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(54) Title: ARTICULATED GAMING CONTROLLER

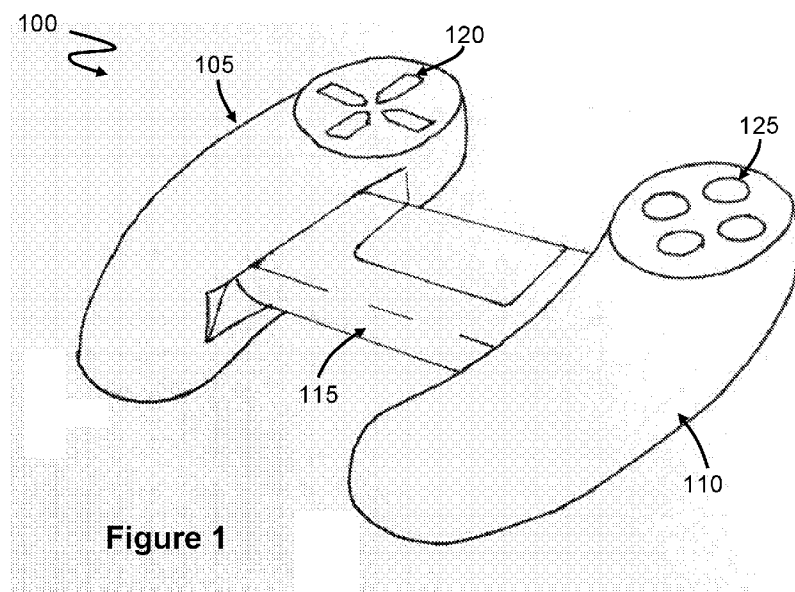


Figure 1

(57) **Abstract:** An articulated controller is provided that enables a user to simply, and intuitively enter complex movements into a game with high accuracy, and while maintaining a constant grip. The controller comprises: a first hand unit, for being held in one hand by the user; a second hand unit, for being simultaneously held in another hand by the user, and an articulation joint coupling the first hand unit and the second hand unit, wherein the articulation joint is at least partly enclosed by the first hand unit to enable the user to maintain a grip on the first hand unit without interference from the articulation joint, and wherein user input is provided to the controller through movement of the articulation joint.



ARTICULATED GAMING CONTROLLER

TECHNICAL FIELD

[0001] The present invention relates to gaming controllers. In particular, the present invention relates to articulated gaming controllers.

BACKGROUND ART

[0002] Since the 1980s, gaming controllers have often been handheld units with buttons and a joystick or joypad. An example of such a gaming controller is the Nintendo Entertainment System (NES) controller, which includes a cross-shaped joypad, two game buttons, and start and select buttons.

[0003] Over time, improvements to gaming controllers have been made, including the incorporation of further buttons, more accurate joysticks, and the use of wireless technology (rather than wired controllers).

[0004] Modern gaming controllers are generally accurate when mastered, but generally require a lot of practice and skill to master, as the controls are generally not intuitive.

[0005] Attempts have been made to make controllers that are more intuitive. For example, steering wheel controllers have been developed, which mimic the steering wheel of a car, as have gun controllers, which mimic guns. Such controllers are, however, only suitable for certain types of games, such as car or shooting games, and as such, generally require the use of different controllers for different games, which is time consuming and expensive.

[0006] More recently, attempts have been made to incorporate motion sensors into controllers, to enable more intuitive interaction. However, such controllers are generally not very accurate, and complex interaction is difficult using motion.

[0007] Similarly, attempts have been made to provide articulated controllers, however, such controllers of the prior art have been difficult to grip and use, particularly when the user is focusing on a screen.

[0008] Accordingly, there is a need for an improving gaming controller.

[0009] It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

SUMMARY OF INVENTION

[0010] The present invention is directed to gaming controllers, which may at least partially overcome at least one of the abovementioned disadvantages or provide the consumer with a useful or commercial choice.

[0011] With the foregoing in view, the present invention in one form, resides broadly in an articulated controller comprising:

- a first hand unit, for being held in one hand by the user;
- a second hand unit, for being simultaneously held in another hand by the user, and
- an articuable joint coupling the first hand unit and the second hand unit, wherein the articuable joint is at least partly enclosed by the first hand unit to enable the user to maintain a grip on the first hand unit without interference from the articuable joint, and wherein user input is provided to the controller through movement of the articuable joint.

[0012] Preferably, the controller is a gaming controller.

[0013] Preferably, the first and second hand units comprise a left hand unit and a right hand unit.

[0014] Preferably, the articuable joint comprises a link, articulated with the first hand unit, and articulated with the second hand unit.

[0015] Preferably, the link is elongate. Preferably, the link is articulated with the first hand unit at one end of the link, and articulated with the second hand unit at an opposing end of the link.

[0016] Preferably, the first hand unit is pivotally attached to the link, and the second hand unit is pivotally attached to the link.

[0017] Preferably, the first and second hand units are configured to pivot around a first axis, and at least one of the first and second hand units is configured to pivot around a second axis. The second axis may be perpendicular to the first axis. The first and second hand units may be configured to pivot around the first axis independently of pivoting around the second axis.

[0018] Preferably, the first and second hand units are configured to pivot around an axis of the link unit. Alternatively, the first and second hand units may be configured to pivot around an axis parallel to an axis of the link.

[0019] Preferably, the first and second hand units are configured to mimic a twisting motion where first and second hand units are rotated in opposite directions around the axis of the link.

[0020] Preferably, the first and second hand units are configured to pivot around ends of the link unit. The first and second hand units may be configured to pivot around axes perpendicular to a front surface of the controller.

[0021] Suitably, the first and second hand units are configured to mimic an up-down motion, where the first and second units are raised or lowered relative to each other, such that an angle is varied between the first unit and the link, and between the second unit and the link.

[0022] Preferably, the first and second hand units each include a channel, for receiving respective ends of the link.

[0023] Preferably, the channels are elongate, and extend along a length of the first and second units.

[0024] Preferably, the channels are located on inside faces of each the first and second unit.

[0025] Preferably, the controller includes an interface, for communicating signals of the controller to a system to be controlled. The system to be controlled may comprise a personal computer or a video game console, for example.

[0026] Preferably, the interface is a wireless interface.

[0027] Preferably, the controller includes a sensor, coupled to the interface, the sensor configured to sense relative movement of the first and second hand units. The sensor may be configured to sense relative movement of the first and second hand units by sensing a movement of the first hand unit with reference to the link.

[0028] Preferably, the link is configured to maintain the first and second hand units in a parallel arrangement.

[0029] Preferably, the link comprises first and second arms, pivotally coupled to the each of the left and right hand units. The first and second arms may be parallel, of equal length, and symmetrically positioned on the first and second units to form a parallelogram with the first and second units. The link may include a cover, covering the first and second arms.

[0030] The controller may include one or more springs, configured to bias the articulable joint into a normal state.

[0031] Preferably, the controller includes a joystick on an upper portion of a front thereof, which enables the user to input left, right up and down motions.

[0032] Preferably, the controller includes one or more buttons on an upper portion of a front thereof, which enables the user to input selections.

[0033] Preferably, the controller is substantially symmetrical. Preferably, the link is symmetrical.

[0034] Preferably, the controller is entirely handheld.

[0035] In another form, the invention resides broadly in an articulated gaming controller comprising:

- a first hand unit, for being held in one hand by the user;
- a second hand unit, for being simultaneously held in another hand by the user, and
- an articulable joint coupling the first hand unit and the second hand unit, wherein the first and second hand units are configured to pivot around a first axis and a second axis, and generate output signals according to the pivoting around the first axis and the second axis.

[0036] Preferably, a first signal component is generated according to pivoting around the first axis, and a second signal component is generated according to pivoting around the second axis.

[0037] Any of the features described herein can be combined in any combination with any one or more of the other features described herein within the scope of the invention.

[0038] The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge.

BRIEF DESCRIPTION OF DRAWINGS

[0039] Various embodiments of the invention will be described with reference to the following drawings, in which:

[0040] Figure 1 illustrates an upper perspective view of a controller, according to an embodiment of the present invention;

[0041] Figure 2 illustrates a front view of the controller of figure 1, according to an embodiment of the present invention;

[0042] Figure 3 illustrates a side view of the controller of Figure 1, according to an embodiment of the present invention;

[0043] Figure 4 illustrates a right side view of the controller of Figure 1 in a first configuration;

[0044] Figure 5 illustrates a front view of the controller of Figure 1 in a second configuration;

[0045] Figure 6 illustrates a right side view of the controller of Figure 1, with a right hand unit and link removed;

[0046] Figure 7 illustrates a hand grip onto the controller as illustrated in Figure 6;

[0047] Figure 8 illustrates a front cross sectional view of the controller along an axis A-A' of Figure 3;

[0048] Figure 9 illustrates a schematic of the controller of Figure 1, according to an embodiment of the present invention;

[0049] Figure 10 illustrates a cutaway portion of the controller of Figure 1, illustrating a flexible PCB membrane, according to an embodiment of the present invention; and

[0050] Figure 11 illustrates a further cutaway portion of the controller of Figure 1, illustrating a position of a toggle sensor mechanism relative to the left unit and the link.

[0051] Preferred features, embodiments and variations of the invention may be discerned from the following Detailed Description which provides sufficient information for those skilled in the art to perform the invention. The Detailed Description is not to be regarded as limiting the scope of the preceding Summary of the Invention in any way.

DESCRIPTION OF EMBODIMENTS

[0052] Figure 1 illustrates an upper perspective view of an articulate gaming controller 100, according to an embodiment of the present invention. Figure 2 illustrated a top view of the controller 100, and Figure 3 illustrates a right side view of the controller 100.

[0053] The gaming controller 100 can be used with various types of games, including car games, fighting games, sports games and the like. The controller 100 enables the user to simply, and intuitively enter complex movements into the game with high accuracy, and while

maintaining a constant grip.

[0054] The gaming controller includes a left hand unit 105, a right hand unit 110, and a link unit 115 connecting the left hand unit 105 and the right hand units 110.

[0055] The left hand unit 105 is pivotally attached to the link unit 115, and the right hand unit 105 is pivotally attached to the link unit 115. As such, the controller 100 can be manipulated by pivoting the left and right hand units 105, 110 relative to the link unit.

[0056] As best illustrated in Figure 4, the left hand unit 105 and the right hand unit 110 are configured to pivot around an axis 205 of the link unit 115, or around an axis parallel to the axis 205 of the link unit 115. As such, the controller 100 can be manipulated through a twisting motion, where the left hand unit 105 and the right hand unit 110 are rotated in opposite directions such that an angle is varied between an axis 405 of the left hand unit 105 and an axis 410 of the right hand unit 110.

[0057] Similarly, and as best illustrated in Figure 5, the left hand unit 105 and the right hand unit 110 are configured to pivot around ends of the link unit 115, and around axes 305 perpendicular to a face (front surface) of the controller 100. As such, the controller 100 can be manipulated through an up-down motion, where the left hand unit 105 and the right hand unit 110 are raised or lowered relative to each other, such that an angle is varied between the left hand unit 105 and the link, and between the right hand unit 110 and the link.

[0058] As such, the controller 100 can be manipulated through a twisting motion, where the left hand unit 105 and the right hand unit 110 are rotated in opposite directions, and an up-down motion, where the left hand unit 105 and the right hand unit 110 are raised and lowered relative to each other. .

[0059] Now turning back to Figure 1 and Figure 2, the left hand unit 105 includes a joystick 120 on an upper portion of a front thereof, which enables the user to input left, right up and down motions. Similarly, the right hand unit 110 includes a plurality of buttons 125 on an upper portion of a front thereof, which enables the user in input a plurality of commands. Similarly, and as illustrated in Figure 3, the right hand unit includes rear buttons 310, which enable the user to provide additional input using his or her fingers.

[0060] Advantageously, the twisting an up-down motions can be performed easily by users with different hand sizes, without looking at the controller, and without requiring careful positioning of the hands on the controller, in clear contrast to a complex button based system.

[0061] As best illustrated with reference to Figure 6, the left hand unit 105 includes a channel 605, in which the link unit 115 is received. The channel 605 is on an inside face 610 of the left hand unit 105, intermediate a front face 615 of the left hand unit 105 and a rear face 620 of the left hand unit 105. As such, pivot joints which enable the pivoting of the left hand unit 105 with reference to the link unit 110 are shielded by the left hand unit from a front of the left hand unit 105 (i.e. by the front face 615), from a rear of the left hand unit 105 (i.e. by the rear face 620).

[0062] A mirrored channel arrangement is provided in the right hand controller 110, shielding the link unit 110.

[0063] As the link unit 110 is shielded by the front face 615 and the rear face 620 of the left and right hand units 105, the user is able to grip the controller 100, and maintain that grip throughout an entire motion range of the controller. More specifically, the user is able to grip the left hand unit 105 and the right hand unit 110, without interfering with the link, as illustrated by the exemplary hand 705 in Figure 7.

[0064] This enables the user to place his or her thumb 705a and/or fingers 705b adjacent to buttons 125, the joypad 120, or any other user input elements that may be present, and maintain that position even while the left and right hand units 105, 110 move relative to each other.

[0065] As illustrated in Figure 8, the link comprises first and second arms 805, pivotally coupled to the each of the left and right hand units 105, 110. The first and second arms 805 are parallel, and of equal length, and are symmetrically positioned on the left and right units 105, 110. As such, the first and second arms 805 form a parallelogram with the left and right units 105, 110.

[0066] The link 115 comprises a cover, which covers the first and second arms and provides the appearance of a single link unit.

[0067] According to certain embodiments, the left hand unit 105 is configured to pivot (rotate) around the axis 405 of the left hand unit 105, and/or the right hand unit 110 is configured to pivot around the axis 510 of the right hand unit 110, and generate a signal based thereon. This may be instead of the pivoting of the left and right hand units 105, 110 around one or both of the axes 205, 305, or in addition thereto, so that the left and right hand units 105, 110 may pivot around three axes.

[0068] By allowing the left or right hand units 105, 110 to pivot around their own axis, the

controller is able to mimic a throttle style input, which is particularly advantageous in motorcycle games.

[0069] Figure 9 illustrates a schematic of the game controller 100, according to an embodiment of the present invention.

[0070] The controller 100 includes sensors 905a, 905b, coupled to the left unit 105 and link 115, and coupled to the right unit 110 and link 115, for detecting a configuration of the controller. In particular, the sensor 905a is configured to detect movement of the left unit 105 relative to the link around two different axes, namely around the axis 205 of the link unit 115, and around an axis 305 perpendicular to a face (front surface) of the controller 100. The sensor 905b is for detecting similar movement of the right unit 110.

[0071] The controller further includes springs 910a, 910b, coupled to the left unit 105 and link 115, and coupled to the right unit 110 and link 115, for biasing the controlled towards a neutral configuration (i.e. as illustrated in Figure 1, where the left unit 105 and right unit 110 are parallel and forming a right angle with the link 115).

[0072] As such, the user applies force to the controller 100 (e.g. twisting or relative lateral movement of the left and right units) as user input. When the user ceases to apply such force to the controller 100, the controller automatically returns to the neutral state.

[0073] The sensors 905a, 905b are coupled to a wireless transmitter 915, to enable a signal of the sensors to be provided to a gaming console, a personal computer, or other device. The skilled addressee will, however, readily appreciate that a wired coupling may instead be provided, and/or that the sensor data may be filtered at the controller prior to being sent to the gaming console or similar.

[0074] Similarly, the joypad 120 and buttons 125 are also coupled to the wireless transmitter 915. As such, an input to the gaming console or similar device is generally a combination of sensor data and other user input.

[0075] As, the left and right units 105, 110 operate symmetrically, the skilled addressee will readily appreciate that sensors 905a, 905b need not be provided in both the left and right controllers. As illustrated in Figure 5, as the right unit 110 moves up, the angle with reference to the link 115 increases by the same amount as the angle decreases between the link 115 and the left unit 105. In particular, the sum of both angles is always constant, regardless of position, namely 180 degrees.

[0076] Similarly, data from the sensors 905a, 905b may be filtered to provide a single input value. Finally, the joypad 120, the sensors 905a, 905b and the buttons 125 are coupled by a single flexible PCB Membrane that extends between the left and right units 105, 110 through the link. As the controller is used, a flexible ribbon component flexes at junctions between the left and right units 105, 110 and the link 115, providing continuity between the sensors and buttons and the wireless interface through all configurations of the controller 100.

[0077] While the sensors 905a, 905b are illustrated as single sensors, the skilled addressee will readily appreciate that each of the sensors 905a, 905b may comprise two single plane sensors, for detection motion around difference axes separately. Similarly, each sensor 905a, 905b may comprise multiple redundant sensors.

[0078] According to certain embodiments, the wireless transmitter may be housed in the link 115, together with a battery, to provide a balanced unit.

[0079] Figure 10 illustrates a cutaway portion of the controller 100, illustrating a flexible PCB membrane 1000, according to an embodiment of the present invention. As previously mentioned, the flexible PCB Membrane 1000 extends between the left and right units 105, 110 through the link 115.

[0080] As the PCB membrane 1000 passes through articulating hinges at both ends of the link 115, it is at risk of wearing and becoming damaged. The membrane 1000 passes through the hinges from the link 115 to the two units 105, 110 in an S-bend configuration. This configuration ensures that the membrane has the necessary flexibility so it will not wear like a directly coupled membrane, and thus has a longer working life. Furthermore, the S-bend configuration provides a longer overall membrane when compared with a directly coupled membrane, which helps spread any movement of the membrane over a larger area.

[0081] Figure 11 illustrates a further cutaway portion of the controller 100, illustrating a position of a toggle sensor mechanism 1100 relative to the left unit 105 and the link 115.

[0082] The toggle sensor mechanism 1100 includes an arm 1105, which extends outwardly from a body 1110. An end of the arm 1105 is coupled to the left unit 105, and an opposite end of the body 1110 is coupled to the link 115

[0083] The toggle sensor mechanism 1100 is positioned within the hinge so that a rotational axis 1115 of the toggle sensor mechanism 1100 sits directly on the axis 305 of the hinge. This enables the toggle sensor mechanism 1100 to sense articulation of the hinge accurately and

without any distortion. In any other position, i.e. when the axes 1115 and 305 are misaligned, the toggle sensor mechanism 1100 will arc within the motion of the hinge, rather than pivot with the motion of the hinge.

[0084] Advantageously, embodiments of the present invention provide several advantages over controllers of the prior art. For example, the controller is intuitive and easy to use, and can be used with a wide variety of games.

[0085] Furthermore, as the left and right units (which form handgrips of the controller) are designed so that the thumb and fingers are able to grip the units without being affected throughout the range of motion. In clear contrast, external hinges generally disrupt the users grip as the controller is moved, which is clearly undesirable in gaming.

[0086] In the present specification and claims (if any), the word 'comprising' and its derivatives including 'comprises' and 'comprise' include each of the stated integers but does not exclude the inclusion of one or more further integers.

[0087] Reference throughout this specification to 'one embodiment' or 'an embodiment' means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases 'in one embodiment' or 'in an embodiment' in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more combinations.

[0088] In compliance with the statute, the invention has been described in language more or less specific to structural or methodical features. It is to be understood that the invention is not limited to specific features shown or described since the means herein described comprises preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims (if any) appropriately interpreted by those skilled in the art.

CLAIMS

1. An articulated controller comprising:
a first hand unit, for being held in one hand by the user;
a second hand unit, for being simultaneously held in another hand by the user, and
an articuable joint coupling the first hand unit and the second hand unit, wherein the articuable joint is at least partly enclosed by the first hand unit to enable the user to maintain a grip on the first hand unit without interference from the articuable joint, and wherein user input is provided to the controller through movement of the articuable joint.
2. The articulated controller of claim 1, wherein the first and second hand units are configured to pivot around a first axis, and at least one of the first and second hand units is configured to pivot around a second axis.
3. The articulated controller of claim 2, wherein the second axis is perpendicular to the first axis.
4. The articulated controller of claim 2, wherein the first and second hand units are configured to pivot around the first axis independently of pivoting around the second axis.
5. The articulated controller of claim 1, wherein the first and second hand units are configured to pivot around an axis of the link unit.
6. The articulated controller of claim 1, wherein the first and second hand units are configured to pivot around an axis parallel to an axis of the link.
7. The articulated controller of claim 1, wherein the first and second hand units are configured to mimic a twisting motion where first and second hand units are rotated in opposite directions around the axis of the link.
8. The articulated controller of claim 1, wherein the first and second hand units are configured to pivot around ends of the link unit.
9. The articulated controller of claim 1, wherein the first and second hand units are configured to pivot around axes perpendicular to a front surface of the controller.
10. The articulated controller of claim 1, wherein the first and second hand units are configured to mimic an up-down motion, where the first and second units are raised or lowered relative to each other, such that an angle is varied between the first unit and the link, and

between the second unit and the link.

11. The articulated controller of claim 1, wherein the controller is a gaming controller.
12. The articulated controller of claim 1, wherein the first and second hand units comprise a left hand unit and a right hand unit.
13. The articulated controller of claim 1, wherein the articulable joint comprises a link, articulated with the first hand unit, and articulated with the second hand unit.
14. The articulated controller of claim 1, wherein the link is elongate.
15. The articulated controller of claim 1, wherein the link is articulated with the first hand unit at one end of the link, and articulated with the second hand unit at an opposing end of the link.
16. The articulated controller of claim 1, wherein the first hand unit is pivotally attached to the link, and the second hand unit is pivotally attached to the link.
17. The articulated controller of claim 1, wherein the first and second hand units each include a channel, for receiving respective ends of the link.
18. The articulated controller of claim 17, wherein the channels are elongate, and extend along a length of the first and second units.
19. The articulated controller of claim 17, wherein the channels are located on inside faces of each the first and second unit.
20. The articulated controller of claim 1, wherein the controller includes an interface, for communicating signals of the controller to a system to be controlled.
21. The articulated controller of claim 20, wherein the interface is a wireless interface.
22. The articulated controller of claim 20, wherein the controller includes a sensor, coupled to the interface, the sensor configured to sense relative movement of the first and second hand units.
23. The articulated controller of claim 1, wherein the sensor is configured to sense relative movement of the first and second hand units by sensing a movement of the first hand unit with reference to the link.

24. The articulated controller of claim 1, wherein the link is configured to maintain the first and second hand units in a parallel arrangement.
25. The articulated controller of claim 1, wherein the link comprises first and second arms, pivotally coupled to the each of the left and right hand units.
26. The articulated controller of claim 25, wherein the first and second arms are parallel, of equal length, and symmetrically positioned on the first and second units to form a parallelogram with the first and second units.
27. The articulated controller of claim 25, wherein the link includes a cover, covering the first and second arms.
28. The articulated controller of claim 1, wherein the controller includes one or more springs, configured to bias the articulating joint into a normal state.
29. The articulated controller of claim 1, wherein the controller includes a joystick on an upper portion of a front thereof, which enables the user to input left, right up and down motions.
30. The articulated controller of claim 1, wherein the controller includes one or more buttons on an upper portion of a front thereof, which enables the user to input selections.
31. The articulated controller of claim 1, wherein the controller is substantially symmetrical.
32. The articulated controller of claim 1, wherein the link is symmetrical.
33. The articulated controller of claim 1, wherein the controller is entirely handheld.
34. An articulated gaming controller comprising:
 - a first hand unit, for being held in one hand by the user;
 - a second hand unit, for being simultaneously held in another hand by the user, and
 - an articulating joint coupling the first hand unit and the second hand unit, wherein the first and second hand units are configured to pivot around a first axis and a second axis, and generate output signals according to the pivoting around the first axis and the second axis.
35. The articulated controller of claim 1, wherein a first signal component is generated according to pivoting around the first axis, and a second signal component is generated according to pivoting around the second axis.

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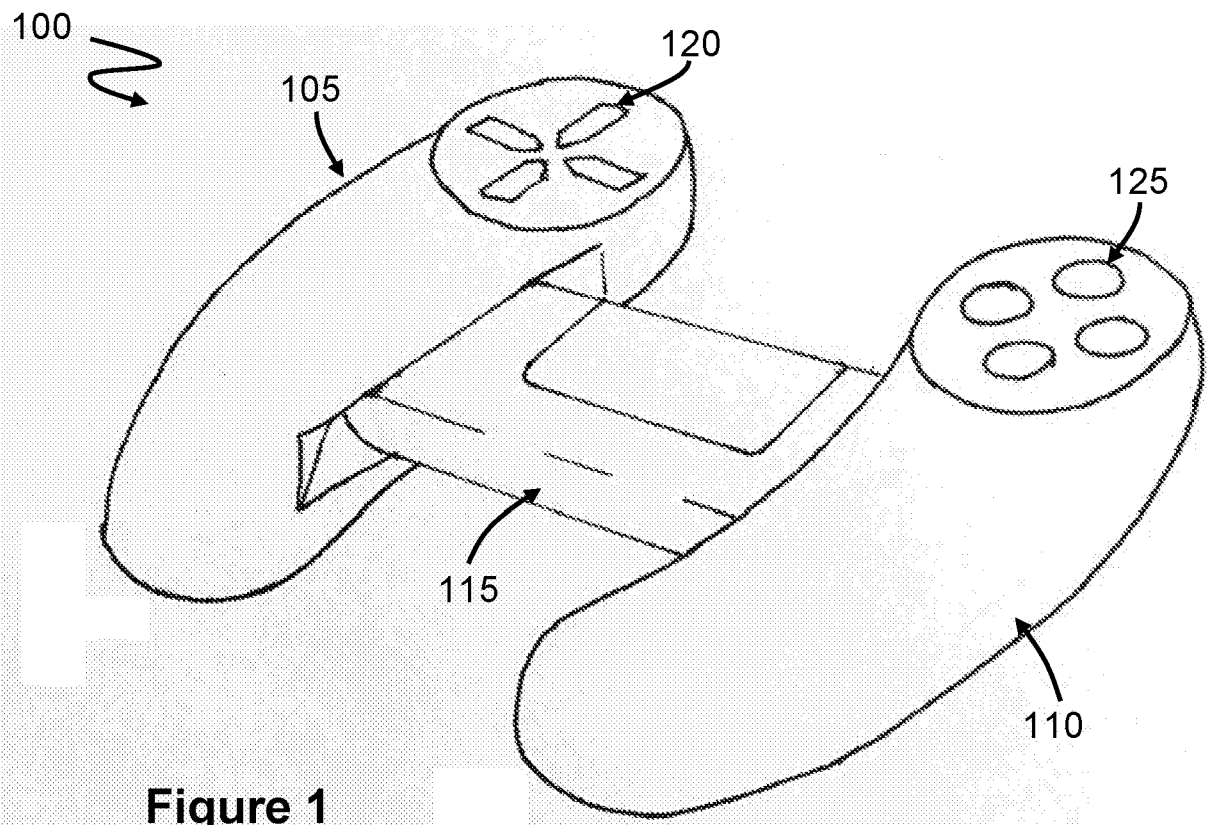


Figure 1

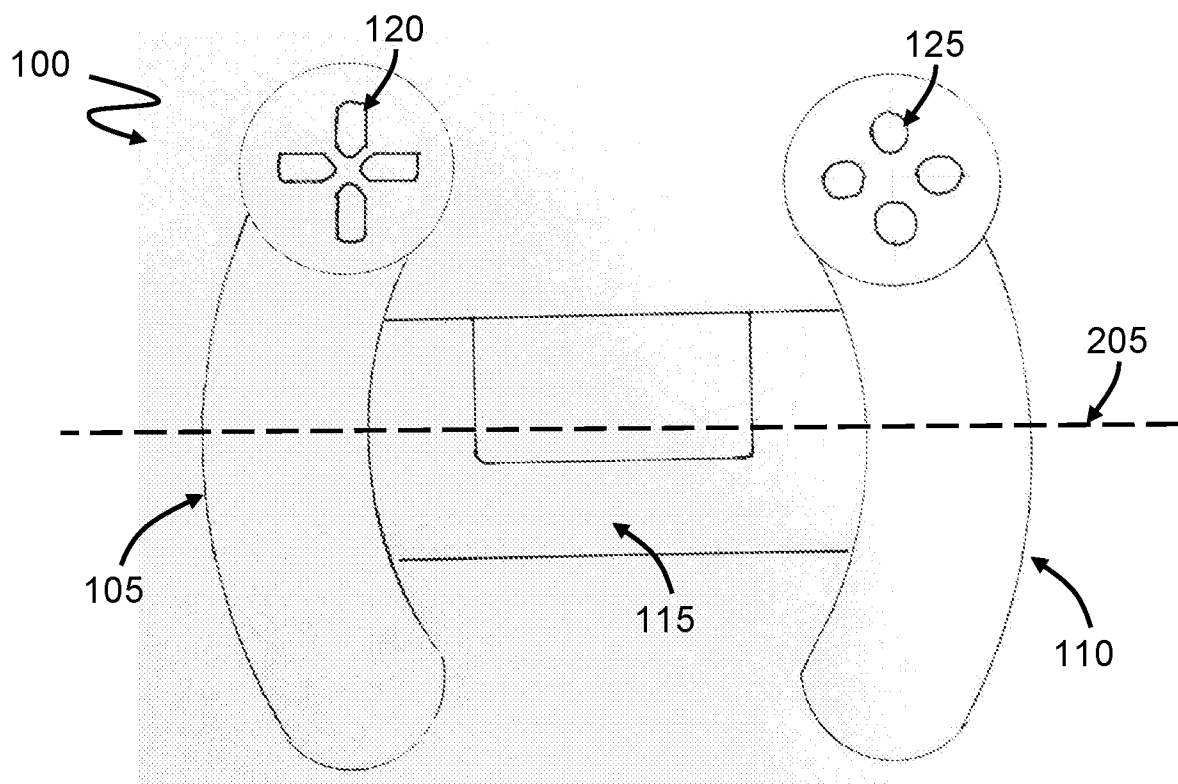


Figure 2

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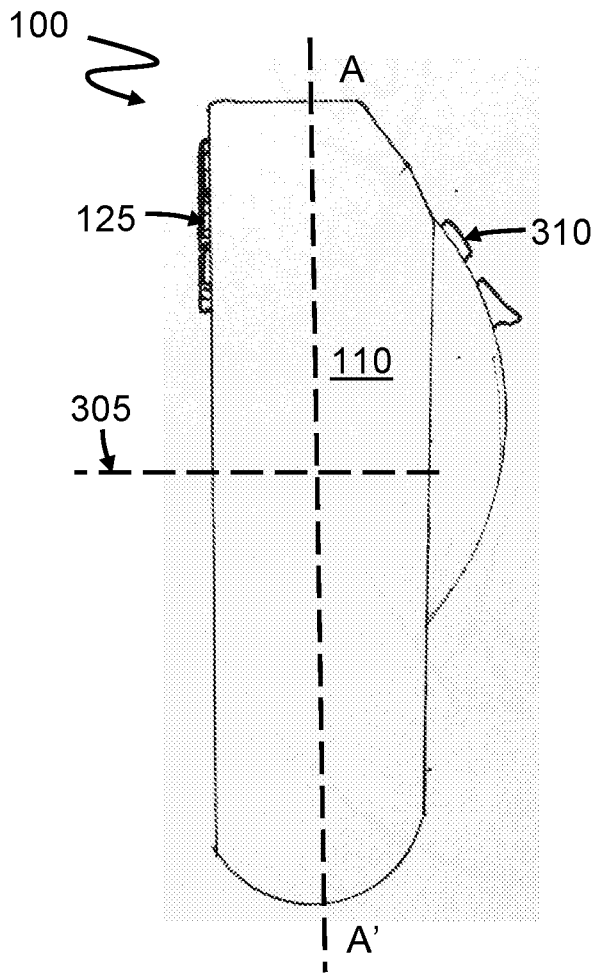


Figure 3

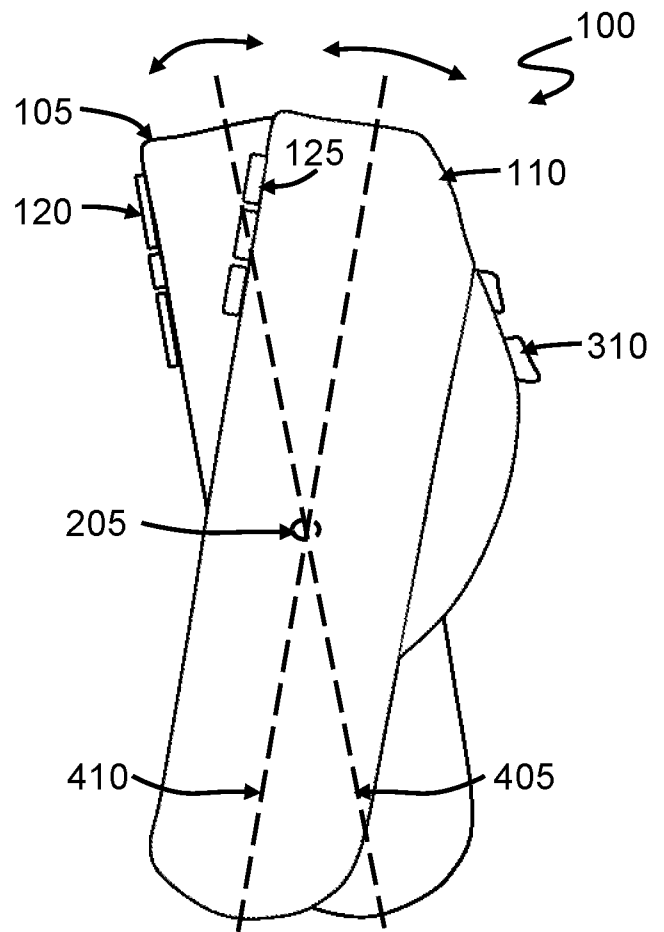


Figure 4

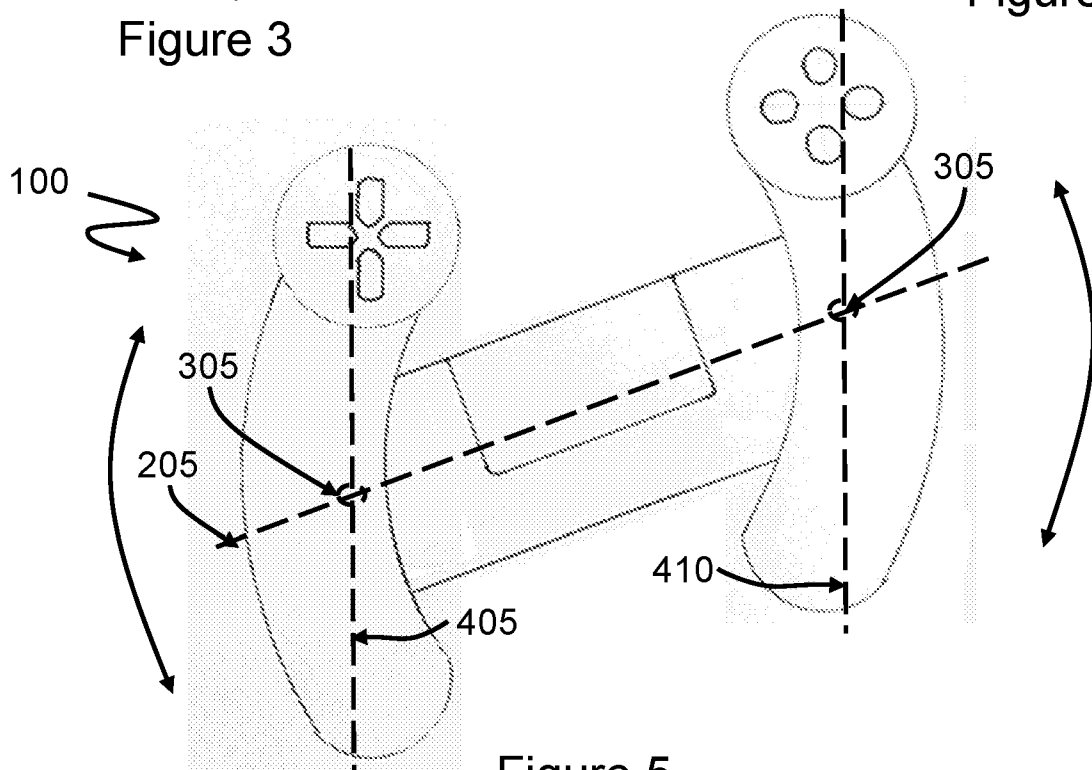


Figure 5

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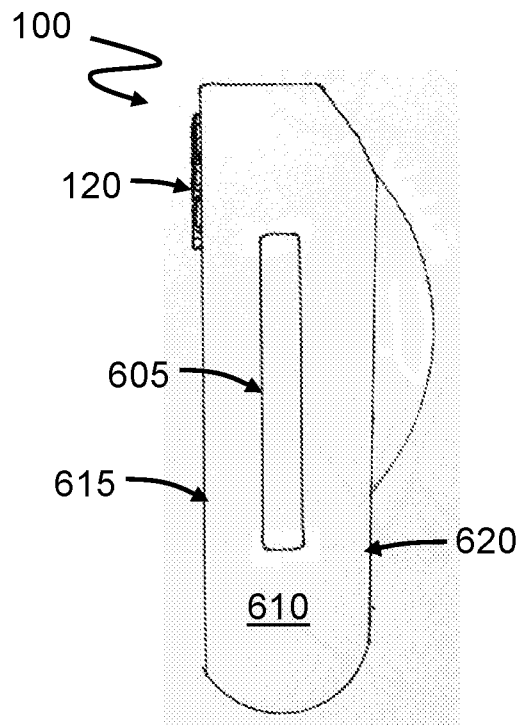


Figure 6

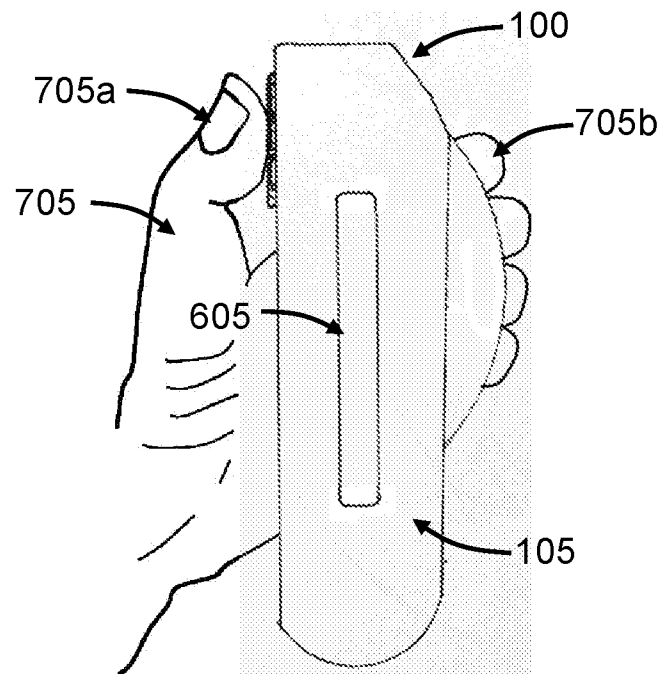


Figure 7

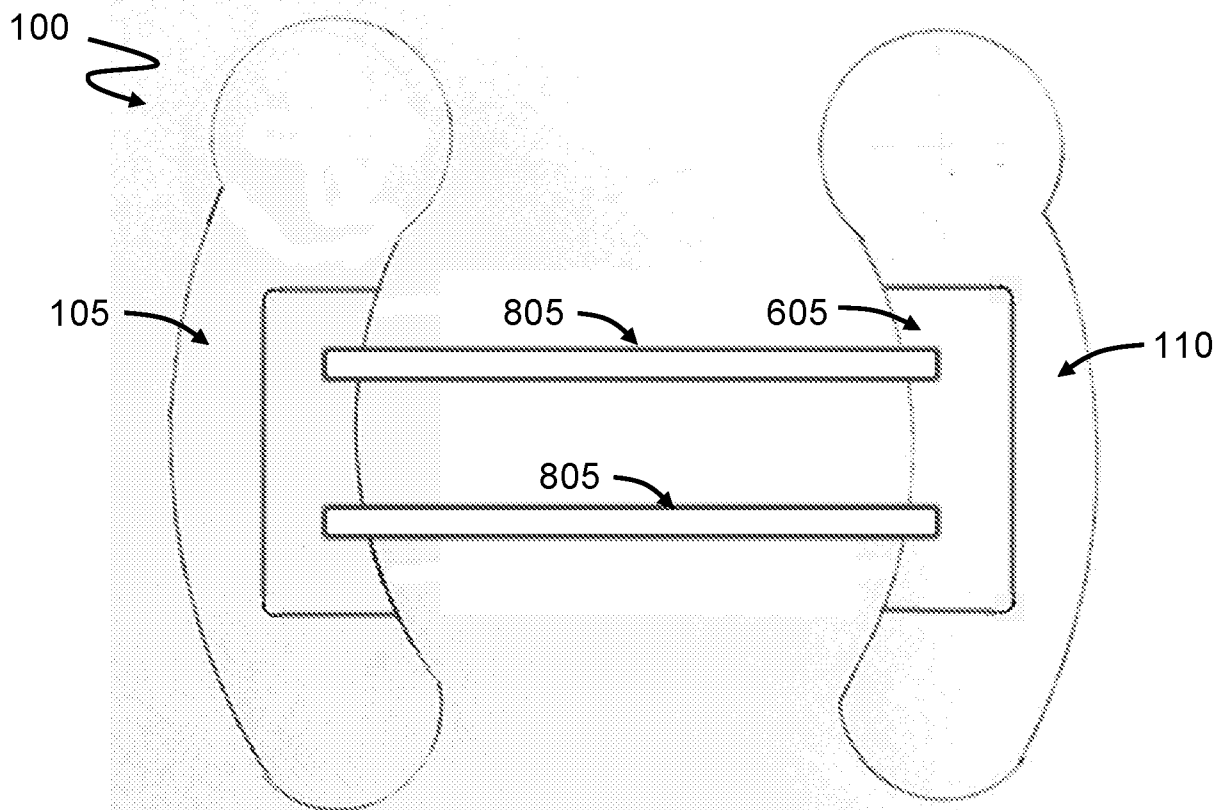


Figure 8

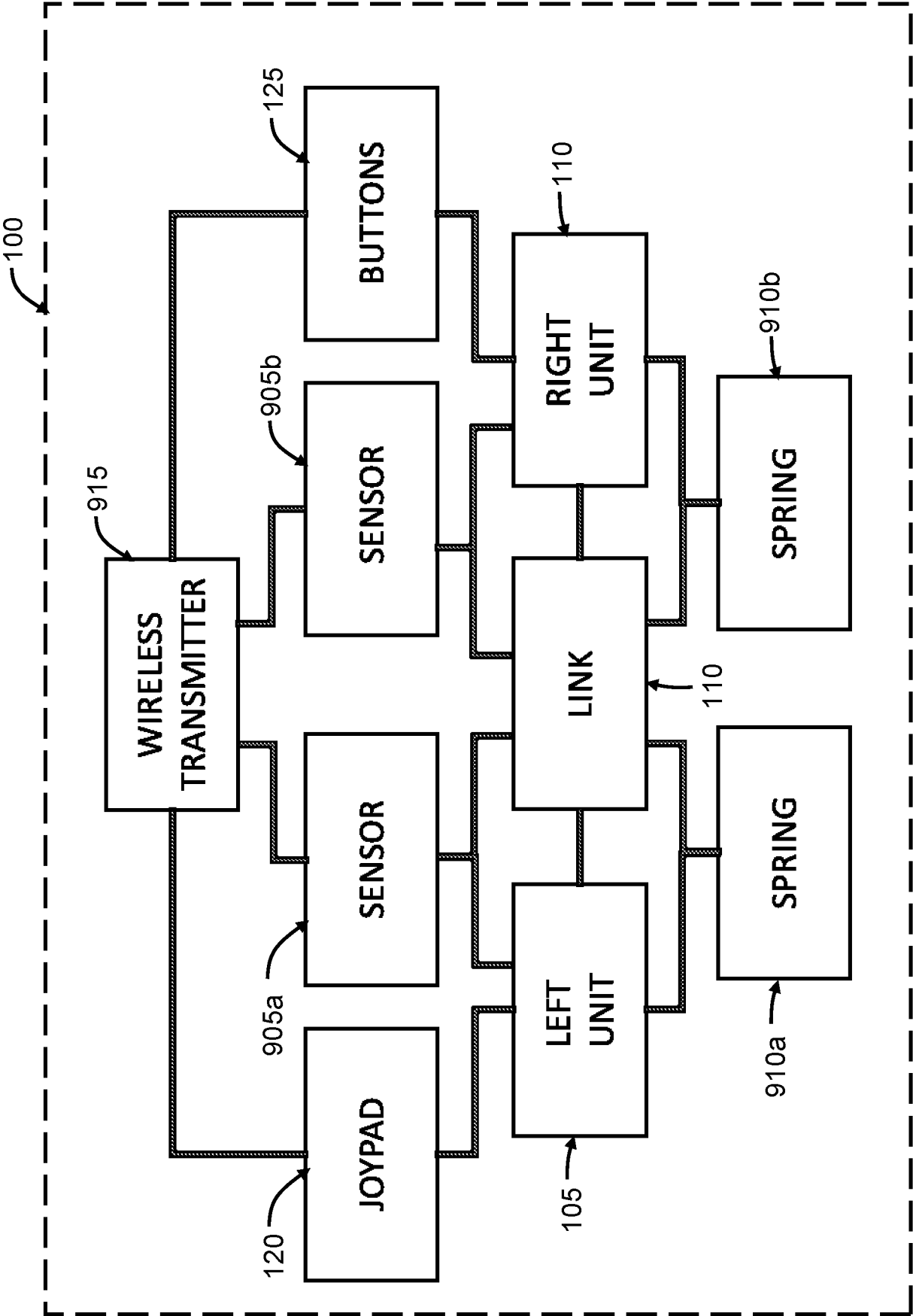


Figure 9

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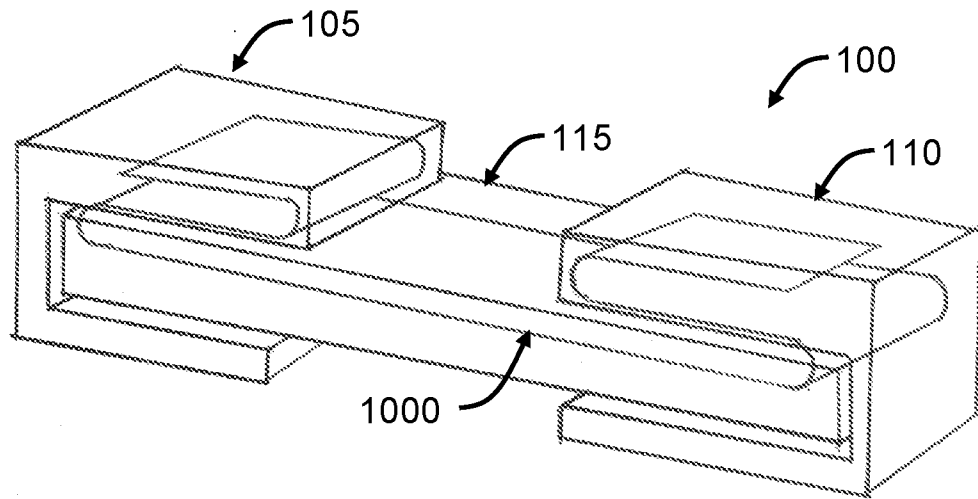


Figure 10

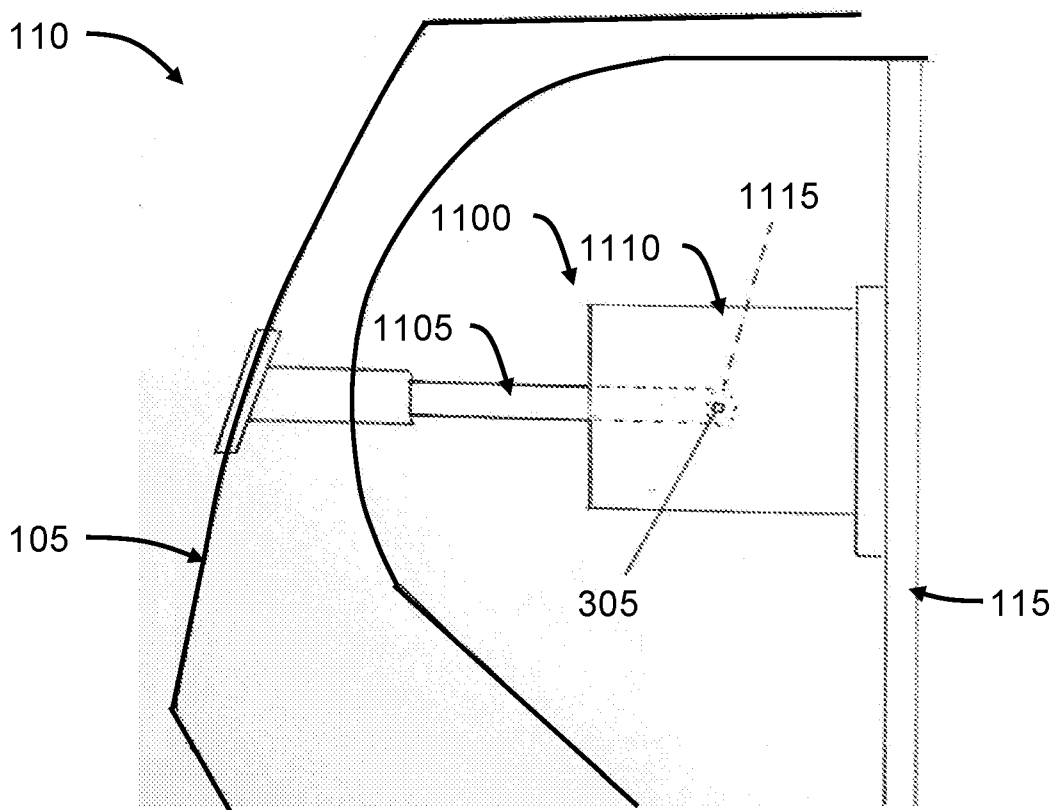


Figure 11

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/AU2017/050165

A. CLASSIFICATION OF SUBJECT MATTER

A63F 13/24 (2014.01) G06F 3/0338 (2013.01)

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)

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)

Databases: WPIAP, EPODOC and TXTE with the following marks and keywords: A63F13/24, B64C13/04, rotate, pivot, articulate, joint, controller, paddle, hand, held, relative, motion, sensor, actuator and like terms.

Espacenet, PAMS Non-OPI Enquiry, Google, Google Patents and Google Scholar: Applicant and inventor names, along with A63F13/24, B64C13/04, rotate, pivot, articulate, joint, controller, paddle, hand, held, relative, motion, sensor, actuator and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 22 May 2017		Date of mailing of the international search report 22 May 2017	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaaustralia.gov.au		Authorised officer Tim Burgess AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No.	

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2017/050165
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X	US 6614420 B1 (Han et al.) 02 September 2003 col. 1 L 19-52; col. 4, L 1-28; col 7-8 L 54-17; col. 10 L 28-44; Figs 1,2	1-4, 11, 12, 20, 22, 28-31, 33-35
X	US 2005/0277470 A1 (Watanachote) 15 December 2005 [0005]; [0092]; [0096]-[0100]; [0107]; Figs 29-33	1-4, 11, 12, 20, 22, 28-31, 33-35
X	US 2010/0279773 A1 (Atzmon) 04 November 2010 title, abstract, [0013], [002], [0022], [0029], [0036]-[0038], Figs 1-3	1-13, 15-24, 29-35
X	JP H0847581 A (Namco Ltd) 20 February 1996 title; abstract; [0022]; [0027]; [0028]; [0039]; Figs 3A,3B, 5	1, 5-20, 22, 23, 28, 30-33
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Information on patent family members		PCT/AU2017/050165	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
Form PCT/ISA/210 (Family Annex)(July 2009)			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2017/050165	
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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2017/050165	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
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End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			