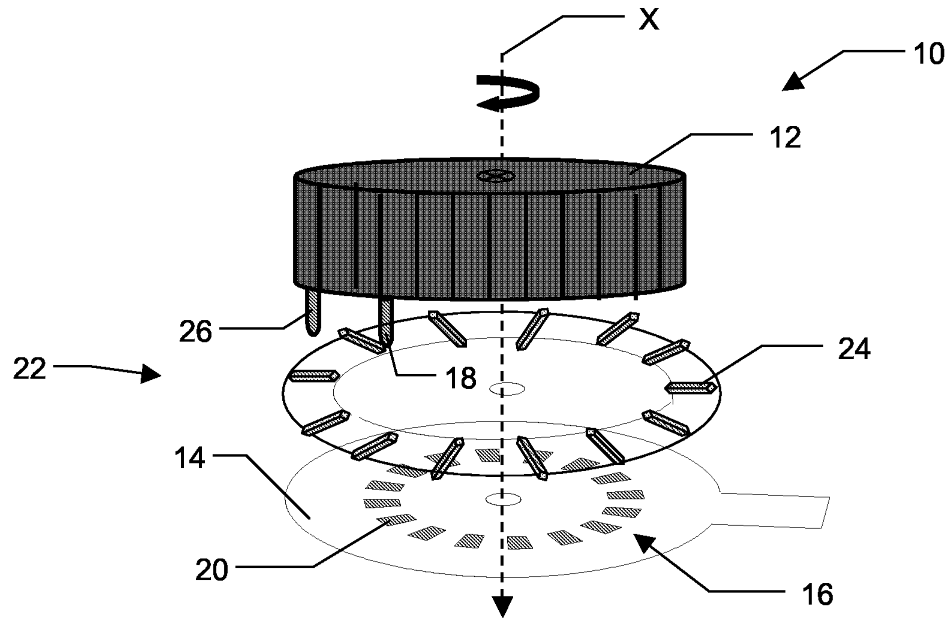

Fig. 1

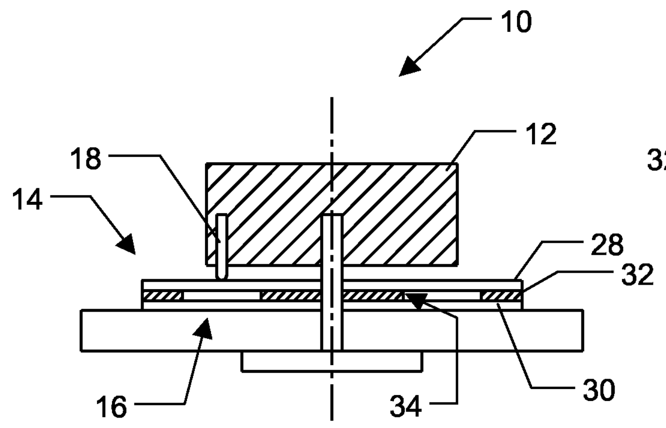

Fig. 2

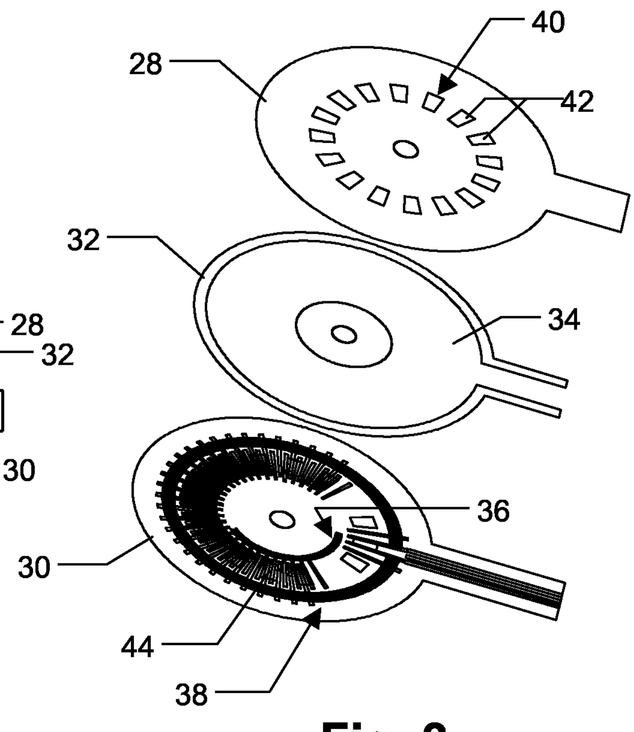

Fig. 3

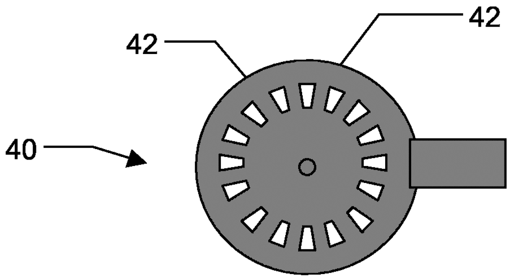

Fig. 4

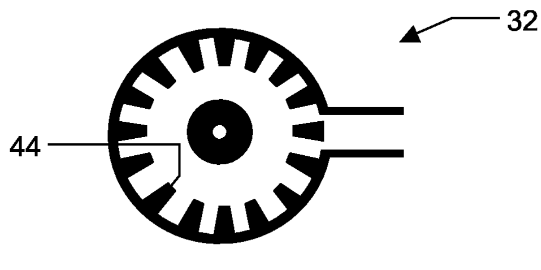

Fig. 5

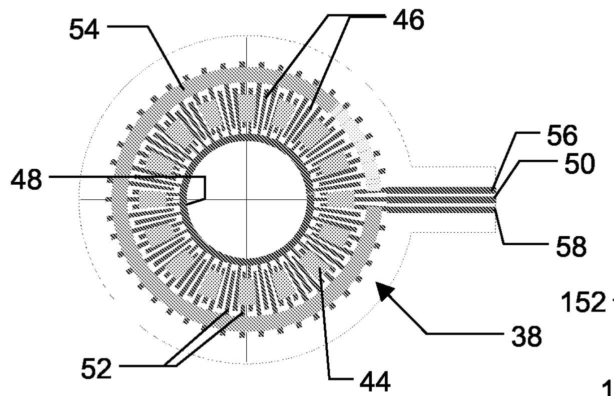

Fig. 6a

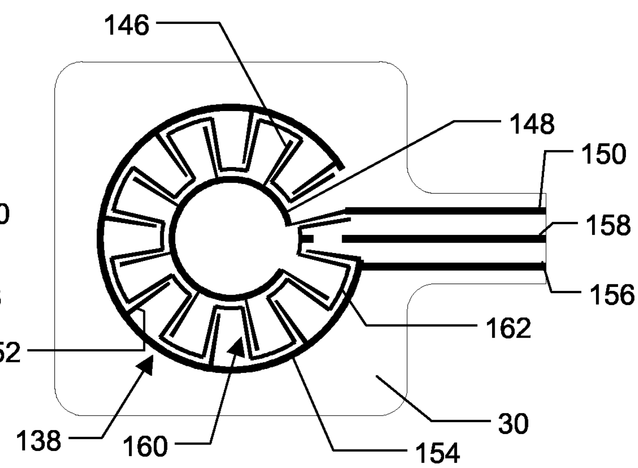

Fig. 6b

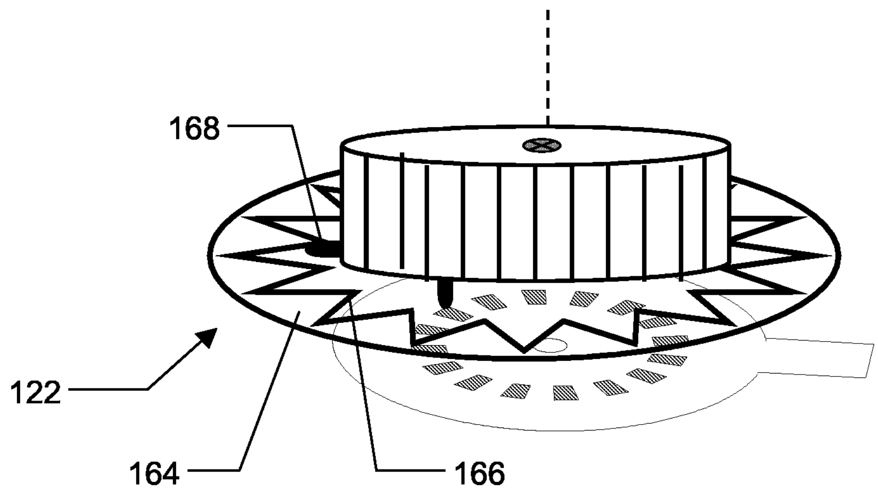

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 04 10 2604

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A	US 3 385 732 A (CURRAN ROBERT A) 28 May 1968 (1968-05-28) * figure 9 * -----	1	
A	US 5 508 703 A (SAKURADA HIDEMASA ET AL) 16 April 1996 (1996-04-16) * figure 8 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	9 November 2004	Ruppert, H

CATEGORY OF CITED DOCUMENTS

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