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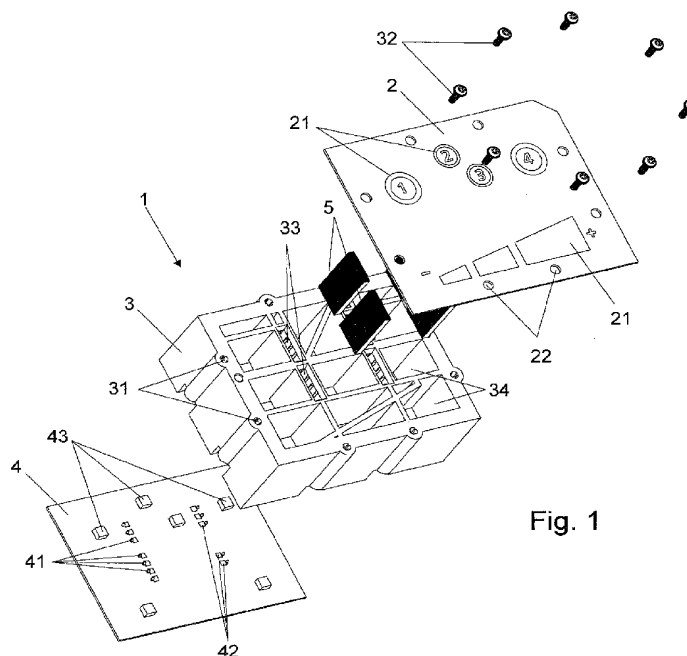


Fig. 1

(57) Abstract: The present invention relates to a capacitive touch panel unit (1) for a motor vehicle control system, comprising a cover (2) marked at its external side with a number of activating areas (21), a support (4) disposed at the internal side of the cover (2) and provided with an electric interface to connect the unit (1) with other components of the control system, a housing (3) disposed between the cover (2) and the support (4), a number of capacitive activating regions (231) adjoining the cover (2) at the internal side thereof at locations corresponding to activating areas (21) of the cover (2) and electrically connected with the electric interface of the support (4). In order to provide a capacitive touch panel unit, which would be cost efficient and simple to manufacture and assembly said cover (2) is coated with a conductive layer (23) comprising said activating regions (231) and connecting pads (233) coupled with said activating regions (231), said support (4) comprises a number of connecting pads (42) at the side of said cover (2) electrically connected with the

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electric interface thereof, said housing (3) comprises at least one coupling slot (33) having a cross-section surrounding said at least one connecting pad (233) of said conductive layer (23) and said at least one connecting pad (42), and the unit further comprises at least one elastomeric connector (5) squeezed inside said slot (33) between said at least one connecting pad (233) of said conductive layer (23) and said at least one connecting pad (42) and consisting of a number of conductive layers (51) separated with a number of insulating layers (52) that run substantially perpendicularly to said cross-section of said slot (33).

CAPACITIVE TOUCH PANEL UNIT OF A MOTOR VEHICLE CONTROL SYSTEM

The present invention relates to a capacitive touch panel unit for a motor vehicle control system, comprising a cover marked at its external side with a number of activating areas, a support disposed at the internal side of the cover and provided with an electric interface to connect the unit with other components of the control system, a housing disposed between the cover and the support, a number of capacitive activating regions adjoining the cover at the internal side thereof at locations corresponding to activating areas of the cover and electrically connected with the electric interface of the support.

10 Background of the Invention

Capacitive touch panels of this kind are frequently used in an automotive industry as panels controlling various components and subsystems of a vehicle. They usually form a compact, preassembled units that at the vehicle assembly line are mechanically fixed to the vehicle dashboard and electrically fixed to the vehicle wiring. The support has usually the form of a printed circuit board provided with an edge enabling to electrically connect such a preassembled unit with an appropriate slotted socket. The capacitive activating region on the other hand is usually imprinted on a flexible foil positioned directly beneath the cover and provided with a flexible tip cooperating with an appropriate slot connector of the printed circuit board.

20 The foil should tightly adhere to the cover as otherwise air particles present between the foil and the cover might affect the foil accuracy. Therefore it has been proposed to embed the foil with the cover at the internal side thereof during a molding process.

Nonetheless both these solutions are relatively expensive, as special tools and machinery are required to produce the foil, and the foil must be manually assembled with the board in a separate assembly step. Furthermore each change of the number, shapes, dimensions, positions, etc. of the activating areas marked on the cover, requires a corresponding redesign of the foil to reflect these changes of the activating areas above the foil.

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It is also known to use metal springs connecting the internal side of the cover with the printed circuit board. Springs are always maintained in a compressed state and form static electrodes bridging the gap between the cover and the board.

5 Nonetheless springs may generate unpleasant noises or even trigger false activations while a vehicle vibrates in certain frequency ranges. Furthermore, relatively small springs typically used in such touch panels have tendency to cling with each other during transportation and their separation at the production line is time consuming.

10 Patent application US2005156906 discloses a capacitive touchpad comprising a membrane and a printed circuit board combined together. The membrane comprises an X trace and a Y trace with an insulator layer inserted therebetween, and the printed circuit board has connection pads on a top side of a substrate that are electrically connected to the X and Y traces. The printed circuit board further
15 comprises vias connected between the connection pads and a conductor layer on the bottom side of the substrate. To form the capacitive touchpad, the membrane and printed circuit board are individually produced in advance, and then combined together. Alternatively, the membrane is printed on the printed circuit board.

Therefore, it has been the object of the present invention to provide a capacitive touch panel unit for a motor vehicle, which would be vibration-proof, as well as cost
20 efficient and simple to manufacture and assembly.

Summary of the Invention

The invention provides a capacitive touch panel unit of the kind mentioned in the outset, that is characterised in that said cover is coated with a conductive layer comprising said activating regions and connecting pads coupled with said activating
25 regions, said support comprises a number of connecting pads at the side of said cover electrically connected with the electric interface thereof, said housing comprises at least one coupling slot having a cross-section surrounding said at least one connecting pad of said conductive layer and said at least one connecting pad, and the unit further comprises at least one elastomeric connector squeezed inside
30 said slot between said at least one connecting pad of said conductive layer and said at least one connecting pad and consisting of a number of conductive layers

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separated with a number of insulating layers that run substantially perpendicularly to said cross-section of said slot.

As the capacitive conductive layer is coated directly on the internal side of the cover, no additional carrier material is required. The invention simplifies production as no additional layers are present and the unit may be manufactured in a one-step assembly stacking process, since there are no additional connectors to be coupled manually. The elastomeric connectors do not generate any undesired noises and no modifications of the assembly process are required in a case a change of the pattern of the activating areas of the cover is needed. The invention may also be used on narrow and curved surfaces.

Said conductive layer may be preferably coated with a conductive ink, paint or lacquer in a pad printing, laser printing, ink printing, spray printing or screen printing process.

Preferably at least two pairs of said connecting pads of said conductive layer and said connecting pads of said electric interface of said support may be connected by means of a single elastomeric connector.

Said support has preferably a form of a printed circuit board fixed to said housing.

Said support may preferably form a part of the housing.

Said housing may be preferably integral with said cover.

Said conductive layer may further comprise a guard pattern.

Said support may be provided with light sources, preferably in a form of light emitting diodes (LED), each disposed in a separate backlit section of said housing.

Said support may preferably comprise a number of conductive projections at the side of said cover cooperating with said at least one elastomeric connector and electrically connected with the electric interface of the support.

Brief description of drawings

The invention shall be described and explained below in connection with the attached drawings on which:

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Fig. 1 is a schematic perspective, exploded view of an embodiment of a capacitive touch panel unit according to the present invention;

Fig. 2 is a schematic perspective view of an assembled panel unit of Fig. 1;

Fig. 3 is a schematic cross-sectional view of the assembled panel unit along the line
5 A₁ of Fig. 8;

Fig. 4 is a schematic perspective view of a cover of the panel unit of Fig. 2 along with the exploded particular layers thereof;

Fig. 5 is a schematic cross-sectional view of a flexible connector along with the fragments of the cover and the support;

10 Fig. 6 is a schematic top view of the cover;

Fig. 7 is a schematic bottom view of the cover along with the flexible connector areas;

Fig. 8 is a schematic top view of the housing; and

Fig. 9 is a schematic top view of the support.

15 Detailed description of preferred embodiment

Presented embodiment of a capacitive touch panel unit 1 according to the present invention may be employed for controlling various components and subsystems of an automotive vehicle. The panel unit 1 comprises a cover 2, a housing 3 and a rigid support 4.

20 The cover 2 is marked at its external side with a schematically shown activating areas 21 available to be touched by a driver or a passenger of the vehicle in order to turn on and off or change the functionality of the subsystems of the vehicle such as lights, A/C, radio, vehicle automation, etc. As the activating areas 21 serve solely to
25 distinct the regions of the cover 2 that may be touched, they can be painted with a regular paint, etched, embossed, projected, backlit, illuminated or otherwise marked in a manner known from the state of art.

At its internal side the cover 2 has been coated with a capacitive conductive layer 23 with a conductive paint in a pad printing (also known as tampo-printing) process. The coated conductive layer 23 comprise activating regions 231, each region 231
30 corresponding to and disposed beneath a particular activating area 21 at the other side of the cover. The activating regions 231 are coupled with connecting pads 233

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ending up in two areas which are collinear with each other forming two lines A_1 and A_2 substantially parallel to each other (cf. Figs. 7-9). The area of the layer 23 which is not coated with activating regions 231 or connecting pads 233, is coated with a conducting guard pattern 232 handling stray parasitic capacitances and crosstalks
5 between the circuits of the activating regions 231 and connecting pads 233. Furthermore to save the coating conductive paint the activating regions 231 and the guard pattern 232 are provided with uncoated technological cavity areas 234. The functionality of the capacitive conductive layer 23 shall be explained later.

The cover 2 is screwed to the housing 3 by means of a number of mounting
10 screws 32 passing thorough mounting holes 22 in the cover 2 and screwed inside mounting holes of the housing 3. In this embodiment, the rigid support 4 has a form of a printed circuit board fixed at the other side the housing 3 and in parallel to the cover 2. Obviously in other embodiments the support 4 may be a part of the housing 3.

15 The circuit board 4 is provided with an electric interface comprising an edge connector (not shown) enabling for connecting the unit 1 by means of an appropriate slotted socket with other components of the control system of an automotive vehicle.

Furthermore the circuit board 4 is provided with light sources 43, in a form of light emitting diodes (LED), each disposed in a separate backlit section 34 of the
20 housing 3. LEDs 43 enable to backlit the activating areas 21 of the cover 2 with different colours and at deferent light intensities depending on desired functionality of the unit 1. This also enable for independent visual tuning of the particular activating areas 21 of the cover 2 that may for example glow in a standby (inactive) mode and shine upon activation, etc.

25 The circuit board 4 also comprises a number of conductive projections 41 and connecting pads 42 electrically connected with the electric interface of the board 4 via conductive paths (not shown). Conductive pads 42 and projections 41 are disposed along lines A_1 and A_2 below the connecting pads 233 of the conductive layer 23. When the unit 1 is assembled, conductive projections 41 and connecting
30 pads 42 of the circuit board 4 along with the connecting pads 233 of the conductive

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layer 23 are disposed within four coupling slots 33 of the cover 3 having substantially constant cross-sections between the cover 2 and the support 4.

Four elastomeric connectors 5 (also known as ZEBRA® connectors) are squeezed inside the slots 33 as shown in Fig. 3 and Fig. 5. Each connector 5 consist of a number of insulating layers 52 separated with a number of conductive layers 51, providing high-density (about 0.1 mm resolution) redundant electrical paths, that run substantially perpendicularly to the cross-sections of the slots 33. In the presented embodiment the cover 2 is parallel to the support 4 so that the layers 51 and 52 of the connectors 5 also run perpendicularly to the support 4 and the cover 2.

As shown on Fig. 5, at the side of the support 4 a conductive projections 41 enter the connectors 5 forming an electrical connection with a conductive layer 51 of the connector 5. At the other side, this conductive layer 51 abuts the connecting pad 233 of the capacitive conductive layer 23 thus forming the second end and closing this electrical connection. In such a manner the activating regions 231 are electrically connected via the connecting pads 233, via the conductive layers 51 of the connectors 5, via the conductive projections 41 and connecting pads 42 and eventually via the conductive paths with the electric interface of the support 4.

Fixing projections 331 of the 33 slots that are perpendicular to the cross-sections of the slots 33 enable for guidance of the connectors 5 and their displacement between the support 4 and the cover 2 allowing for a formation of electrical connections between the particular areas of the capacitive conductive layer 23 and the conductive pads 42 and projections 41 of the support 4.

The above embodiments of the present invention are merely exemplary. The figures are not necessarily to scale and some features may be exaggerated or minimized. These and other factors however should not be considered as limiting the spirit of the invention, the intended scope of protection of which is indicated in appended claims.

List of reference numerals

1. capacitive touch panel unit
2. cover
21. activating area

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- 22. mounting hole
- 23. capacitive conductive layer
 - 231. activating region
 - 232. ground pattern
 - 5 233. connecting pad
 - 234. technological cavity areas
- 3. housing
 - 31. mounting hole
 - 32. mounting screw
 - 10 33. coupling slot
 - 331. fixing projection
 - 34. backlit section
- 4. support (printed circuit board)
 - 41. conductive projection
 - 15 42. connecting pad
 - 43. light source (LED)
- 5. connector
 - 51. conductive layer
 - 52. insulating layer
 - 20

Claims

1. A capacitive touch panel unit (1) for a motor vehicle control system, comprising a cover (2) marked at its external side with a number of activating areas (21), a support (4) disposed at the internal side of the cover (2) and provided with an electric interface to connect the unit (1) with other components of the control system,
- 5 a housing (3) disposed between the cover (2) and the support (4), a number of capacitive activating regions (231) adjoining the cover (2) at the internal side thereof at locations corresponding to activating areas (21) of the cover (2) and electrically connected with the electric interface of the support (4),
- 10 characterised in that said cover (2) is coated with a conductive layer (23) comprising said activating regions (231) and connecting pads (233) coupled with said activating regions (231),
- 15 said support (4) comprises a number of connecting pads (42) at the side of said cover (2) electrically connected with the electric interface thereof, said housing (3) comprises at least one coupling slot (33) having a cross-section surrounding said at least one connecting pad (233) of said conductive layer (23) and said at least one connecting pad (42),
- 20 and the unit further comprises at least one elastomeric connector (5) squeezed inside said slot (33) between said at least one connecting pad (233) of said conductive layer (23) and said at least one connecting pad (42) and consisting of a number of conductive layers (51) separated with a number of insulating layers (52) that run
- 25 substantially perpendicularly to said cross-section of said slot (33).
2. The touch panel according to Claim 1, characterized in that, said conductive layer (23) is coated with a conductive ink, paint or lacquer in a pad printing, laser printing, ink printing, spray printing or screen printing process.
3. The touch panel according to Claim 1 or 2, characterized in that, at least two
- 30 pairs of said connecting pads (233) of said conductive layer (23) and said

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connecting pads (42) of said electric interface of said support (4) are connected by means of a single elastomeric connector (5).

4. The touch panel according to Claim 1 or 2 or 3, characterized in that, said support (4) has a form of a printed circuit board fixed to said housing (3).
- 5 5. The touch panel according to Claim 1 or 2 or 3, characterized in that, said support (4) forms a part of the housing (3).
6. The touch panel according to any one of preceding Claims, characterized in that, said housing (3) is integral with said cover (2)
7. The touch panel according to any one of preceding Claims, characterized in that, said conductive layer (23) further comprises a guard pattern (232).
10
8. The touch panel according to any one of preceding Claims, characterized in that, said support (4) is provided with light sources (43), preferably in a form of light emitting diodes (LED), each disposed in a separate backlit section (34) of said housing (3).
- 15 9. The touch panel according to any one of preceding Claims, characterized in that, said support (4) comprises a number of conductive projections (41) at the side of said cover (2) cooperating with said at least one elastomeric connector (5) and electrically connected with the electric interface of the support (4).

AMENDED CLAIMS

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1. A capacitive touch panel unit (1) for a motor vehicle control system, comprising
a cover (2) marked at its external side with a plurality of activating areas (21),
a support (4) disposed at the internal side of the cover (2) and provided with an
5 electric interface to connect the unit (1) with other components of the control
system,
a housing (3) disposed between the cover (2) and the support (4),
a number of capacitive activating regions (231) adjoining the cover (2) at the
internal side thereof at locations corresponding to activating areas (21) of the
10 cover (2) and electrically connected with the electric interface of the support (4),
characterised in that
said cover (2) is coated with a conductive layer (23) comprising said activating
regions (231) and connecting pads (233) coupled with said activating
regions (231),
15 said support (4) comprises a number of connecting pads (42) at the side of said
cover (2) electrically connected with the electric interface thereof,
said housing (3) comprises at least one coupling slot (33) having a cross-
section surrounding said at least one connecting pad (233) of said conductive
layer (23) and said at least one connecting pad (42),
20 and the unit further comprises
at least one elastomeric connector (5) squeezed inside said slot (33) between
said at least one connecting pad (233) of said conductive layer (23) and said at
least one connecting pad (42) and consisting of a number of conductive
layers (51) separated with a number of insulating layers (52) that run
25 substantially perpendicularly to said cross-section of said slot (33) providing
high-density redundant electrical paths, wherein
said support (4) has a form of a printed circuit board fixed to said housing (3),
said conductive layer (23) further comprises a guard pattern (232) and
said support (4) comprises a number of conductive projections (41) at the side
30 of said cover (2) cooperating with said at least one elastomeric connector (5)
and electrically connected with said connecting pads (42) and the electric
interface of the support (4).

2. The touch panel according to Claim 1, characterized in that, said conductive layer (23) is coated with a conductive ink, paint or lacquer in a pad printing, laser printing, ink printing, spray printing or screen printing process.
3. The touch panel according to Claim 1 or 2, characterized in that, at least two
5 pairs of said connecting pads (233) of said conductive layer (23) and said connecting pads (42) of said electric interface of said support (4) are connected by means of a single elastomeric connector (5).
4. The touch panel according to any one of preceding Claims, characterized in that, said housing (3) is integral with said cover (2).
- 10 5. The touch panel according to any one of preceding Claims, characterized in that, said support (4) is provided with light sources (43), preferably in a form of light emitting diodes (LED), each disposed in a separate backlit section (34) of said housing (3).

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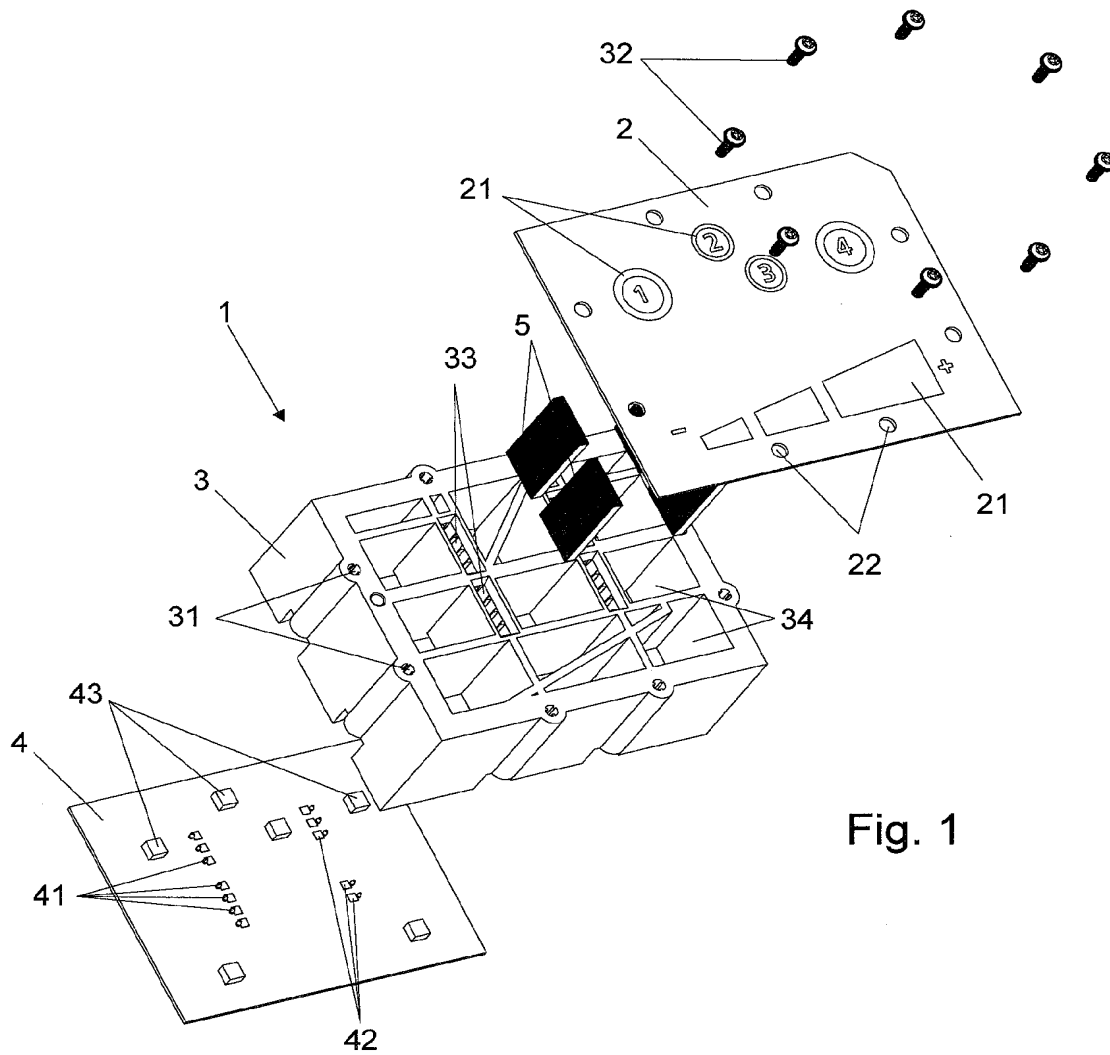


Fig. 1

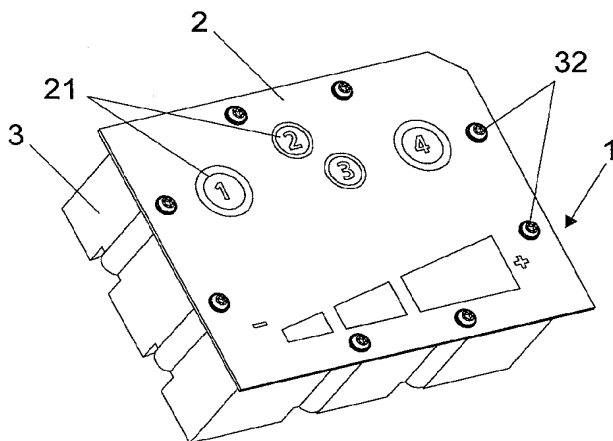


Fig. 2

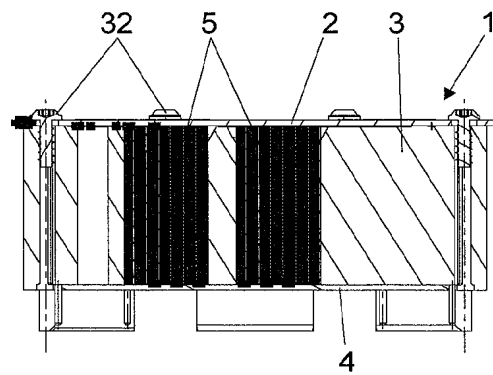
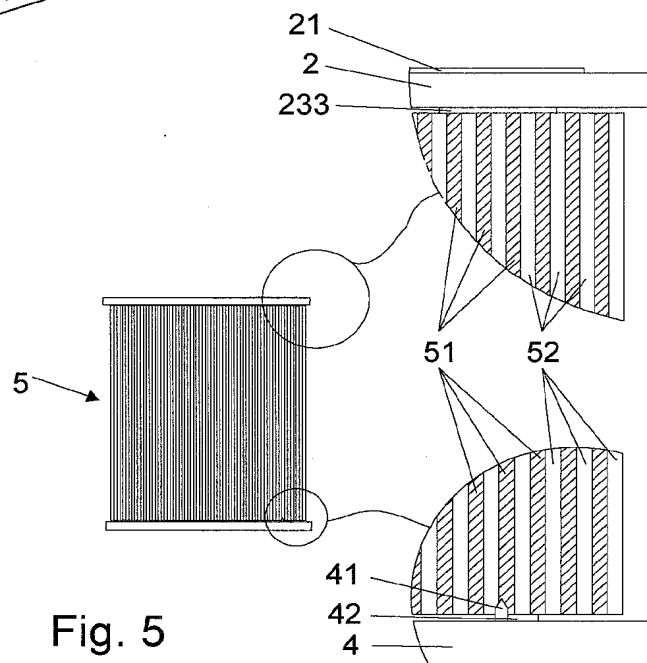
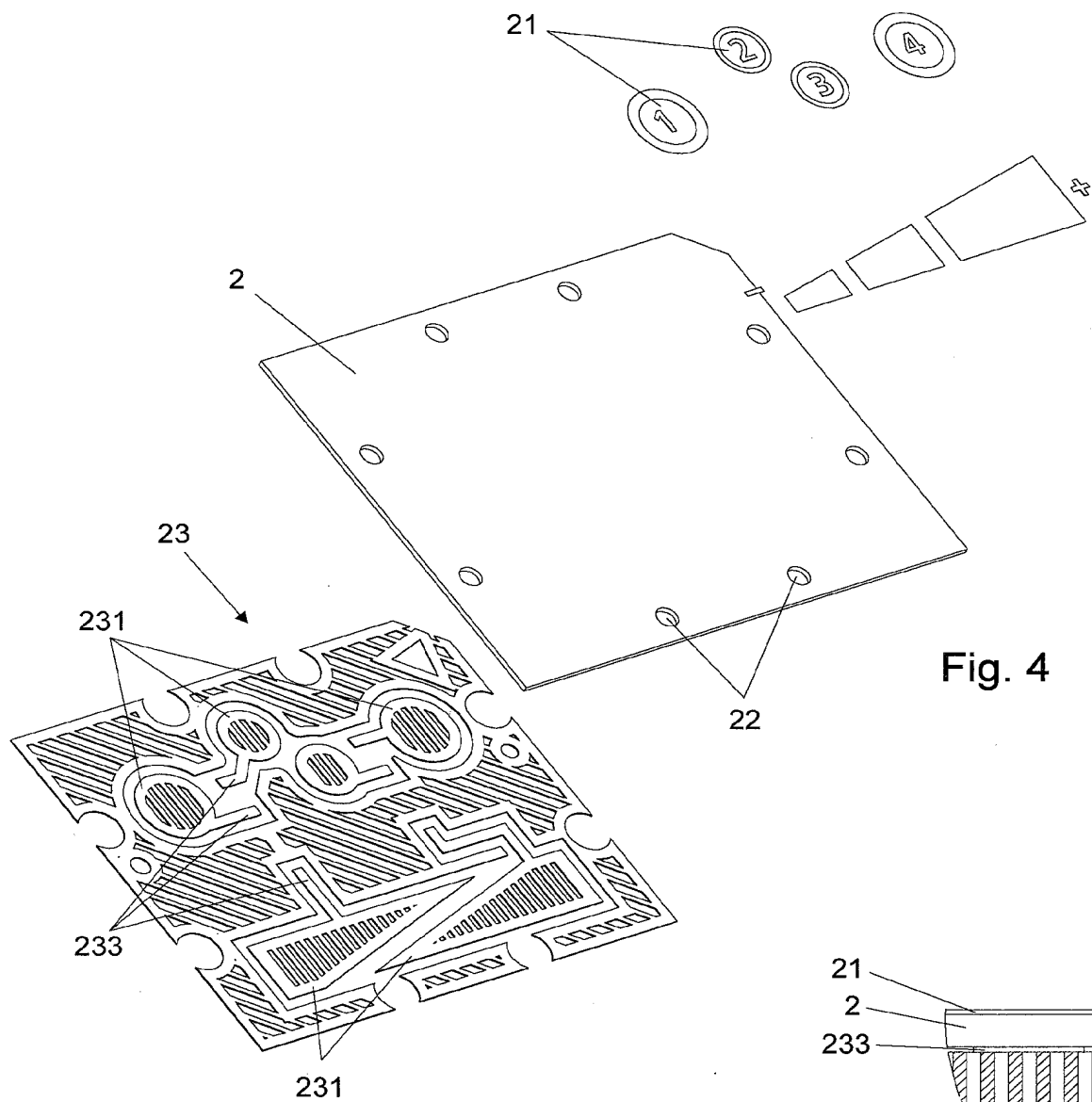


Fig. 3

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3/3

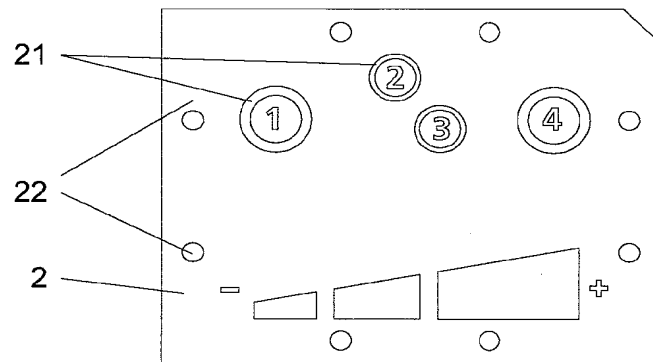


Fig. 6

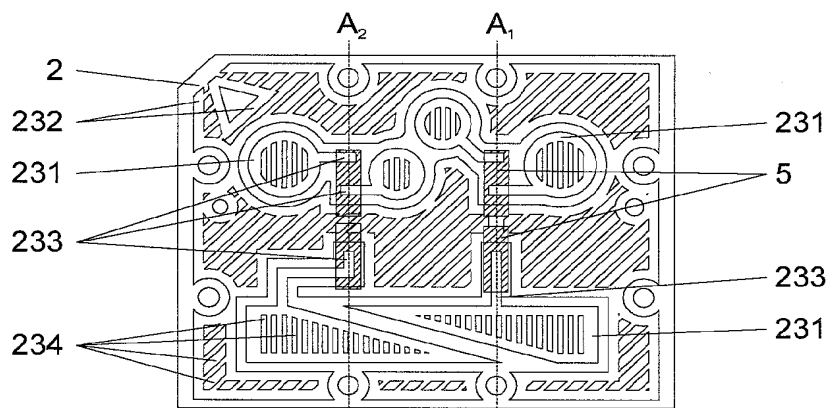


Fig. 7

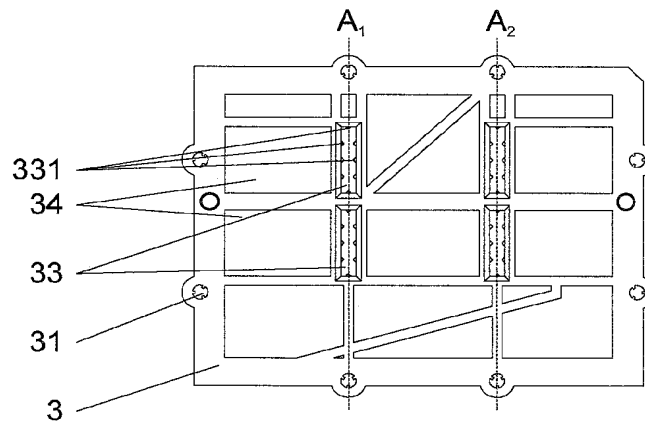


Fig. 8

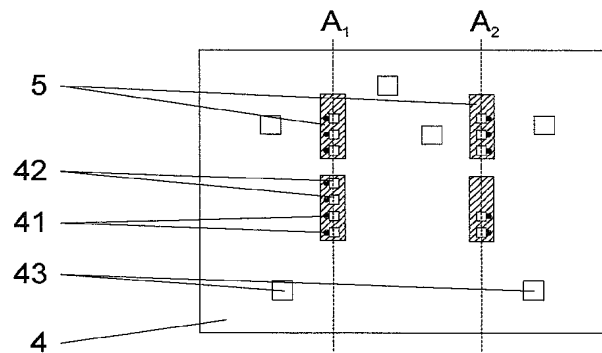


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2017/000094

A. CLASSIFICATION OF SUBJECT MATTER

INV. G06F3/044 H03K17/96 H01R13/24 B60K35/00 B60K37/06
H05K3/32 H05K3/12 H05K1/14

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F H03K H01R B60K H01H H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/079153 A1 (MALOOF JIM [US] ET AL) 1 April 2010 (2010-04-01) abstract paragraph [0024] - paragraph [0033] paragraph [0038] - paragraph [0039] figures 1, 3, 4, 7 -----	1-9
X	US 2013/169294 A1 (BOLLESEN MICHAEL [US] ET AL) 4 July 2013 (2013-07-04) abstract paragraph [0043] - paragraph [0046] paragraph [0051] - paragraph [0054] paragraph [0070] paragraph [0100] - paragraph [0101] figures 6, 7, 9A-9D, 17, 24A, 24B -----	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

4 June 2018

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010079153	A1	01-04-2010	NONE
US 2013169294	A1	04-07-2013	CN 103185602 A 03-07-2013
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