(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 825 818 B1

(12) # EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
25.09.2024 Bulletin 2024/39

(21) Application number: **20205909.3**

(22) Date of filing: **05.11.2020**

(51) International Patent Classification (IPC):
G06F 3/01 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
G06F 3/016

(54) **CONTROLLER APPARATUS, CONTROLLER APPARATUS CONTROLLING METHOD, AND PROGRAM**

STEUERVORRICHTUNG, VERFAHREN ZUR STEUERUNG EINER STEUERVORRICHTUNG UND PROGRAMM

APPAREIL D'ORGANE DE COMMANDE, PROCÉDÉ DE COMMANDE D'APPAREIL D'ORGANE DE COMMANDE ET PROGRAMME

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **19.11.2019 JP 2019209031**

(43) Date of publication of application:
26.05.2021 Bulletin 2021/21

(73) Proprietor: **Sony Interactive Entertainment Inc.**
Tokyo 108-0075 (JP)

(72) Inventors:
- **SAWADA, Takuro**
  Tokyo, 108-0075 (JP)
- **ENOKIHARA, Takashi**
  Tokyo, 108-0075 (JP)

(74) Representative: **Müller Hoffmann & Partner**
Patentanwälte mbB
St.-Martin-Straße 58
81541 München (DE)

(56) References cited:
EP-B1- 3 217 255
WO-A1-2019/107207
JP-B2- 6 149 895
US-A1- 2019 224 565
US-A1- 2020 333 883

EP 3 825 818 B1

Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Japanese Priority Patent Application JP 2019-209031 filed November 19, 2019.

BACKGROUND

[0002] The present disclosure relates to a controller apparatus, a controller apparatus controlling method, and a program.

[0003] There exists a controller apparatus furnished with a push-in button arranged to be movable between a predetermined first position and a predetermined second position. The push-in button biased in the first position can be pushed in the direction of the second position by a user's push-in operation.

[0004] This controller apparatus may also be furnished with a vibration mechanism coming into contact periodically with a back side of the push-in button (i.e., an opposite side of a side pushed in by the user) so as to vibrate the push-in button.

[0005] US 2019/0224565 A1 discloses an operation device with a movable portion to which tactile force sense is presented. Moreover, vibration might be presented at the movable portion, the vibration having an intended width.

[0006] From JP 6 149895 B2, a pachinko machine is known to comprise an operation switch unit. The operation switch unit includes a push button member, which enables a pushing operation. The pushing operation of the push button member is detected by an operation detection sensor. By the pushing operation of the push button member, moreover, a display performance corresponding to the operation is performed in a pattern display device. In this case, the operation switch unit comprises a transmission case housing a vibration motor. When the vibration motor is vibrating, the push button member is pushed and abuts against the transmission case so that the push button member vibrates.

[0007] WO 2019/107027 A1 relates to an information processing apparatus that is connected to a device having a button that can be pressed within a prescribed movement range, the apparatus detecting the push-in position when the button is pressed, and being capable of presenting a resistance force against a pressing force of the button.

[0008] EP 3217255 B1 describes a system that generates a haptic effect experienced at a user input element in response to the received position of the user input element. The peripheral device including a housing, a user input element, a haptic output device located within the housing and coupled to the user input element, and a haptic diminishment prevention component. The system further causes the haptic diminishing prevention component to create a range that the user input element can move within in response to the output force when the trigger is in a maximum open position outside of the range, or a maximum closed position outside of the range.

SUMMARY

[0009] One problem with the above-mentioned controller apparatus incorporating the existing vibration mechanism is that with the push-in button moved to the second position, activating the vibration mechanism can propagate vibration to various components of the controller apparatus in a manner generating an unintended vibration noise.

[0010] The present disclosure has been devised in view of the above circumstances, and it is desirable to provide a controller apparatus, a controller apparatus controlling method, and a program for suppressing the generation of an unintended vibration noise.

[0011] The problem is solved by the subject-matter of the independent claims.

[0012] According to an embodiment of the present disclosure, there is provided a controller apparatus including a vibrating body movable within a predetermined movable range as defined by claim 1.

[0013] According to another embodiment of the present disclosure, there is provided a controller apparatus controlling method as defined by claim 2.

[0014] According to a further embodiment of the present disclosure, there is provided a program as defined by claim 4.

[0015] According to the embodiments of the present disclosure, the generation of an unintended vibration noise is suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic explanatory diagram depicting a typical configuration of a controller apparatus according to one embodiment of the present disclosure;

FIG. 2 is an explanatory diagram depicting a relation between a push-in button and a vibration presentation section of the controller apparatus according to the embodiment of the present disclosure;

FIG. 3 is a block diagram depicting a typical circuit configuration of the controller apparatus according to the embodiment of the present disclosure;

FIG. 4 is a schematic explanatory diagram depicting a typical vibration presentation section of the controller apparatus according to the embodiment of the disclosure; and

FIG. 5 is a functional block diagram of a control section included in the controller apparatus according to the embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] A preferred embodiment of the present disclosure is described below with reference to the accompanying drawings. As depicted in FIG. 1, a controller apparatus 1 according to the embodiment of the present disclosure includes a main body section 11, grips 12 that extend from both sides of the main body section 11 to the front side of the main body section 11, an operation section 13 arranged on the main body section 11, a vibration presentation section 14, and a circuit section 15. The controller apparatus 1 sends and receives operation-related information to and from an information processing apparatus 2.

[0018] The operation section 13 of the controller apparatus 1 in this embodiment includes a push-in button 131 to be pushed for operation by a user. The operation section 13 may also include other buttons and controls such as joysticks to be tilted for operation as well as arrow keys. As an example here of the embodiment, the push-in button 131 is positioned to be operable with the index finger or the middle finger of the user holding the grips 12 of the controller apparatus 1 with the balls of the thumbs, little fingers, and ring fingers.

[0019] The push-in button 131 is formed to be substantially columnar. The push-in button 131 has an external surface 131F exposed outside a housing and touched by the user's fingertip, and a back surface 131B that is located inside the housing and has its normal line in parallel or substantially parallel (within a predetermined range of angles relative to the parallel) with the push-in direction.

[0020] In this example of the embodiment, when not operated by the user, the push-in button 131 has its external surface 131F forced into a default position typically by an elastic body. When pushed into the housing of the controller apparatus 1 by the user, the external surface 131F moves into the housing up to a limit position defined by a mechanically predetermined range.

[0021] The push-button 131 electrically detects its pushed-in position and outputs information indicative of the detected pushed-in position to the circuit section 15. The method of detecting the pushed-in position involves using various well-known sensors and thus will not be discussed further.

[0022] Here, the pushed-in position is represented by the position of the back surface 131B of the push-in button 131 as depicted in FIG. 2. It is assumed that a first position Pa denotes the position of the back surface 131B at the time the external surface 131F is in the default position and that a second position Pb stands for the position of the back surface 131B at the time the external surface 131F is pushed into the housing up to the limit position. Thus the position of the push-in button 131 is between the first position Pa and the second position Pb, i.e., within the stroke of the button 131 (moving range R).

[0023] The vibration presentation section 14 vibrates the push-in button 131, thereby presenting the user operating the push-in button 131 with vibration. A specific configuration and operations of the vibration presentation section 14 will be discussed later.

[0024] The circuit section 15 receives from the operation section 13 information indicative of the details of operation performed by the user on the controller apparatus 1. The circuit section 15 outputs the received information to the information processing apparatus 2. In one example of this embodiment, as depicted in FIG. 3, the circuit section 15 includes a processor 151, a storage section 152, and a communication section 153.

[0025] Here, the processor 151 is a program-controlled device that operates in accordance with programs held in the storage section 152. In this embodiment, the processor 151 receives from the operation section 13 information indicative of operation details including the push-in amount of the push-in button 131 in the operation section 13. The processor 151 outputs the received information regarding the operation details to the information processing apparatus 2. The processor 151 further controls the vibration presentation section 14. The operation of the processor 151 will be discussed later in detail.

[0026] The storage section 152 is a memory device that holds the programs to be executed by the processor 151. The storage section 152 also acts as a work memory for the processor 151.

[0027] The communication section 153 sends and receives information to and from the information processing apparatus 2 by wire or wirelessly. That is, under instructions input from the processor 151, the communication section 153 outputs information indicative of processing details to the information processing apparatus 2. The communication section 153 further outputs to the processor 151 diverse information received from the information processing apparatus 2.

[0028] In an example of this embodiment, the controller apparatus 1 may further include a tilt sensor (not depicted), push switches, and joysticks to be tilted for operation. In this case, the processor 151 sends to the information processing apparatus 2 the information indicative of the operation details including the posture of the controller apparatus 1 detected by the tilt sensor (tilt angle information) as well as information regarding push switch and joystick operations.

[Configuration and operations of the vibration presentation section]

[0029] A typical configuration and operations of the vibration presentation section 14 are explained below. In this embodiment, the vibration presentation section 14 vibrates the push-in button 131 to present the user operating the push-in button 131 with vibration. In a specific example, as depicted in FIG. 4, the vibration presentation section 14 includes an actuator 141 and an arm 142 (corresponding to a vibrating body of the present disclosure) rotated by the actuator 141.

[0030] Here, the actuator 141 is controlled by the processor 151 in the circuit section 15. The actuator 141 has a rotating shaft 141r furnished with the arm 142 extending in the direction of a circumference tangent of the shaft. Under instructions input from the processor 151, the actuator 141 rotates the arm 142 in a designated direction around the rotating shaft 141r. The actuator 141 further includes an encoder that acquires information regarding a rotation angle θ of the rotating shaft 141r relative to a reference angle in a predetermined reference state (e.g., in which the arm 142 is fully retracted into the housing). The actuator 141 outputs the rotation angle information to the processor 151.

[0031] In this embodiment, by the operation of the actuator 141, a tip of the arm 142 moves in a range overlapping with a moving range (movement trajectory) R of the back surface 131B of the push-in button 131 depicted in FIG. 2. Specifically, on the underside (into the housing), the tip of the arm 142 has its limit position located in a position Px further into the housing past the second position Pb. On the upper side (on the side of the button 131), the tip of the arm 142 has its limit position located in a position Py further into the housing past the first position Pa.

[0032] Thus, in this embodiment, a moving range Px-Py of the arm 142 as the vibrating body (i.e., vibrating body moving range) overlaps partially with the moving range R of the push-in button 131 (its back surface 131B).

[0033] The operation of the processor 151 is explained next. In this embodiment, the processor 151 is connected communicably with the information processing apparatus 2 by wire or wirelessly. When acting in accordance with the programs held in the storage section 152, the processor 151 functionally implements a configuration that includes a reception section 41, a detection section 42, and a vibration control section 43 as depicted in FIG. 5.

[0034] The reception section 41 receives an instruction to generate vibration (vibration instruction) from the information processing apparatus 2, and outputs the received instruction to the vibration control section 43. This instruction includes vibration strength information indicative of the strength of the vibration. The reception section 41 further receives an instruction to end vibration (vibration end instruction) from the information processing apparatus 2, and outputs the received instruction to the vibration control section 43.

[0035] The detection section 42 receives information regarding the position within the moving range R of the back surface 131B of the push-in button 131 used as an operating member, detects the position Q of the back surface 131B of the push-in button 131, and outputs the information indicative of the detected position Q.

[0036] The vibration control section 43 gives vibration to the push-in button 131 by controlling the rotational position and vibration of the actuator 141 in the vibration presentation section 14 in accordance with the vibration instruction received by the reception section 41 for vibration generation and with the information regarding the position of the push-in button 131 (the position of its back surface 131B) detected by the detection section 42.

[0037] Specifically, upon receipt of the vibration instruction by the reception section 41, the vibration control section 43 in this embodiment controls the rotational position of the actuator 141 in such a manner that the arm 142 comes into contact with the position Q of the back surface 131B of the push-in button 131 detected by the detection section 42.

[0038] In an example of this embodiment, the vibration control section 43 obtains information regarding the position of the arm 142 on the basis of the rotation angle information regarding the rotating shaft 141r, the information being output by the actuator 141 (in the ensuing description, the position of the arm 142 refers to a point 142p that is part of the tip of the substantially columnar arm 142 and is closest to an outer circumference of the housing). In keeping with the information indicative of the position of the back surface 131B of the push-in button 131 (within the moving range R) and indicative of the position of the arm 142 (corresponding to the rotational position of the actuator 141), the vibration control section 43 generates position range information quantitatively representing each of 10 stages (P0 to P9 in FIG. 2) in which the moving range R and the movable range of the arm 142 overlap with each other.

[0039] Then, the vibration control section 43 controls the rotational position of the actuator 141 in such a manner that when the position Q of the back surface 131B of the push-in button 131 detected by the detection section 42 is in the quantified position stage P4, for example, the arm 142 is moved to a target position inside the position stage P4 (e.g., to the center of the position stage P4).

[0040] While controlling an amplitude of the rotation angle of the actuator 141 on the basis of the vibration strength information included in the vibration instruction received by the reception section 41, the vibration control section 43 causes the actuator 141 to reciprocate continuously across the controlled amplitude in a manner causing the arm 142 to also reciprocate continuously across that amplitude. As a result, the arm 142 enters a vibrating state (under vibration control). At this point, the amplitude of the rotation angle is within the range between two angles: the angle at which the position of the arm 142 is rotated by θa from a target angle θt corresponding to the above-mentioned target position in the direction in which the arm 142 is caused to approach a position Px (in the direction in which the arm 142 is retracted into the housing) on one hand, and the angle at which the position of the arm 142 is rotated by θb from the target angle θt in the direction in which the arm 142 is caused to approach a position Py (in the direction in which the push-in button 131 is pushed up) on the other hand. Here, the angle θa is set using a monotonically increasing function in which, given a strength value "s" represented by the vibration strength information received by the reception section 41, the angle θa is set for $\theta a = \alpha \cdot s$ (α is an experimentally determined positive constant), for example. The angle θb may be a predetermined value. Alternatively, as with the angle θa, the angle θb may be set using a monotonically increasing function in which, given the strength value "s," the angle θb is set for $\theta b = \beta$-s (as with α, β is an experimentally determined positive constant), for example.

[0041] When controlling the vibration of the arm 142, the vibration control section 43 initially sets, for example, $\theta t - \theta a$ as the target angle for the actuator 141. Thereafter, whenever the actuator 141 stops rotating or every time the actuator 141 reaches the target position, the vibration control section 43 sets $\theta t + \theta b$ or $\theta t - \theta a$ alternately as the target angle for the actuator 141 and causes the actuator 141 to reciprocate accordingly.

[0042] The vibration control section 43 vibrates the arm 142 continuously until the reception section 41 receives the vibration end instruction to terminate vibration. While continuing the vibration, the vibration control section 43 repeatedly acquires the information regarding the position of the push-in button 131B detected by the detection section 42. Every time the position information is changed, the vibration control section 43 controls the rotational position of the actuator 141 in a manner bringing the arm 142 into contact with the changed position for continuous vibration.

[0043] One thing characterizing this embodiment is that when in a state where predetermined conditions are satisfied, the vibration control section 43 controls the vibration of the arm 142 in a manner correcting the vibration designated by the vibration instruction received by the reception section 41 (e.g., the vibration is controlled on the basis of the strength value obtained by correcting the vibration strength value represented by the vibration strength information).

[0044] The conditions here may include one specifying that the back surface 131B of the push-in button 131 as one operating member be in a position stage close to the second position Pb (i.e., the above-mentioned position stage P9). That is, in this example of the embodiment, while the arm 142 is being vibrated, for example, moving the back surface 131B of the push-in button 131 to a position within the position stage P9 (i.e., the user pushes the push-in button 131 into a position close to the limit) causes the vibration control section 43 to control the vibration of the arm 142 with a strength obtained by correcting the designated vibration strength.

[0045] The correction of the vibration strength may alternatively involve causing the strength value represented by the designated vibration strength information to be multiplied by a parameter defined by a predetermined function. For example, this function is determined for each different condition. Given a condition specifying that the back surface 131B of the push-in button 131 be in a position P (position stage P9 in the above-mentioned 10-stage position range) close to the second position Pb, the function may be a monotonic function of the position P such that the smaller the difference is between the position P of the back surface 131B of the push-in button 131 on one hand and the position Pb as the most pushed-in position of the back surface 131B of the push-in button 131 on the other hand, the closer the parameter is to "0," and that the larger the difference becomes, the closer the parameter is to "1" (wherever the position, the value is between "0" and "1" inclusive). The value of the strength is corrected by multiplying the strength value designated by the vibration strength information, by the parameter defined by the monotonic function of the position P.

[0046] In this example of the correction, the user pushes in the push-in button 131. With the back surface 131B of the push-in button 131 within the position stage P9, the user further pushes in the push-in button 131. The vibration of the arm 142 is then controlled in such a manner that the closer the back surface 131B is to the limit position, the smaller the strength becomes with which the arm 142 is vibrated than the vibration strength designated by the information processing apparatus 2. This makes it possible to sufficiently reduce the vibration when the push-in button 131 is pushed to its limit position, which prevents the vibration from propagating to various components of the controller apparatus 1 and inhibits an unintended vibration noise from being generated.

[Other typical conditions]

[0047] It has been explained above that the condition specifies that the back surface 131B of the push-in button 131 be in the position P close to the second position Pb (within the position stage P9). However, this is not limitative of the condition in which the vibration is corrected with this embodiment.

[0048] For example, in this embodiment, the vibration may be corrected on the condition that when the arm 142 is controlled to be vibrated, the push-in button 131 is operated and moved by the user from the current position.

[0049] Specifically, given the vibration instruction in this embodiment, the vibration control section 43 controls the rotational position of the actuator 141 in such a manner that the tip of the arm 142 is moved to the position Q of the back surface 131B of the push-in button 131 detected by the detection section 42.

[0050] That is, the vibration control section 43 sets the target position to which to move the tip of the arm 142 at the position Q of the back surface 131B of the push-in button 131. The vibration control section 43 further sets the target angle at the rotation angle θt of the actuator 141 at the time the arm 142 is rotated until its tip reaches the target position. Then, on the basis of information regarding the current rotation angle and the target angle output by the actuator 141, the vibration control section 43 controls the rotation direction and rotation velocity (typically represented by the current supplied to the actuator 141) of the actuator 141. This control may be implemented using a common feedback control scheme and thus will not be discussed further.

[0051] The vibration control section 43 repeatedly references the rotation angle information output by the actuator 141 at predetermined timing intervals. When the rotation angle output by the actuator 141 reaches the target angle within a predetermined time period after the start of control, the target angle θt for the rotation angle of the actuator 141 is updated by $\theta t + \Delta\theta$. Again, under feedback control, the tip of the arm 142 is moved. Here, the angle $\Delta\theta$ is to be determined beforehand.

[0052] In the case where, despite the control over the rotation direction and rotation velocity, the rotation angle output by the actuator 141 fails to reach the target angle within a predetermined time period after the start of control (i.e., the position Q of the back surface 131B of the push-in button 131 is closer to the second position than to the position of the tip of the arm 142 rotated to the target angle, so that the tip of the arm 142 comes into contact with the push-in button 131 and stops at the position Q), the vibration control section 43 switches from feedback control to a control scheme (vibration control) under which the vibration control section 43 controls the rotation angle amplitude of the actuator 141 on the basis of the vibration strength information included in the vibration instruction received by the reception section 41. In so doing, the vibration control section 43 causes the actuator 141 to continuously reciprocate across the amplitude, causing likewise the arm 142 to continuously reciprocate across the amplitude.

[0053] At the start of vibration control, the vibration control section 43 retains the position of the arm 142 (rotation angle of the actuator 141) as an initial position θs. Initially, the correction value λ of the amplitude is set for $\lambda = \lambda min$, where λmin is a value of 0 or larger and smaller than 1.

[0054] The vibration control section 43 vibrates the tip of the arm 142 (under vibration control) by setting the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by $\lambda \cdot \theta b$ from the initial position θs in the direction in which the push-in button 131 is pushed up (i.e., $\theta s + \lambda \cdot \theta b$) on one hand, and the angle at which the actuator 141 is rotated by $\lambda \cdot \theta a$ from the initial position θs into the housing (i.e., $\theta s - \lambda \cdot \theta a$) on the other hand.

[0055] By referencing the rotation angle output by the actuator 141 under vibration control, the vibration control section 43 obtains a rotation angle θu on the upper side when the arm 142 is most outside the housing (close to the first position). When the rotation angle θu satisfies the relation $\theta s - \theta u > \theta th$ (where θth is a positive threshold value) (i.e., when, after the start of vibration, the push-button 131 is pushed into the housing by more than a predetermined movement amount), the vibration control section 43 assumes that the amplitude correction value λ is set for $\lambda = 1$, and sets the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by $\lambda \cdot \theta b$ from the rotation angle θu in the direction in which the push-in button 131 is pushed up (i.e., $\theta u + \lambda \cdot \theta b$) on one hand, and the angle at which the actuator 141 is rotated by $\lambda \cdot \theta a$ from the rotation angle θu into the housing (i.e., $\theta u - \lambda \cdot \theta a$) on the other hand.

[0056] Meanwhile, when the relation $0 \leq \theta s - \theta u \leq \theta th$ is satisfied, the vibration control section 43 assumes that the amplitude correction value λ is set for $\lambda = f(\theta s - \theta u)$, where f(x) is a monotonically increasing function with respect to "x." Given $x > \theta th$, then $f(x) = 1$, where $f(0) = \lambda min$.

[0057] The vibration control section 43 then sets the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by $\lambda \cdot \theta b$ from the rotation angle θu in the direction in which the push-in button 131 is pushed up (i.e., $\theta u + \lambda \cdot \theta b$) on one hand, and the angle at which the actuator 141 is rotated by $\lambda \cdot \theta a$ from the rotation angle θu into the housing (i.e., $\theta u - \lambda \cdot \theta a$) on the other hand.

[0058] That is, in this embodiment, when the push-in button 131 is to be presented with vibration by vibrating the arm 142, the vibration control section 43 retains, as initial position information, the information regarding the position of the arm 142 corresponding to the position of the push-in button 131 in the vibration start position (the information used in the above example is the rotation angle of the actuator 141 in a position where the arm 142 is in contact with the push-in button 131). The further the push-in button 131 is pushed beyond the position designated by the initial position information, the larger the vibration amplitude (strength) is made. Also, the closer the arm 142 is to the initial position, the smaller the vibration amplitude (strength) becomes.

[0059] In this manner, it is possible to suppress the noise generated when the vibration is presented in a state where the user's fingertip is leaving the push-in button 131 (the state in which the push-in button 131 is returning to the first position from the pushed-in position, i.e., the state where the push-in button 131 is pushed further from the initial position, before returning to the initial position).

[Operations]

[0060] The controller apparatus 1 of this embodiment in the above configuration operates as explained below. In an example that follows, the controller apparatus 1 sets the amplitude θa of the arm 142 using a monotonically increasing function in which, given the vibration strength "s" designated by the information processing apparatus 2, the amplitude θa is monotonically increased for $\theta a = \alpha \cdot s$ (α is an experimentally determined positive constant) except at the start of vibration or except when the push-in button 131 is pushed to the limit (with the back surface 131B reaching a position within the position stage P9).

[0061] Initially, it is assumed that the user grips the controller apparatus 1 and pushes the push-in button 131 until its back surface 131B reaches the position Q within the position stage P4. At this time, a game application running on the information processing apparatus 2 performs a process of outputting a vibration instruction including the vibration strength information specifying that vibration be generated with a predetermined strength "s." Upon receipt of the vibration instruction, the processor 151 operates as follows:

The processor 151 detects that the back surface 131B of the push-in button 131 is in the position Q. The processor 151 then sets the target position of the arm 142 at the position Q of the back surface 131B of the push-in button 131. The processor 151 further sets as the target angle the rotation angle θt of the actuator 141 at the time the arm 142 reaches the target position. The processor 151 then performs feedback control such that the rotation direction and rotation velocity of the actuator 141 are controlled on the basis of the information regarding the current rotation angle and the target angle output by the actuator 141.

[0062] The processor 151 repeatedly references the rotation angle information output by the actuator 141 at predetermined timing intervals. When the rotation angle output by the actuator 141 reaches the target angle θt within a predetermined time period after the start of feedback control, the processor 151 sets the amplitude correction value λ for λ = λmin, and vibrates the tip of the arm 142 (under vibration control) by setting the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by λ·θb from the target angle θt in the direction in which the push-in button 131 is pushed up (i.e., θs + λ·θb) on one hand, and the angle at which the actuator 141 is rotated by λ·θa from the initial position θs into the housing (i.e., θs - λ·θa) on the other hand.

[0063] Thereafter, by referencing the rotation angle output by the actuator 141 under vibration control, the processor 151 obtains the rotation angle θu on the upper side when the arm 142 is most outside the housing (close to the first position). When the rotation angle θu satisfies the relation θs - θu > θth (where θth is a positive threshold value), the processor 151 assumes that the amplitude correction value λ is set for λ = 1, and sets the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by λ·θb from the rotation angle θu in the direction in which the push-in button 131 is pushed up (i.e., θu + λ·θb) on one hand, and the angle at which the actuator 141 is rotated by λ·θa from the rotation angle θu into the housing (i.e., θu - λ·θa) on the other hand. Meanwhile, when the relation 0 ≤ θs - θu ≤ θth is satisfied, the processor 151 sets the amplitude correction value λ for λ = f(θs - θu), where f(x) is a monotonically increasing function with respect to "x." Given x > θth, then f(x) = 1, where f(0) = λmin.

[0064] The processor 151 then sets the actuator 141 to rotate reciprocatingly between two angles: the angle at which the actuator 141 is rotated by λ·θb from the rotation angle θu in the direction in which the push-in button 131 is pushed up (i.e., θu + λ·θb) on one hand, and the angle at which the actuator 141 is rotated by λ·θa from the rotation angle θu into the housing (i.e., θu - λ·θa) on the other hand.

[0065] Under the above control, in the state where the user is pushing the external surface 131F of the push-in button 131 with the fingertip (i.e., where the external surface 131F is under the force of the fingertip), the push-in button 131 is moved into the housing from a position equivalent to the initial position, the correction value λ is monotonically increased, and the vibration is increased accordingly. When the push-in button 131 is pushed by more than a predetermined push-in amount from the position equivalent to the initial position, then the correction value λ is set for λ = 1, so that the predetermined vibration is presented.

[0066] Thereafter, when the user stops pushing the push-in button 131 (or reduces the pushing force), the push-in button 131 returns to the position equivalent to the initial position, the correction value λ is monotonically decreased, and the vibration is reduced accordingly. When the push-in button 131 is moved close to the default position beyond the position equivalent to the initial position, the vibration is not presented.

[0067] Thus, in the state where the user's fingertip does not act as a vibration damper (i.e., the state in which the user's fingertip is not fully in contact with the push-in button 131), the vibration is reduced and the generation of noise is suppressed.

[0068] Suppose that the user pushes the push-in button 131 until its back surface 131B reaches the position P within the position stage P9, and then pushes the push-in button 131 further to the limit (with the back surface 131B of the push-in button 131 reaching the second position Pb). During this time, a game application running on the information processing apparatus 2 may perform a process of outputting a vibration instruction including the vibration strength information specifying that vibration be generated with a predetermined strength "s." Upon receipt of the vibration instruction, the processor 151 operates as follows:

The processor 151 detects that the back surface 131B of the push-in button 131 is in the position Pb. The processor 151 then sets the target position of the arm 142 at the position P of the back surface 131B of the push-in button 131. The processor 151 further sets as the target angle the rotation angle θt of the actuator 141 at the time the arm 142 reaches the target position. The processor 151 then performs feedback control such that the rotation direction and rotation velocity of the actuator 141 are controlled on the basis of the information regarding the current rotation angle and the target angle output by the actuator 141.

[0069] The processor 151 repeatedly references the rotation angle information output by the actuator 141 at predetermined timing intervals. When the rotation angle output by the actuator 141 reaches the target angle θt within a predetermined time period after the start of feedback control, the processor 151 thereupon switches from feedback control to determination of the rotation angle amplitude of the actuator 141 on the basis of the vibration strength information included in the received vibration instruction.

[0070] Specifically, the smaller the difference is between the position P of the back surface 131B of the push-in button 131 on one hand and the position Pb constituting the most pushed-in position of the back surface 131B of the push-in button 131 on the other hand, the closer the value of a monotonic function g(P) of the position P is to "0" (this is a function whose value is between "0" and "1" inclusive, wherever the position), and the larger the difference, the closer the value of the function is to "1." The value of the vibration strength is corrected by multiplying the monotonic function g(P) of the position P by the value "s" of the strength designated by the vibration strength information.

[0071] That is, the amplitude θa is set for $\theta a = \alpha \cdot g(P) \cdot s$.

[0072] The processor 151 then establishes the amplitude between two angles: the angle at which the position of the arm 142 is rotated by θb from the target angle θt in the direction in which the push-in button 131 is pushed up (i.e., $\theta t + \theta b$) on one hand, and the angle at which the position of the arm 142 is rotated by θa, determined by the above-described method, from the target angle θt into the housing (i.e., $\theta t - \theta a$) on the other hand. Control (vibration control) is performed such that the actuator 141 is caused to continuously reciprocate across this amplitude range, causing the arm 142 to vibrate. The amount θb is a predetermined value.

[0073] Here, the processor 151 determines, during vibration control, whether or not the rotation angle θ output by the actuator 141 becomes larger than a predetermined threshold value θh ($0 < \theta h \leq \theta b$) in the direction in which the push-in button 131 is pushed up from the previously set target angle θt (i.e., whether or not the relation $\theta > \theta t + \theta h$ is satisfied).

[0074] In this example, it is assumed that the rotation angle θ output by the actuator 141 does not exceed the predetermined threshold value θh in the direction in which the push-in button 131 is pushed up from the target angle $\theta t + \Delta\theta$.

[0075] Thereafter, the processor 151 repeatedly acquires the back surface 131B of the push-in button 131 and sets the amplitude θa for $\theta a = \alpha \cdot g(P) \cdot s$ for vibration control. The correction function g(P) causes the processor 151 to perform control such that the larger the amount by which the user pushes the push-in button 131, the smaller the amplitude becomes.

[0076] Under the above control, the amplitude of the vibration is restricted when the push-in button 131 is pushed to the limit. The user is thus presented with the vibration designated typically by a game application, with no unintended noise generated.

Claims

1. A controller apparatus (1) comprising:

   a vibrating body (142) movable within a predetermined movable range thereof;
   an operating member (131) operated by a user, the operating member (131) being movably operable within a movable range thereof overlapping partially with the movable range of the vibrating body (142);
   a reception section (41) configured to receive a vibration instruction designating generation of vibration from an information processing apparatus external to the controller apparatus (1);
   a detection section (42) configured to detect a position of the operating member (131) within the movable range thereof; and
   a control section (43) configured to give vibration to the operating member (131) by controlling a position and vibration of the vibrating body (142) in accordance with the received vibration instruction and the detected position of the operating member (131),
   wherein, when predetermined conditions are satisfied, the control section (43) controls the vibration of the vibrating body (142) in a manner correcting the vibration designated by the vibration instruction,
   wherein the vibration instruction includes information for designating strength of vibration, and when the predetermined conditions are satisfied, the control section (43) corrects the designated vibration strength by a predetermined correction method, so as to control the vibration of the vibrating body (142) in a manner giving vibration to the operating member (131) with the corrected vibration strength,
   the correction method providing reduction of the vibration strength when the operating member (131) is pushed to its limit position.

2. The controller apparatus (1) according to claim 1,

   wherein the movable range of the operating member (131) ranges from a first position of the operating member (131) not operated by the user to a second position of the operating member (131) in a limit position up to which the user pushes the operating member (131) into a housing of the controller apparatus (1), and
   the predetermined conditions include either

      a condition specifying that the operating member (131) be in the second position, or
      a condition specifying that the position of the operating member (131) be moved starting from a time at which the vibrating body (142) starts vibrating.

3. A controller apparatus controlling method for use with a controller apparatus (1) including a vibrating body (142) movable within a predetermined movable range thereof, an operating member (131) operated

by a user, the operating member (131) being movably operable within a movable range thereof overlapping partially with the movable range of the vibrating body (142), a reception section (41) configured to receive a vibration instruction designating generation of vibration from an information processing apparatus external to the controller apparatus (1), a detection section (42) configured to detect a position of the operating member (131) within the movable range thereof, and a control section (43),
the controller apparatus controlling method comprising:

causing the control section (43) to give vibration to the operating member (131) by controlling a position and vibration of the vibrating body (142) in accordance with the received vibration instruction and the detected position of the operating member (131); and
causing the control section (43), when predetermined conditions are satisfied, to control the vibration of the vibrating body (142) in a manner correcting the vibration designated by the vibration instruction,
wherein the vibration instruction includes information for designating strength of vibration, and when the predetermined conditions are satisfied, the control section (43) corrects the designated vibration strength by a predetermined correction method, so as to control the vibration of the vibrating body (142) in a manner giving vibration to the operating member (131) with the corrected vibration strength,
the correction method providing reduction of the vibration strength when the operating member (131) is pushed to its limit position.

4. A program for use with a controller apparatus (1) including a vibrating body (142) movable within a predetermined movable range thereof, an operating member (131) operated by a user, the operating member (131) being movably operable within a movable range thereof overlapping partially with the movable range of the vibrating body (142), a reception section (41) configured to receive a vibration instruction designating generation of vibration from an information processing apparatus external to the controller apparatus (1), a detection section (42) configured to detect a position of the operating member (131) within the movable range thereof, and a control section (43),
the program comprising:

causing the control section (43) to give vibration to the operating member (131) by controlling a position and vibration of the vibrating body (142) in accordance with the received vibration instruction and the detected position of the operating member (131); and
when predetermined conditions are satisfied, causing the control section (43) to control the vibration of the vibrating body (142) in a manner correcting the vibration designated by the vibration instruction,
wherein the vibration instruction includes information for designating strength of vibration, and when the predetermined conditions are satisfied, the control section (43) corrects the designated vibration strength by a predetermined correction method, so as to control the vibration of the vibrating body (142) in a manner giving vibration to the operating member (131) with the corrected vibration strength,
the correction method providing reduction of the vibration strength when the operating member (131) is pushed to its limit position.

Patentansprüche

1. Steuerungseinrichtung (1) umfassend:

einen vibrierenden Körper (142), der innerhalb eines vorbestimmten beweglichen Bereichs davon beweglich ist;
ein Bedienelement (131), das durch einen Benutzer bedient wird, wobei das Bedienelement (131) innerhalb eines beweglichen Bereichs beweglich bedienbar ist, der sich teilweise mit dem beweglichen Bereich des vibrierenden Körpers (142) überlappt;
einen Aufnahmeabschnitt (41), der konfiguriert ist, um eine Vibrationsanweisung zu empfangen, die eine Erzeugung einer Vibration von einer Informationsverarbeitungseinrichtung außerhalb der Steuerungseinrichtung (1) bezeichnet;
einen Erkennungsabschnitt (42), der konfiguriert ist, um eine Position des Bedienelements (131) innerhalb des beweglichen Bereichs davon zu erkennen; und
einen Steuerabschnitt (43), der konfiguriert ist, um dem Bedienelement (131) eine Vibration zu verleihen, indem er eine Position und Vibration des vibrierenden Körpers (142) gemäß der empfangenen Vibrationsanweisung und der erkannten Position des Bedienelements (131) steuert,
wobei, wenn vorbestimmte Bedingungen erfüllt sind, der Steuerabschnitt (43) die Vibration des vibrierenden Körpers (142) in einer Weise steuert, die die durch die Vibrationsanweisung bezeichnete Vibration korrigiert,
wobei die Vibrationsanweisung Informationen zum Bezeichnen einer Vibrationsstärke einschließt, und,
wenn die vorbestimmten Bedingungen erfüllt

sind, der Steuerabschnitt (43) die bezeichnete Vibrationsstärke durch ein vorbestimmtes Korrekturverfahren korrigiert, um die Vibration des vibrierenden Körpers (142) in einer Weise zu steuern, die dem Bedienelement (131) eine Vibration mit der korrigierten Vibrationsstärke verleiht,
wobei das Korrekturverfahren eine Reduzierung der Vibrationsstärke bereitstellt, wenn das Bedienelement (131) bis zu seiner Grenzposition gedrückt wird.

2. Steuerungseinrichtung (1) nach Anspruch 1,

wobei der bewegliche Bereich des Bedienelements (131) von einer ersten, von dem Benutzer nicht bedienten Position des Bedienelements (131) zu einer zweiten, in einer Grenzposition des Bedienelements (131) reicht, bis zu der der Benutzer das Bedienelement (131) in ein Gehäuse der Steuerungseinrichtung (1) drückt, und
wobei die vorbestimmten Bedingungen eines einschließen von
einer Bedingung, die angibt, dass sich das Bedienelement (131) in der zweiten Position befindet oder
einer Bedingung, die angibt, dass die Position des Bedienelements (131) ab einem Zeitpunkt bewegt wird, an dem der vibrierende Körper (142) zu vibrieren beginnt.

3. Steuerungseinrichtungssteuerverfahren zur Verwendung mit einer Steuerungseinrichtung (1), die einen vibrierenden Körper (142) einschließt, der innerhalb eines vorbestimmten beweglichen Bereichs davon beweglich ist, ein Bedienelement (131), das durch einen Benutzer bedient wird, wobei das Bedienelement (131) innerhalb eines beweglichen Bereichs davon beweglich bedienbar ist, der sich teilweise mit dem beweglichen Bereich des vibrierenden Körpers (142) überlappt, einen Aufnahmeabschnitt (41), der konfiguriert ist, um eine Vibrationsanweisung zu empfangen, die eine Erzeugung einer Vibration von einer Informationsverarbeitungseinrichtung außerhalb der Steuerungseinrichtung (1) bezeichnet, einen Erkennungsabschnitt (42), der konfiguriert ist, um eine Position des Bedienelements (131) innerhalb des beweglichen Bereichs davon zu erkennen, und einen Steuerabschnitt (43),
wobei das Steuerungseinrichtungssteuerverfahren umfasst:

Veranlassen des Steuerabschnitts (43), dem Bedienelement (131) eine Vibration zu verleihen, indem eine Position und Vibration des vibrierenden Körpers (142) gemäß der empfangenen Vibrationsanweisung und der erkannten Position des Bedienelements (131) gesteuert wird; und
Veranlassen des Steuerabschnitts (43), wenn vorbestimmte Bedingungen erfüllt sind, die Vibration des vibrierenden Körpers (142) in einer Weise zu steuern, die die durch die Vibrationsanweisung bezeichnete Vibration korrigiert,
wobei die Vibrationsanweisung Informationen zum Bezeichnen einer Vibrationsstärke einschließt, und,
wenn die vorbestimmten Bedingungen erfüllt sind, der Steuerabschnitt (43) die bezeichnete Vibrationsstärke durch ein vorbestimmtes Korrekturverfahren korrigiert, um die Vibration des vibrierenden Körpers (142) in einer Weise zu steuern, die dem Bedienelement (131) eine Vibration mit der korrigierten Vibrationsstärke verleiht,
wobei das Korrekturverfahren eine Reduzierung der Vibrationsstärke bereitstellt, wenn das Bedienelement (131) bis zu seiner Grenzposition gedrückt wird.

4. Programm zur Verwendung mit einer Steuerungseinrichtung (1), die einen vibrierenden Körper (142) einschließt, der innerhalb eines vorbestimmten beweglichen Bereichs davon beweglich ist, ein Bedienelement (131), das durch einen Benutzer bedient wird, wobei das Bedienelement (131) innerhalb eines beweglichen Bereichs davon beweglich bedienbar ist, der sich teilweise mit dem beweglichen Bereich des vibrierenden Körpers (142) überlappt, einen Aufnahmeabschnitt (41), der konfiguriert ist, um eine Vibrationsanweisung zu empfangen, die eine Erzeugung einer Vibration von einer Informationsverarbeitungseinrichtung außerhalb der Steuerungseinrichtung (1) bezeichnet, einen Erkennungsabschnitt (42), der konfiguriert ist, um eine Position des Bedienelements (131) innerhalb des beweglichen Bereichs davon zu erkennen, und einen Steuerabschnitt (43),
das Programm umfassend:

Veranlassen des Steuerabschnitts (43), dem Bedienelement (131) eine Vibration zu verleihen, indem eine Position und Vibration des vibrierenden Körpers (142) gemäß der empfangenen Vibrationsanweisung und der erkannten Position des Bedienelements (131) gesteuert wird; und
wenn vorbestimmte Bedingungen erfüllt sind, Veranlassen des Steuerabschnitts (43), die Vibration des vibrierenden Körpers (142) in einer Weise zu steuern, die die durch die Vibrationsanweisung bezeichnete Vibration korrigiert,
wobei die Vibrationsanweisung Informationen zum Bezeichnen einer Vibrationsstärke einschließt, und,

wenn die vorbestimmten Bedingungen erfüllt sind, der Steuerabschnitt (43) die bezeichnete Vibrationsstärke durch ein vorbestimmtes Korrekturverfahren korrigiert, um die Vibration des vibrierenden Körpers (142) in einer Weise zu steuern, die dem Bedienelement (131) eine Vibration mit der korrigierten Vibrationsstärke verleiht,
wobei das Korrekturverfahren eine Reduzierung der Vibrationsstärke bereitstellt, wenn das Bedienelement (131) bis zu seiner Grenzposition gedrückt wird.

Revendications

1. Appareil de dispositif de commande (1), comprenant :

un corps vibrant (142) mobile dans une plage de mobilité prédéterminée de celui-ci ;
un organe de fonctionnement (131) mis en fonctionnement par un utilisateur, l'organe de fonctionnement (131) pouvant être mis en fonctionnement de manière mobile dans une plage mobile de celui-ci chevauchant partiellement la plage mobile du corps vibrant (142) ;
une section de réception (41) configurée pour recevoir une instruction de vibration désignant la génération d'une vibration à partir d'un appareil de traitement d'informations externe à l'appareil de dispositif de commande (1) ;
une section de détection (42) configurée pour détecter une position de l'organe de fonctionnement (131) dans la plage mobile de celui-ci ; et
une section de commande (43) configurée pour transmettre une vibration à l'organe de fonctionnement (131) en commandant une position et une vibration du corps vibrant (142) en fonction de l'instruction de vibration reçue et de la position détectée de l'organe de fonctionnement (131),
dans lequel, lorsque des conditions prédéterminées sont satisfaites, la section de commande (43) commande la vibration du corps vibrant (142) de manière à corriger la vibration désignée par l'instruction de vibration,
dans lequel l'instruction de vibration comporte des informations permettant de désigner l'intensité de la vibration, et
lorsque les conditions prédéterminées sont satisfaites, la section de commande (43) corrige l'intensité de vibration désignée par un procédé de correction prédéterminé, afin de commander la vibration du corps vibrant (142) de manière à transmettre une vibration à l'organe de fonctionnement (131) avec l'intensité de vibration corrigée,
le procédé de correction fournissant une réduction de l'intensité de vibration lorsque l'organe de fonctionnement (131) est poussé jusqu'à sa position limite.

2. Appareil de dispositif de commande (1) selon la revendication 1,

dans lequel la plage mobile de l'organe de fonctionnement (131) est comprise entre une première position de l'organe de fonctionnement (131) lorsqu'il n'est pas mis en fonctionnement par l'utilisateur et une seconde position de l'organe de fonctionnement (131) dans une position limite jusqu'à laquelle l'utilisateur pousse l'organe de fonctionnement (131) dans un boîtier de l'appareil de dispositif de commande (1), et
les conditions prédéterminées comportent, soit une condition spécifiant que l'organe de fonctionnement (131) doit être dans la seconde position, soit
une condition spécifiant que la position de l'organe de fonctionnement (131) doit être déplacée à partir d'un moment où le corps vibrant (142) commence à vibrer.

3. Procédé de commande d'un appareil de dispositif de commande à utiliser avec un appareil de dispositif de commande (1) comportant un corps vibrant (142) mobile dans une plage mobile prédéterminée, un organe de fonctionnement (131) mis en fonctionnement par un utilisateur, l'organe de fonctionnement (131) pouvant être mis en fonctionnement de manière mobile dans une plage mobile de celui-ci chevauchant partiellement la plage mobile du corps vibrant (142), une section de réception (41) configurée pour recevoir une instruction de vibration désignant la génération d'une vibration à partir d'un appareil de traitement d'informations externe à l'appareil de dispositif de commande (1), une section de détection (42) configurée pour détecter une position de l'organe de fonctionnement (131) dans la plage mobile de celui-ci, et une section de commande (43),
le procédé de commande d'appareil de dispositif de commande comprenant :

le fait d'amener la section de commande (43) à transmettre une vibration à l'organe de fonctionnement (131) en commandant une position et une vibration du corps vibrant (142) en fonction de l'instruction de vibration reçue et de la position détectée de l'organe de fonctionnement (131) ; et
le fait d'amener la section de commande (43), lorsque des conditions prédéterminées sont satisfaites, à commander la vibration du corps vibrant (142) de manière à corriger la vibration désignée par l'instruction de vibration,

dans lequel l'instruction de vibration comporte des informations permettant de désigner l'intensité de la vibration, et
lorsque les conditions prédéterminées sont satisfaites, la section de commande (43) corrige l'intensité de vibration désignée par un procédé de correction prédéterminé, afin de commander la vibration du corps vibrant (142) de manière à transmettre une vibration à l'organe de fonctionnement (131) avec l'intensité de vibration corrigée,
le procédé de correction fournissant une réduction de l'intensité de vibration lorsque l'organe de fonctionnement (131) est poussé jusqu'à sa position limite.

4. Programme à utiliser avec un appareil de dispositif de commande (1) comportant un corps vibrant (142) mobile dans une plage mobile prédéterminée de celui-ci, un organe de fonctionnement (131) mis en fonctionnement par un utilisateur, l'organe de fonctionnement (131) pouvant être mis en fonctionnement dans une plage mobile de celui-ci chevauchant partiellement la plage mobile du corps vibrant (142), une section de réception (41) configurée pour recevoir une instruction de vibration désignant la génération d'une vibration à partir d'un appareil de traitement d'informations externe à l'appareil de dispositif de commande (1), une section de détection (42) configurée pour détecter une position de l'organe de fonctionnement (131) dans la plage mobile de celui-ci, et une section de commande (43),
le programme comprenant :

le fait d'amener la section de commande (43) à transmettre une vibration à l'organe de fonctionnement (131) en commandant une position et une vibration du corps vibrant (142) en fonction de l'instruction de vibration reçue et de la position détectée de l'organe de fonctionnement (131) ; et
lorsque des conditions prédéterminées sont satisfaites, le fait d'amener la section de commande (43) à commander la vibration du corps vibrant (142) de manière à corriger la vibration désignée par l'instruction de vibration,
dans lequel l'instruction de vibration comporte des informations permettant de désigner l'intensité de la vibration, et
lorsque les conditions prédéterminées sont satisfaites, la section de commande (43) corrige l'intensité de vibration désignée par un procédé de correction prédéterminé, afin de commander la vibration du corps vibrant (142) de manière à transmettre une vibration à l'organe de fonctionnement (131) avec l'intensité de vibration corrigée,
le procédé de correction fournissant une réduction de l'intensité de vibration lorsque l'organe de fonctionnement (131) est poussé jusqu'à sa position limite.

FIG.1

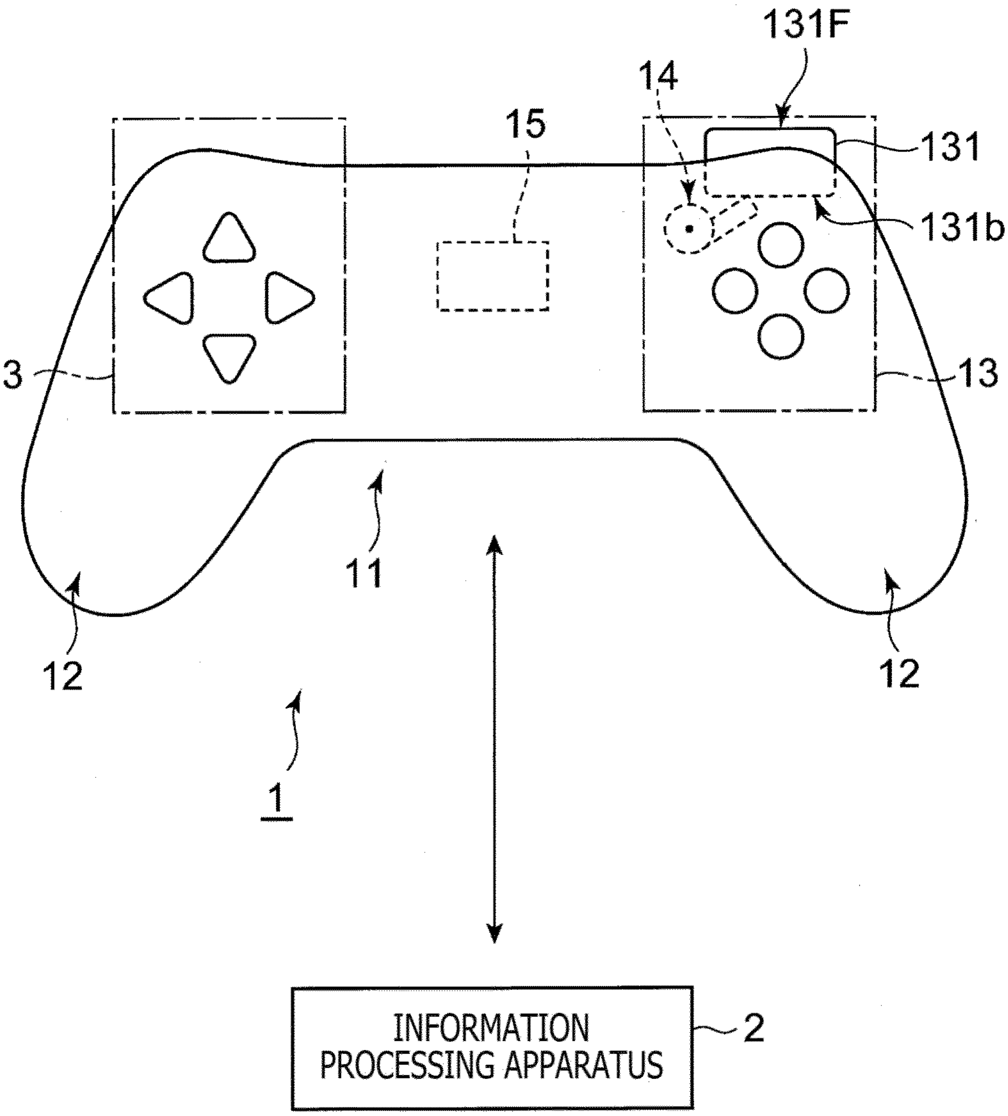

131F
14
15
131
131b
13
13
11
12
12
1
INFORMATION PROCESSING APPARATUS
2

FIG. 2

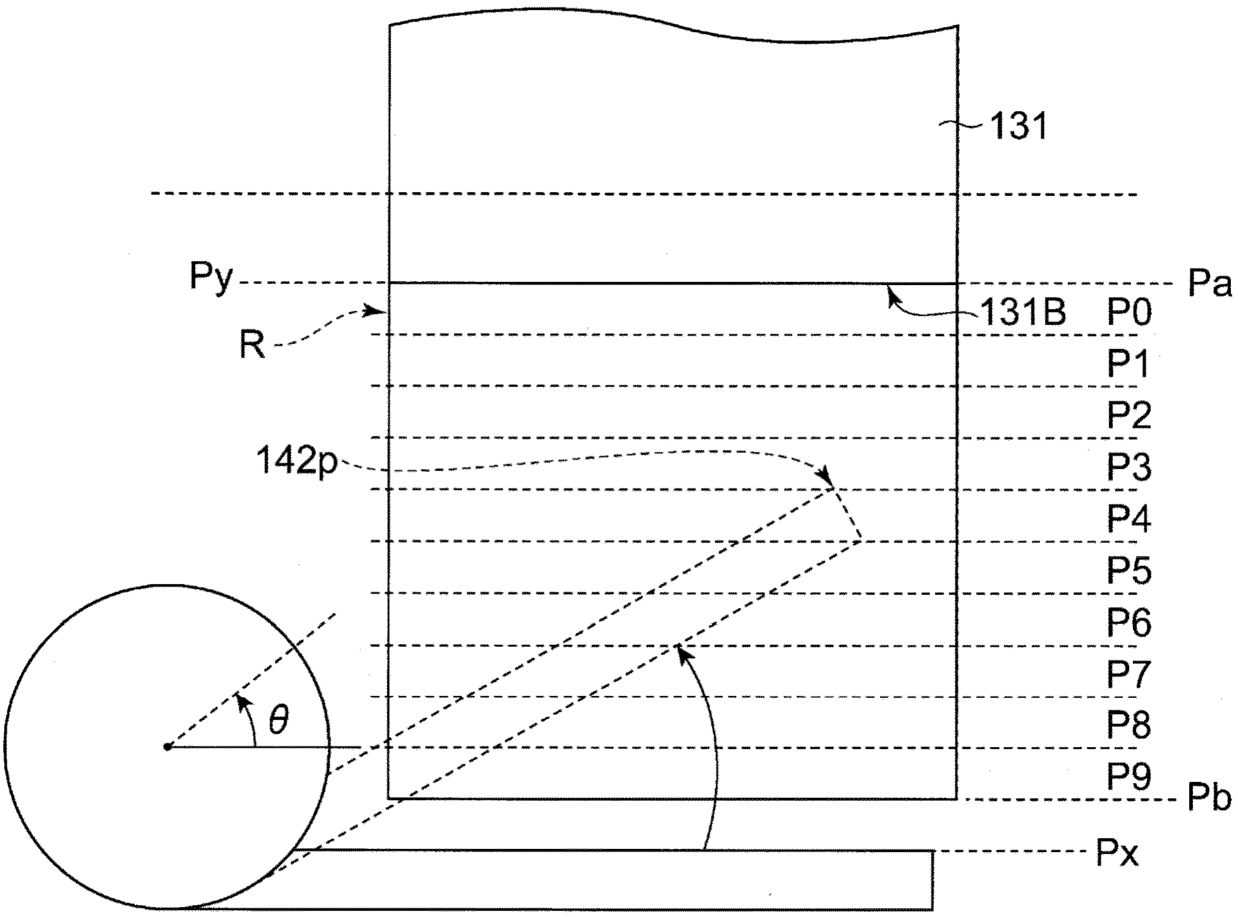


FIG.3

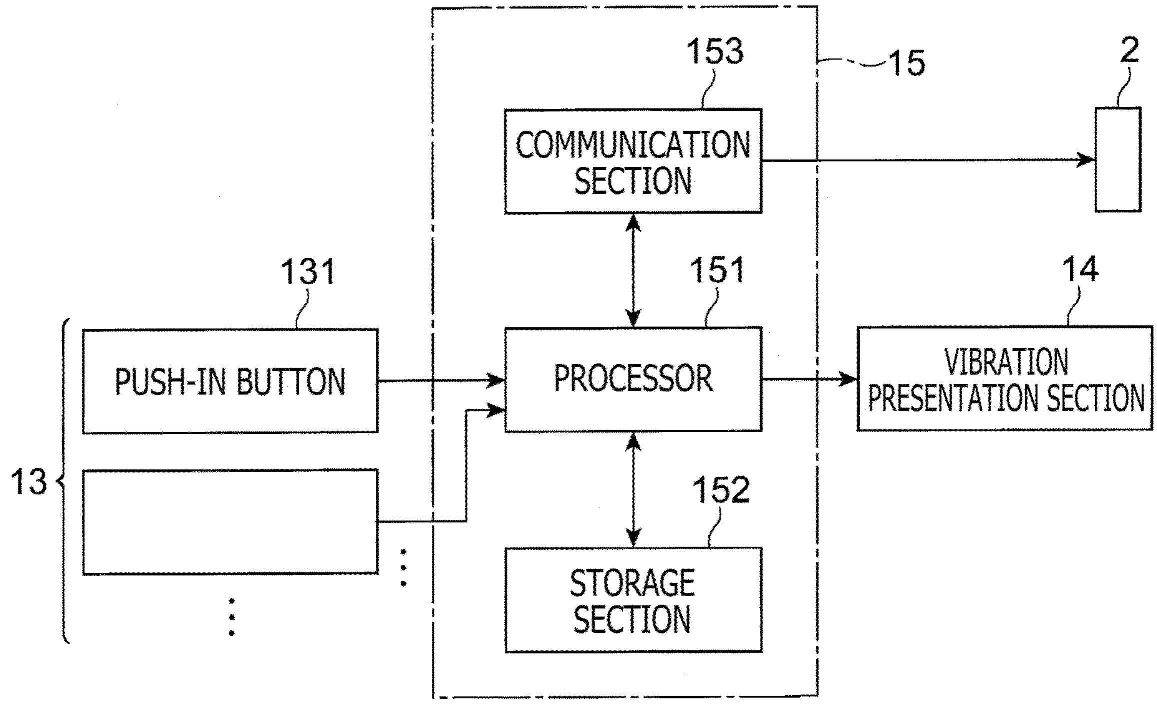

153
15
2
COMMUNICATION SECTION
131
151
14
PUSH-IN BUTTON
PROCESSOR
VIBRATION PRESENTATION SECTION
13
152
STORAGE SECTION

FIG.4

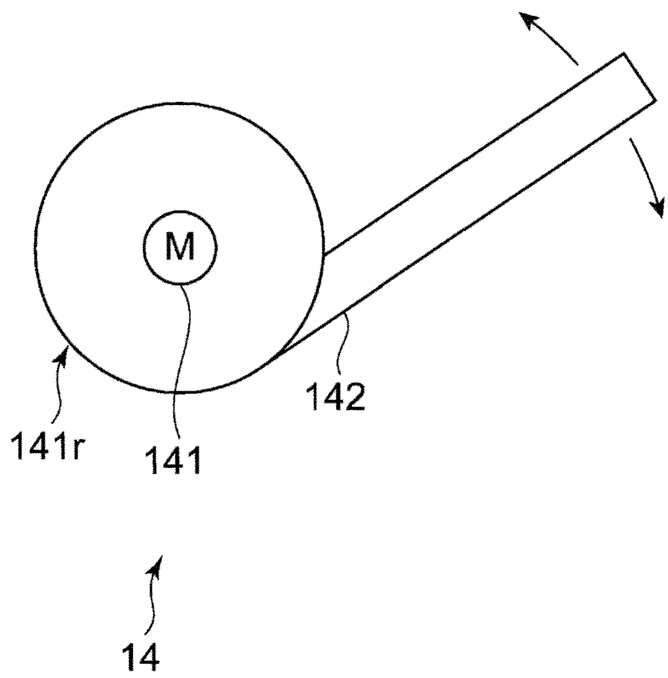
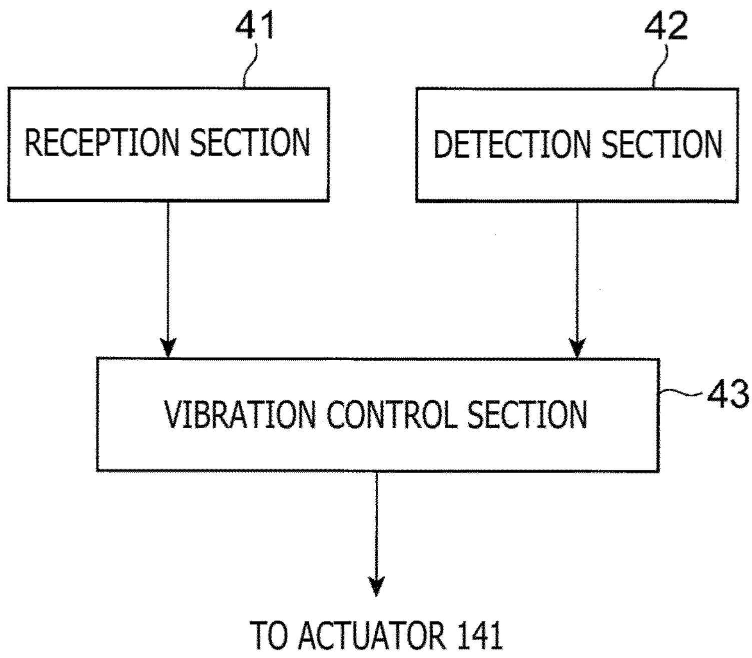

M
142
141r
141
14

FIG.5


41
42
RECEPTION SECTION
DETECTION SECTION
VIBRATION CONTROL SECTION
43
TO ACTUATOR 141

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2019209031 A **[0001]**
- US 20190224565 A1 **[0005]**
- JP 6149895 B **[0006]**
- WO 2019107027 A1 **[0007]**
- EP 3217255 B1 **[0008]**