



- (51) **International Patent Classification:**
H01H 13/807 (2006.01) *H04M 1/23* (2006.01)
- (21) **International Application Number:**
PCT/US2013/058995
- (22) **International Filing Date:**
10 September 2013 (10.09.2013)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
13/608,624 10 September 2012 (10.09.2012) US
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- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

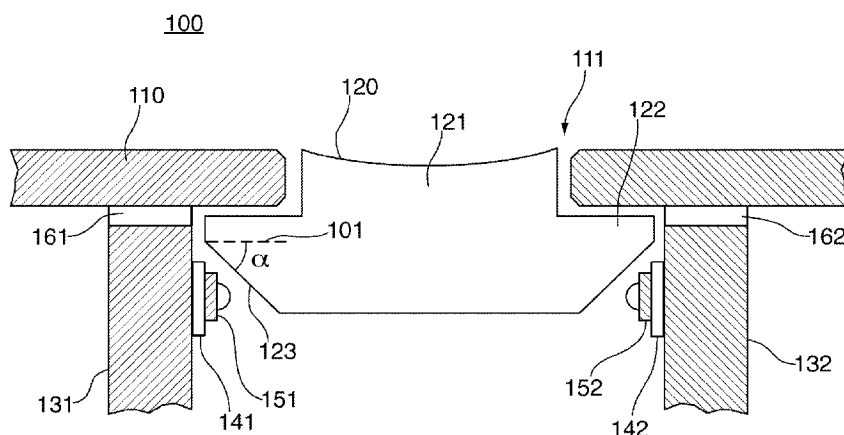
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))

(54) **Title:** CYLINDRICAL ACTIVATION OF MENU BUTTONS

(57) **Abstract:** Cylindrical switch assemblies and methods of making the same are provided. Cylindrical switch assemblies can mitigate false presses by using switch assembly designs with vertically or near vertically mounted activation elements positioned around a perimeter of a button. The activation elements (e.g., switches) of the switch assemblies may be fixed to a vertical sidewall of a bracket and positioned such that a portion of the activation elements extend beneath the button. When the button is actuated by a user, the button activates the activation elements. Positioning multiple activation elements around the perimeter of the button ensures that the user can press anywhere on the button and still activate the activation elements.

CYLINDRICAL ACTIVATION OF MENU BUTTONS

Cross-Reference to Related Applications

This Patent Cooperation Treaty patent application claims priority to U.S. non-provisional application No. 13/608,624, filed September 10, 2012, and titled “Cylindrical Activation of Menu Buttons”, the contents of which are incorporated herein by reference in their entirety.

Background

This disclosure is directed to switch assemblies, and more particularly is directed to switch assemblies with vertically mounted and near vertically mounted activation elements.

Users can provide inputs to electronic devices (e.g., portable media players and cellular telephones) using many different approaches. Some known input components are conventional switch assemblies, which may include a stack up having a switch (e.g., a dome switch).

Depending on design, a switch assembly stack up may contain several components. A conventional stack up of a switch assembly can include a dome switch having two leads that are soldered to a circuit board, and the circuit board is attached to a bracket. When the switch is pressed, an inner conductive surface of the switch contacts a contact pad on the circuit board to complete a circuit. In many cases, a cosmetic button is placed over the switch. In response to the user pressing the cosmetic button, the switch is in turn depressed and contacts the contact pad thereby generating an input.

In conventional switch assemblies, the circuit board and switch are typically positioned directly beneath the button. In some cases, a user may press on an edge of the cosmetic button (e.g., away from a center line of the button) in an attempt to actuate the switch. When force is applied to the edge of the button, the button may tilt and may contact another component of the electronic device before achieving activation of the switch. For example, the button may bottom out on the circuit board before activating the switch. In these cases, the user may experience a “false press” where the user believes input has been provided to the electronic device, but in fact the switch has not been activated. False presses may cause confusion and frustration.

Accordingly, there is a need for improved switch assemblies that mitigate false presses.

Summary

Cylindrical switch assemblies and methods of making the same are provided. Cylindrical switch assemblies can mitigate false presses by using switch assembly designs with vertically or near vertically mounted activation elements positioned around a perimeter of a button. The switch

assemblies may include a button and a bracket with a vertical sidewall. The bracket may surround the perimeter of the button. The activation elements (e.g., switches) of the switch assemblies may be fixed to the vertical sidewall and positioned such that a portion of the activation elements extend beneath the button. When the button is actuated by a user, the button
5 activates the activation elements. Positioning multiple activation elements around the perimeter of the button ensures that the user can press anywhere on the button and still activate the activation elements.

In some embodiments, actuator arms may be attached to a bottom surface of the button. The actuator arms may be positioned to contact the activation elements when the button is actuated.

10 In other embodiments, the button may include an angled sidewall that contacts the activation elements when the button is actuated. In embodiments that include a button with an angled sidewall, the sidewall of the bracket may also be angled to match the button. Angled sidewalls may provide more reliable activation of the activation elements.

In addition to mitigating false presses, embodiments of this invention may also utilize the interior
15 space of an electronic device more efficiently. By mounting the activation elements on a sidewall of a bracket, space directly beneath the button may be made available for additional components (e.g., sensors) of the electronic device.

In one embodiment, a switch assembly for an electronic device may include a button, a bracket, a flexible printed circuit board, a dome switch, and an actuator arm. The button may include a
20 peripheral edge defining an outer boundary of the button. The bracket can be offset from the peripheral edge of the button and the bracket may include a vertical wall. The flexible printed circuit board can be fixed to the vertical wall. The dome switch can be coupled to the flexible printed circuit board such that a portion of the dome switch extends beneath the button. The actuator arm can be fixed to a bottom surface of the button. The actuator arm may activate the
25 dome switch when the button is actuated.

In another embodiment, a switch assembly for an electronic device may include a button, a bracket, a flexible printed circuit board, and a dome switch. The button may form an exterior surface of the electronic device and include a sidewall having an angled portion. The bracket can be positioned around a perimeter of the button. The flexible printed circuit board can be fixed to
30 the bracket. The dome switch can be coupled to the flexible printed circuit board. The dome switch may be activated by the angled portion of the button when the button is actuated.

In yet another embodiment, an electronic device may include a housing, a button, a bracket, a flexible printed circuit board, and a dome switch. The housing may form an exterior surface of the electronic device and include an aperture. The button may be positioned within the aperture. The bracket can be coupled to an inner surface of the housing and may be offset from an outer
5 periphery of the button. The bracket may include a vertical wall. The flexible printed circuit board can be mounted to the vertical wall. The dome switch can be coupled to the flexible printed circuit board such that the dome switch is activated by the button when the button is actuated.

In yet another embodiment, a method for constructing a switch assembly may include
10 positioning a bracket having a vertical sidewall around an outer periphery of a button. The method may also include securing a flexible printed circuit board to the vertical sidewall. The method may further include coupling a dome switch to the flexible printed circuit board such that a portion of the dome switch extends beneath the button. The dome switch may be activated by the button when the button is actuated.

15 Brief Description of the Drawings

The above and other features of the present invention, its nature and various advantages will be more apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings in which:

FIG. 1 shows a cross-sectional view of an illustrative electronic device including a switch
20 assembly in accordance with an embodiment of the invention;

FIG. 2 shows a top cross-sectional view of an illustrative switch assembly in accordance with an embodiment of the invention;

FIG. 3A shows a cross-sectional view of another exemplary electronic device including an illustrative switch assembly in accordance with an embodiment of the invention;

25 FIG. 3B shows a top view of the button of FIG. 3A in accordance with an embodiment of the invention;

FIG. 4 shows a cross-sectional view of yet another exemplary electronic device including an illustrative switch assembly in accordance with an embodiment of the invention;

FIG. 5A shows a top view of an illustrative flexible printed circuit board in accordance with an
30 embodiment of the invention;

FIG. 5B shows a top view of the flexible printed circuit board of FIG. 5A in accordance with an embodiment of the invention; and

FIG. 6 shows an illustrative method for assembling a switch assembly in accordance with some embodiments of the invention.

Detailed Description

Switch assemblies with vertically mounted and near vertically mounted activation elements, and methods for making the same are described below with reference to FIGS. 1-6.

FIG. 1 shows a cross-sectional view of electronic device 100 in accordance with an embodiment of the invention. Electronic device 100 may be a portable media device (e.g., an iPod™ or iPhone™ available from Apple, Inc. of Cupertino, CA) or a personal media device accessory (e.g., a controller for a media device). Electronic device 100 may include housing 110, button 120, brackets 131 and 132, flexible printed circuit boards (PCB) 141 and 142, and dome switches 151 and 152. When a user presses button 120, dome switches 151 and 152 may be activated to provide an input to electronic device 100. The user can press button 120 to change an attribute of electronic device 100 (e.g., what is shown on a display of the device) or a functional state of device 100 (e.g., whether the device should power up or turn off). Although only two dome switches are shown, it is understood that electronic device 100 may include more than two dome switches. Additionally, although two brackets 131 and 132 can be formed by a single cylindrical bracket in some embodiments.

Housing 110 may form an exterior surface of electronic device 100. Housing 110 may include aperture 111 for accommodating button 120 or device 100. Housing 110 may be made from any suitable material. For example, housing 110 may be made from glass, plastic, metal, or any combination of these. In one embodiment, housing 110 is made of glass.

Button 120 may be positioned within aperture 111 of housing 110 and may form an external surface of electronic device 100. Button 120 may include cosmetic portion 121. Cosmetic portion 121 may extend through aperture 111 such that cosmetic portion 121 is accessible to a user of the device. The user may apply a force to cosmetic portion 111 in order to actuate button 110. Button 120 may also include flange portion 122. Flange portion 122 may extend from a sidewall of button 120. Flange portion 122 can engage portions of housing 110 and keep button 120 from passing through aperture 111 of housing 110. In this manner, flange portion 122 can secure button 120 to housing 110.

Button 120 may further include a sidewall with angled portion 123. Angled portion 123 may provide a surface for contacting dome switches 151 and 152 when button 120 is actuated. Angled portion 123 may form any suitable angle α with horizontal plane 101. For example in some

embodiments, angle α may be 45 degrees. In other embodiments angle α may be greater than or less than 45 degrees. Providing button 120 with angled portion 123 may allow button 120 to activate dome switches 151 and 152 more reliably without damaging switches 151 and 152.

Button 120 may be made from any suitable material, including, but not limited to, plastic, glass, and/or metal.

Brackets 131 and 132 may serve as a mounting surface for flexible PCBs 141 and 142. Brackets 131 and 132 may each include a vertical wall that flexible PCBs 141 and 142 can be fixed to.

Brackets 131 and 132 can support the flexible PCBs when button 120 presses on dome switches 151 and 152. In this manner, brackets 131 and 132 may ensure that flexible PCBs 141 and 142

and dome switches 151 and 152 do not move or recede when force is applied to them. Brackets 131 and 132 may be attached to an inner surface of housing 110 using any suitable method. For example, brackets 131 and 132 may be attached using adhesives 161 and 162, respectively.

Flexible PCBs 141 and 142 may include traces for relaying switch events to another component of electronic device 100. For example, when switch events occur within dome switches 151 and

152, flexible PCBs 141 and 142 may relay the switch events to a processing unit (not shown) of electronic device 100. Flexible PCBs 141 and 142 may be shaped to fit around some or all of brackets 131 and 132. Dome switches 151 and 152 may be coupled to flexible PCBs 141 and 142 using any suitable approach, for example, via solder.

By mounting dome switches 151 and 152 around a perimeter of button 120, the resulting switch assembly can mitigate false presses. Regardless of where the user presses on cosmetic portion 121 of button 120, at least one of the dome switches of electronic device 100 will be activated.

Thus, the user will not experience any confusion or frustration associated with false presses.

Additionally, removing flexible PCBs 141 and 142 and dome switches 151 and 152 from beneath button 120 allows the space beneath button 120 to be used for another purpose. As a result, the interior space of electronic device 100 may be configured more efficiently. For example, the space beneath button 120 may accommodate another component of electronic device 100.

FIG. 2 shows a top cross-sectional view of illustrative switch assembly 200 in accordance with an embodiment of the invention. For clarity, the button that would normally be a part of switch assembly 200 has been removed. Switch assembly 200 may be substantially similar to the switch assembly included in electronic device 100 of FIG. 1. As a result, similarly numbered elements of FIGS. 1 and 2 may share any features described with respect to them.

Switch assembly 200 may include a button (not shown), brackets 231 and 232, flexible PCBs 241 and 242, and dome switches 251-254. The button associated with switch assembly 200 may be circular. As a result, brackets 231 and 232 may be curved to correspond to the shape of the button. Although, brackets 231 and 232 are shown to be curved, it is understood that they may have any shape necessary to match a corresponding shape of the button. Additionally, in some embodiments, instead of being two separate elements, brackets 231 and 232 may instead be formed by a single element. Flexible PCBs 241 and 242 may be fixed to an inner surface of brackets 231 and 232. The flexible PCBs may conform to the shape of the brackets. Dome switches 251-254 may be secured to flexible PCBs 241 and 242 at various locations using any suitable method. For example, dome switches 251-254 may be soldered to flexible PCBs 241 and 242. Although four dome switches are shown in FIG. 2, it is understood that any suitable number of dome switches can be used. In some embodiments, brackets 231 and 232 may include screw plates 265-268. Screw plates 265-268 may secure brackets 231 and 232 to a housing or other component of an electronic device.

FIGS. 3A and 3B show views of another exemplary electronic device including an illustrative switch assembly in accordance with an embodiment of the invention. In particular, FIG. 3A shows a cross-sectional view of electronic device 300 and FIG. 3B shows a top view of the button of FIG. 3A. Electronic device 300 may include housing 310, button 320, brackets 331 and 332, flexible PCBs 341 and 342, dome switches 351 and 352, and actuator arms 371 and 372. Electronic device 300 may be substantially similar to electronic device 100 of FIG. 1. As a result, electronic device 300 may share any features described with respect to electronic device 100, and vice versa.

As shown in FIG. 3A, button 320 may fit within an opening of housing 310. Brackets 331 and 332 may be positioned adjacent to the opening and may be fixed to housing 310 using adhesives 361 and 362. Flexible PCBs 341 and 342 may be attached to brackets 331 and 332. Dome switches 351 and 352 may be secured to flexible PCBs 341 and 342.

In some embodiments, actuator arms 371 and 372 may be attached to button 320. Actuator arms 371 and 372 may align with dome switches 351 and 352, and may activate the dome switches when button 320 is actuated. Actuator arms 371 and 372 may be attached to button 320 using a glue or an adhesive (e.g., adhesives 391 and 392). In some embodiments, actuator arms 371 and 372 may instead be molded as part of button 320. Using actuator arms 371 and 372 may maximize the space available in cavity 301. For example, actuator arms 371 and 372 may be

shaped to follow an outer contour of cavity 301 so that they occupy as little of cavity 301 as possible.

In some embodiments, electronic device 300 may include seal 381. Seal 381 may be coupled to button 320 and housing 310. Seal 381 may provide a water tight seal that prevents foreign liquids or other debris from entering electronic device 300. Seal 381 may be made from any suitable compliant material. For example, seal 381 may be formed from silicone.

FIG. 4 shows a cross-sectional view of yet another exemplary electronic device including an illustrative switch assembly in accordance with an embodiment of the invention. Electronic device 400 may include housing 410, button 420, brackets 431 and 432, flexible PCBs 441 and 442, and dome switches 451 and 452. Electronic device 400 may be substantially similar to electronic device 100 of FIG. 1. As a result, electronic device 400 may share any features described with respect to electronic device 100, and vice versa.

As shown in FIG. 4, button 320 may fit within opening 411 of housing 410. Flange portion 422 of button 420 may engage housing 410 and help retain button 420 within opening 411. Brackets 431 and 432 may be positioned adjacent to opening 411 and may be fixed to housing 410 using adhesives 461 and 462.

In some embodiments, brackets 431 and 432 may include an angled sidewall. Flexible PCBs 441 and 442 may be attached to the angled sidewall of brackets 431 and 432. Dome switches 451 and 452 may be secured to flexible PCBs 441 and 442. The angled sidewalls may have any suitable angle, including substantially the same angle as angled portion 423 of button 420. Embodiments that include brackets with angled sidewalls may achieve easier and more reliable actuation of dome switches 451 and 452.

In some embodiments, button 420 may include cutout 424 in a bottom surface. Cutout 424 may provide additional space to accommodate another component of electronic device 400. Although cutout 424 is shown as being substantially rectangular, it is understood that cutout 424 can have any suitable shape.

Referring now to FIGS. 5A and 5B, various views of an illustrative flexible printed circuit board are shown in accordance with an embodiment of the invention. In particular, FIG. 5A shows a top view of flexible PCB 541 lying flat and FIG. 5B shows a top view of flexible PCB 541 in an assembled state such that it takes a semi-circular shape. Dome switch 551 may be coupled to flexible PCB 541. Flexible PCB 541 may be substantially similar to flexible PCB 441 or 442 of

FIG. 4. As a result, flexible PCB 541 may share any features described with respect to flexible PCB 441, and vice versa.

Referring briefly back to FIG. 4, in some embodiments, a flexible PCB (e.g., flexible PCB 441) may need to follow a curved, angled surface (e.g., the angled sidewall of bracket 431). Thus, in order to help flexible PCB 541 achieve a desired final shape, flexible PCB 541 may include shaped cutouts. For example, referring back to FIGS. 5A and 5B, flexible PCB 541 may include cutouts 542-544. Cutouts 542-544 may help flexible PCB 541 achieve a curved, angled shape without folding or buckling.

The number, size, and shape of cutouts 542-544 may be chosen based on the size and shape of a switch assembly it will be incorporated in. For example, the length of outer edge 545 may be chosen based on a first diameter of a bracket (e.g., a first diameter of the angled sidewall of bracket 431). The width of cutouts 542-544 (e.g., x_1 , x_2 , and x_3 , respectively) may then be chosen based on a second diameter of the bracket. Once assembled into its final shape, flexible PCB 541 will have an outer diameter equal to the length of edge 545 and an inner diameter equal to the length of edge 545 less the sum of the width of cutouts 542-544 (i.e., the result will be an inner diameter shown as edge 546). Although only three cutouts are discussed, it is understood that any suitable number of cutouts may be used within the scope of this disclosure.

FIG. 6 shows an illustrative method for constructing a switch assembly in accordance with some embodiments of the invention. Method 600 may begin at step 602. At step 602, a bracket having a vertical sidewall may be positioned around an outer periphery of a button. For illustrative purposes, the bracket and button may be similar to bracket 331 and button 320 of FIG. 3. At step 604, a flexible PCB (e.g., similar to flexible PCB 341) may be secured to the vertical sidewall of the bracket.

At step 606, a dome switch (e.g., similar to dome switch 351) may be coupled to the flexible PCB. The dome switch may be positioned such that a portion of the switch extends beneath the button. When the button is actuated, the dome switch may be activated by the button. The resulting configuration may look similar to the switch assembly of FIG. 3. Although the method for constructing a switch assembly is presented using sequentially numbered steps, it is understood that the order of the steps may be altered without deviating from the scope of this disclosure.

As used herein, the term “electronic device” can include, but is not limited to, music players, video players, still image players, game players, other media players, music recorders, video

recorders, cameras, other media recorders, radios, medical equipment, calculators, cellular telephones, other wireless communication devices, personal digital assistants, programmable remote controls, pagers, laptop computers, printers, or combinations thereof.

5 The previously described embodiments are presented for purposes of illustration and not of limitation. It is understood that one or more features of an embodiment can be combined with one or more features of another embodiment to provide systems and/or methods without deviating from the spirit and scope of the invention. It will also be understood that various directional and orientational terms are used herein only for convenience, and that no fixed or absolute directional or orientational limitations are intended by the use of these words. For
10 example, the devices of this invention can have any desired orientation. If reoriented, different directional or orientational terms may need to be used in their description, but that will not alter their fundamental nature as within the scope and spirit of this invention. Those skilled in the art will appreciate that the invention can be practiced by other than the described embodiments, which are presented for purposes of illustration rather than of limitation, and the invention is
15 limited only by the claims which follow.

What is Claimed is:

1. A switch assembly for an electronic device, the switch assembly comprising:

a button, the button comprising a peripheral edge defining an outer boundary of the button;

5 a bracket offset from the peripheral edge of the button, the bracket comprising a vertical wall;

a flexible printed circuit board fixed to the vertical wall;

a switch coupled to the flexible printed circuit board, a portion of the switch extending beneath the button; and

10 an actuator arm fixed to a bottom surface of the button, the actuator arm operative to activate the switch when the button is actuated.

2. The switch assembly of claim 1, further comprising a seal coupled to the button and the bracket, the seal operative to prevent foreign substances from entering an interior space defined by the switch assembly.

3. The switch assembly of claim 1, wherein the outer boundary of the button is substantially circular, and wherein the vertical wall of the bracket is curved.

4. The switch assembly of claim 1, wherein the bracket, flexible printed circuit board, and switch define a cavity beneath the button.

5. The switch assembly of claim 1, wherein the actuator arm is fixed to the bottom surface using an adhesive.

6. A switch assembly for an electronic device, the switch assembly comprising:

a button forming an exterior surface of the electronic device, the button comprising a sidewall having an angled portion;

5 a bracket positioned around a perimeter of the button;

a flexible printed circuit board fixed to the bracket; and

a switch coupled to the flexible printed circuit board, wherein the switch is activated by the angled portion of the button when the button is actuated.

7. The switch assembly of claim 6, wherein the bracket comprises a vertical wall and the flexible printed circuit board is fixed to the vertical wall.

8. The switch assembly of claim 6, wherein the bracket comprises an angled wall and the flexible printed circuit board is fixed to the angled wall.

9. The switch assembly of claim 8, wherein the angled portion and the angled wall are substantially parallel.

10. The switch assembly of claim 8, wherein the flexible printed circuit board comprises at least one cutout.

11. The switch assembly of claim 6, wherein a bottom surface of the button comprises a cutout.

12. The switch assembly of claim 6, wherein the bracket comprises a screw plate.

13. An electronic device, comprising:

a housing including an aperture; and a switch assembly, comprising:

a bracket mounted to the housing, the bracket defining a cavity;

at least two switches mounted on an inside surface of the bracket; and

5 a button positioned within the aperture and the cavity, the button operative to engage at least one of the at least two switches when actuated.

14. The electronic device of claim 13, wherein the bracket comprises a cylindrical wall extending in a direction perpendicular to a first surface of the housing, and the at least two switches are mounted to an inside surface of the cylindrical wall.

15. The electronic device of claim 14, wherein the button comprises an angular portion operative to engage at least one of the two switches when actuated.

16. The electronic device of claim 13, wherein the button comprises a flange portion operative to help retain the button within the aperture.

17. The electronic device of claim 13, wherein the cavity is operative to receive another component of the electronic device.

18. The electronic device of claim 13, further comprising a seal coupled to the button and an interior surface of the housing, the seal operative to prevent foreign substances from entering the electronic device.

19. The electronic device of claim 13, wherein the bracket comprises an angular portion that is not perpendicular to a first surface of the housing, and the at least two switches are mounted to the angular portion.

20. The electronic device of claim 19, wherein the button comprises an angular portion operative to engage at least one of the at least two switches when actuated, wherein the angular portions of the button and bracket are substantially parallel.

21. A method for constructing a switch assembly, the method comprising:
positioning a bracket having a vertical sidewall around an outer periphery of a button;

securing a flexible printed circuit board to the vertical sidewall; and

5 coupling a switch to the flexible printed circuit board such that a portion of the switch extends beneath the button, wherein the switch is activated by the button when the button is actuated.

22. The method of claim 21, further comprising coupling a seal to the bracket and a bottom surface of the button.

23. The method of claim 21, wherein the outer periphery is substantially circular, and wherein the vertical wall is shaped to follow the outer periphery.

24. A switch assembly for a device, the switch assembly comprising:
a button, the button comprising a vertical sidewall having a side contact portion;
a housing positioned at least partially around the button; and
at least one switch coupled to a surface of the housing facing the side contact

5 portion;

wherein the button is manipulatable to activate the at least one switch by contacting the switch with the side contact portion.

25. The switch assembly of claim 24, wherein the button is manipulatable to activate the at least one switch by applying a force to the button.

26. The switch assembly of claim 24, wherein the surface of the housing comprises a vertical sidewall.

27. The switch assembly of claim 26, wherein the side contact portion and the vertical sidewall are substantially parallel.

28. The switch assembly of claim 24, wherein the button is manipulatable to activate the at least one switch by applying a force to a side of the button.

29. The switch assembly of claim 24, wherein the button is positioned at least partially within a cavity of the housing.

30. The switch assembly of claim 29, wherein the surface of the housing comprises a vertical sidewall of the cavity.

31. The switch assembly of claim 24, wherein the button comprises a button head.

32. The switch assembly of claim 31, wherein the button is manipulatable to activate the at least one switch by applying a force to one side of the button head.

33. A device, comprising:

a housing;

a button positioned at least partially within the housing, the button comprising a vertical sidewall having a side contact portion; and

5 at least one switch coupled to a surface of the housing facing the side contact portion;

wherein the button is manipulatable to activate the at least one switch utilizing the side contact portion.

34. The device of claim 33, wherein the button further comprises a button head.

35. The device of claim 34, wherein the button is manipulatable to activate the at least one switch utilizing the side contact portion by applying a force to a side of the button head.

36. The device of claim 33, wherein the button is positioned at least partially within a cavity of the housing.

37. The device of claim 36, wherein the surface of the housing comprises a vertical sidewall of the cavity.

38. The device of claim 33, wherein the button is manipulatable to activate the at least one switch utilizing the side contact portion by applying a force to a side of the button.

39. The device of claim 33, wherein the surface of the housing comprises a vertical sidewall.

40. The device of claim 39, wherein the side contact portion and the vertical sidewall are substantially parallel.

41. The device of claim 33, wherein the button is manipulatable to activate the at least one switch by applying a force to the button.

42. A method for constructing a switch assembly, comprising:

positioning a button at least partially within a housing, the button comprising a vertical sidewall having a side contact portion; and

5 coupling at least one switch to a surface of the housing facing the side contact portion such that the button is manipulatable to contact the at least one switch with the side contact portion.

43. A method of operating a button, comprising:

manipulating a button that is positioned at least partially within a housing and comprises a vertical sidewall having a side contact portion; and

5 contacting at least one switch coupled to a surface of the housing with the side contact portion in response to the manipulation; and

activating the at least one switch in response to the contacting.

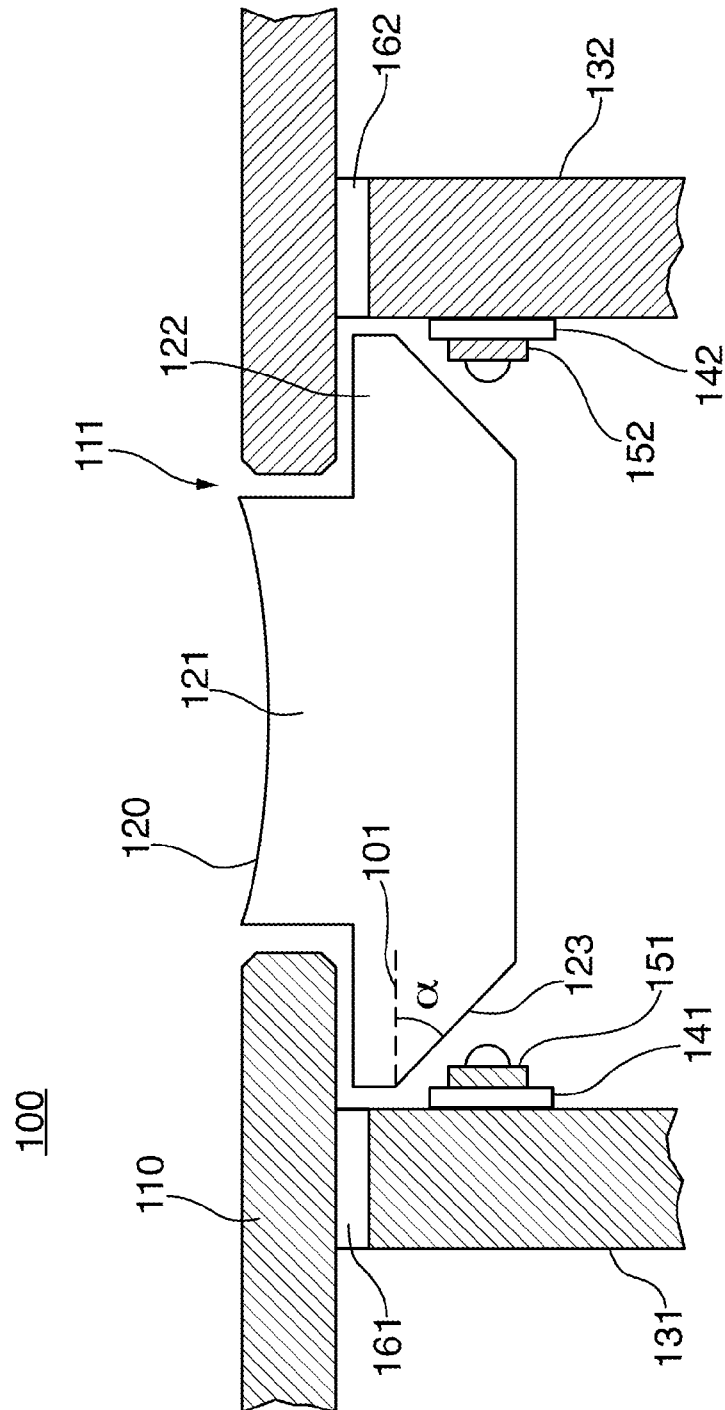


Fig. 1

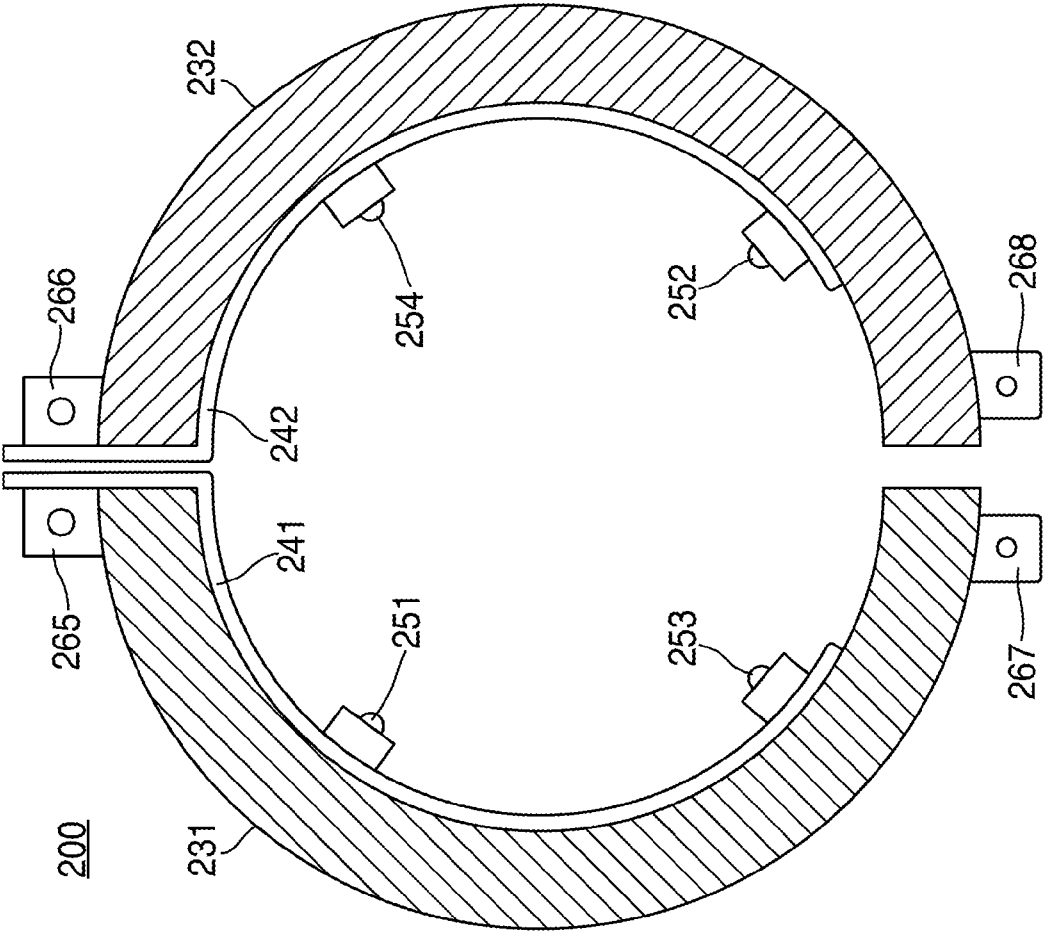


FIG. 2

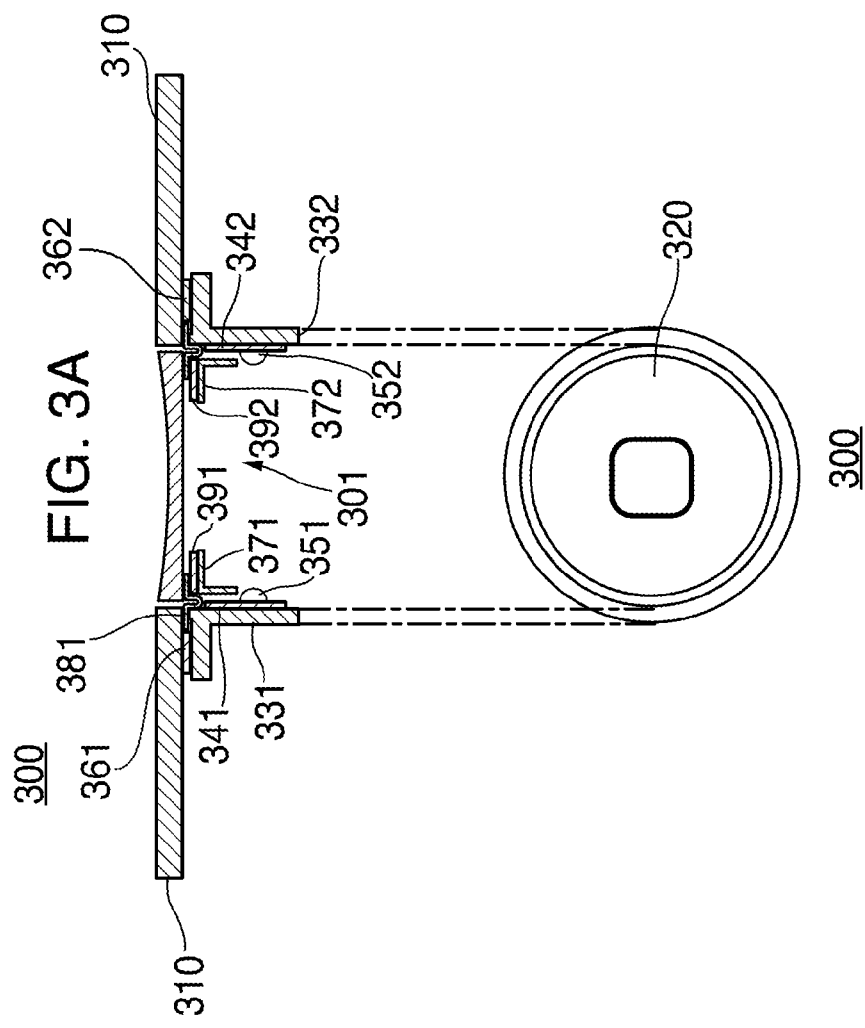


FIG. 3B

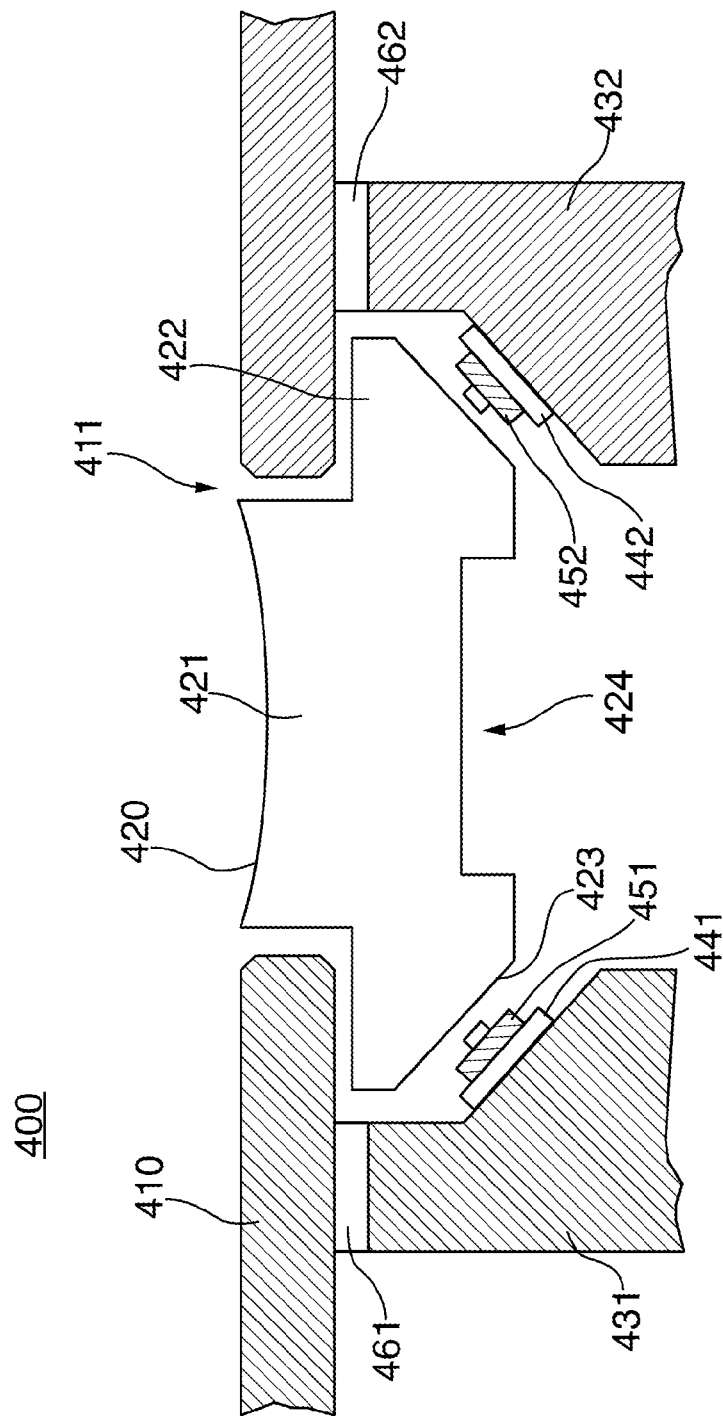


FIG. 4

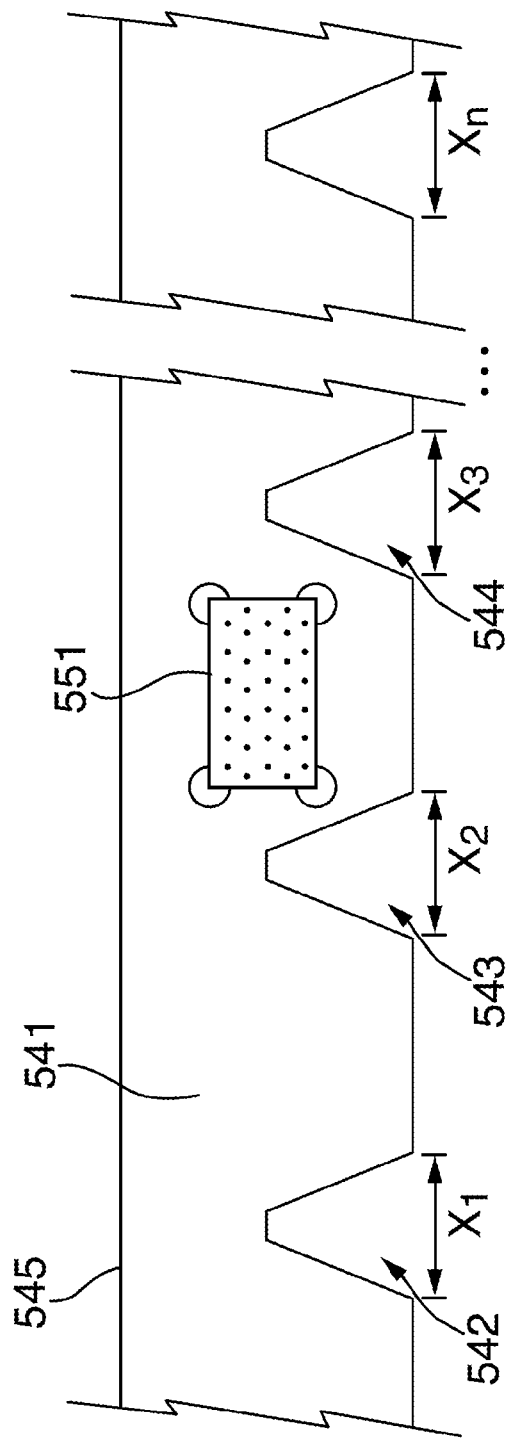


FIG. 5A

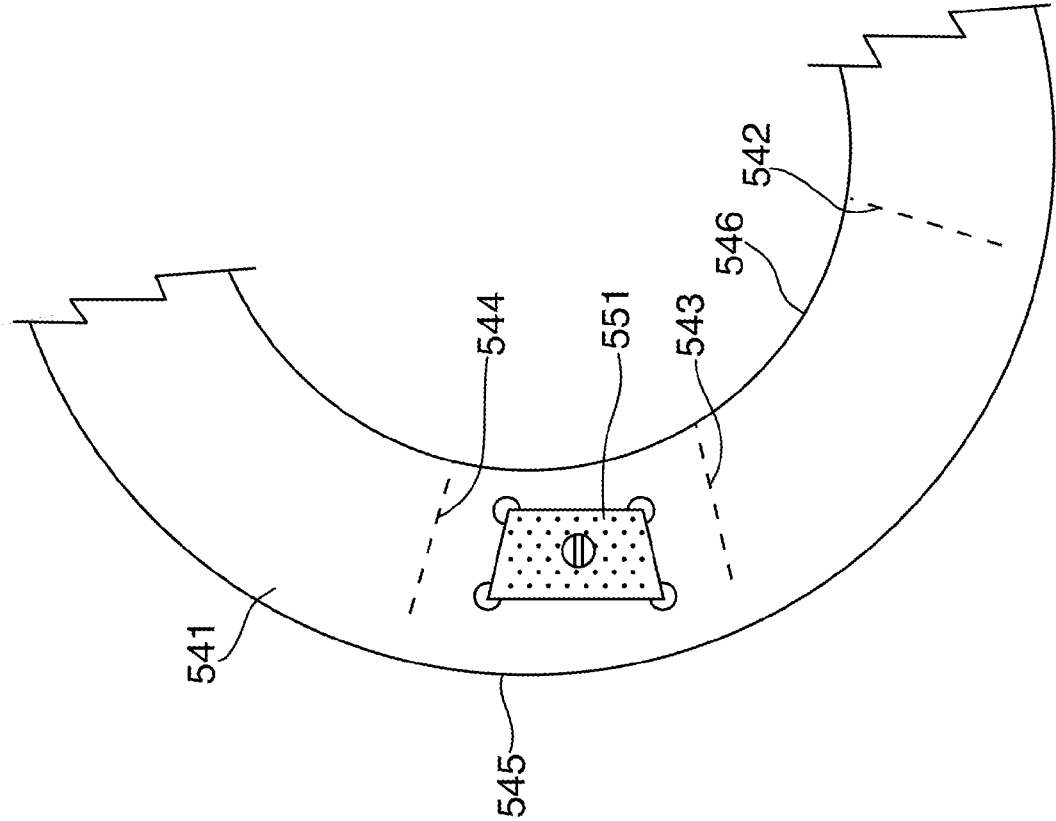


FIG. 5B

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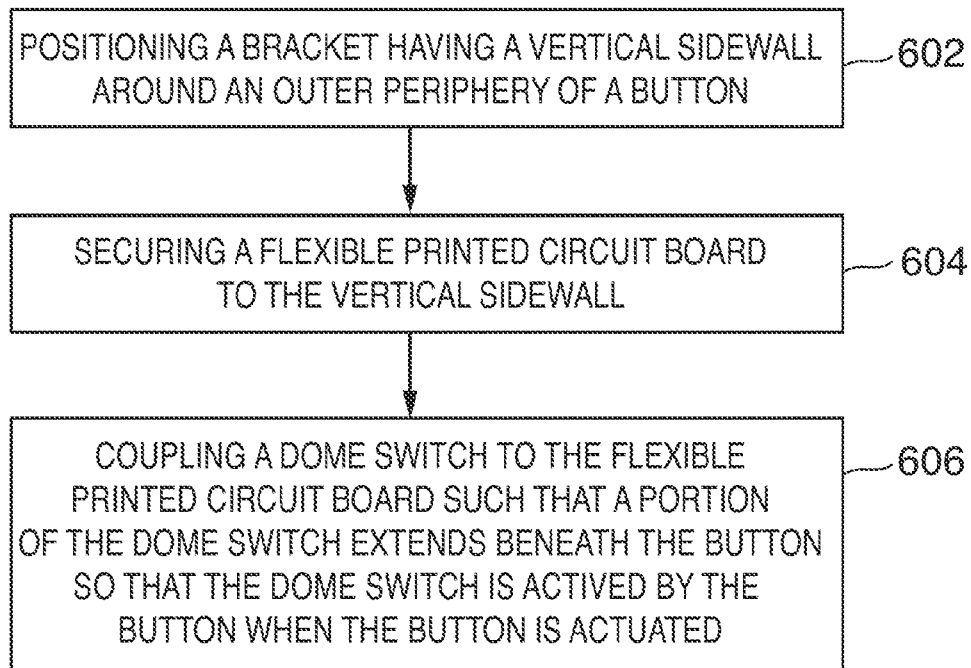
600

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/058995

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01H13/807 H04M1/23
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)
H01H H04M

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	EP 2 511 926 A1 (SONY ERICSSON MOBILE COMM AB [SE]) 17 October 2012 (2012-10-17) paragraph [0026] - paragraph [0069]; figures 1-5	1-43
Y	----- WO 00/31949 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]) 2 June 2000 (2000-06-02) page 3, line 5 - page 4, line 34; figures 1-5	1-43
Y	----- US 2010/226084 A1 (CHEN MING-PIN [TW]) 9 September 2010 (2010-09-09) paragraph [0012] - paragraph [0023]; figures 1-6	1-43
	----- -/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

12 December 2013

Date of mailing of the international search report

20/12/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
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Authorized officer

Nieto, José Miguel

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/058995

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 1-43(partially)
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of Item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/058995

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/069501 A1 (LAI JIN-SHI [CN]) 22 March 2012 (2012-03-22) paragraph [0013] - paragraph [0016]; figure 3 -----	2, 18, 22

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 1-43(partially)

Apparatus claims 1, 6, 13, 24 and 33 and method claims 21, 42 and 43 have been drafted as independent claims and have at least partly overlapping scope.

Drafting such a plurality of independent claims with overlapping scope makes it impossible to figure out which subject-matter could represent the invention for which protection is sought, so that the claims as a whole fail to comply with the clarity and conciseness requirements of Article 6 PCT to such an extent that a meaningful search could not be carried out.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/058995

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 2511926	A1	17-10-2012	NONE	
WO 0031949	A1	02-06-2000	CN 1289498 A EP 1051826 A1 JP 2002530843 A US 6166337 A WO 0031949 A1	28-03-2001 15-11-2000 17-09-2002 26-12-2000 02-06-2000
US 2010226084	A1	09-09-2010	CN 201392756 Y US 2010226084 A1	27-01-2010 09-09-2010
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